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EDUCATIONAL PSYCHOLOGY

The Role of Self-esteem, Self-efficacy, Social Support and Resilience in Psychological Adjustment in Schoolchildren

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Background. There has been a recent increase in research to empirically verify different personal and contextual variables that impact psychological adjustment indicators, but further research is still needed in the construction of explanatory models, especially for children.

Objective. This study aimed to analyze the role of self-esteem, self-efficacy, and family social support in resilience, and their effect on indicators of psychological adjustment, in children living in at-risk contexts.

Design. A sample of 450 participants (229 boys, 221 girls) aged 9 to 12 years, with a mean age of 1.70 (SD = .67), participated in the study. With the parents' consent, the children completed a questionnaire containing sociodemographic questions and seven scales for the measurement of each of the variables under study.

Results. Significant differences in the predictor variables were found according to the levels of resilience, but not with respect to gender, and the correlations between the variables were found to be significant. The proposed structural model was verified, which shows acceptable fit indices and highlights that family social support is related to resilience and psychological adjustment.

Conclusion. Personality characteristics and family social support, as personal and social variables, constitute protective factors during childhood in the context of psychosocial risk, suggesting that they must be taken into account when implementing programs to promote resilience and well-being.

Keywords: psychological resilience, psychological adjustment, childhood, vulnerability, protective factors

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Introduction

Resilience is an important topic in positive psychology (Gínez-Silva et al., 2019) that has been conceptualized in multiple ways. Most researchers define it as a set of personal qualities that lead to spiritual growth and development in the face of adversity, resulting in optimal functioning after having overcome one or more traumatic events (Morán-Astorga et al., 2019). Other authors define resilience as a result of a dynamic and evolutionary process that may vary according to individual circumstances, the nature of the trauma, and the context and stage of life (Cyrulnik, 2001). In Bronfenbrenner's (1979) ecological model, emphasis is placed on the relationships that individuals have with their environment, allowing for successful adaptation. Thus, based on this model, resilience is defined in this study as the ability to face and recover from stressful situations and demands of the environment; it is dynamic in the sense that it implies an interaction between the processes of risk and protection, both internal and external to the individual, which are put into play to modify the effects of adverse events (González-Arratia et al., 2022).

Throughout life, people are presented with at least one event that can be considered potentially traumatic (Bonanno & Mancinni, 2008), so different psychological resources must be mobilized to facilitate adaptation to the environment and, thus, ensure psychological adjustment (Cobos-Sánchez et al., 2016). In the case of children and adolescents, there is greater vulnerability due to inadequate psychological development that arises from the risk conditions associated with physical and emotional changes, as well as social and contextual changes such as exposure to violence, neglect, poverty, family dysfunction, and neglectful parenting style or overly demanding parents who can negatively affect their child's behavior (Martínez-Cárdenas & González-Sábado, 2017). In addition, according to Masten and Reed (2002), with the accumulation of biological, cognitive, and environmental changes, along with their interaction, new conflicts that arise during this development period result in a more vulnerable situation (Steingberg et al., 2006). Adolescents living in contexts of social vulnerability such as poverty may find it difficult to overcome to adversity if they have low levels of psychosocial adjustment. However, "they can develop resources that allow them to cope with adverse conditions" (Díaz & Morales, 2021, p. 3).

It has been observed that despite living in situations of adversity and/or risk, people can cope with and even overcome such adversity if they have protective factors, which can be individual factors, such as psychosocial adjustment, familial factors, or social factors, that cushion the impact of psychosocial risk. This is usually understood as being equivalent to adaptation and "indicates the appropriate response to the different situations and demands of the surrounding context" (Madariaga et al., 2014, p. 305).

Sanmarco et al. (2019) define resilience as the ability to use coping strategies that are aimed at maintaining an optimal level of functioning and a balance between internal and external needs; therefore, this definition implies that there is an efficient use of available material and psychological resources. In addition, psychological adjustment is linked to the surrounding context, as well as to some personality char-

acteristics such as self-esteem, self-efficacy, and family social support (Gutiérrez & Pastor, 2021).

To achieve psychological adjustment, there must be a balance in the emotional, cognitive, and social aspects of the individual, which, consequently, leads to well-being; however, if there is psychological maladjustment, the probability of experiencing discomfort and behavioral problems increases (Cobos-Sánchez et al., 2016; Gavazzi, 2013; Fuentes et al., 2015). The model proposed by Madariaga et al. (2014) indicates that psychosocial adjustment is facilitated by the presence of "psychological variables such as self-concept, emotional intelligence, social skills that have their expression in satisfaction or well-being and entail the absence of antisocial behaviors or psychological symptoms of a clinical nature" (p. 305).

Among the psychological variables associated with resilience, self-esteem stands out as a determinant of psychological adjustment (Gómez-Baya et al., 2019; Gökmen, 2016). Froxán et al. (2020) define self-esteem as the set of verbalizations and assessments with which a person describes themselves. These verbalizations are part of the judgment towards oneself and are made up of adaptive or dysfunctional thoughts that elicit behaviors through which positive or negative emotions are experienced. High self-esteem allows an individual to face stressful situations when living in poverty with a better attitude (González-Arratia, 2018) and successfully overcome difficulties; it predicts psychosocial adjustment as it is related to fewer emotional and behavioral problems (Schoeps et al., 2019; Rolandi, 2023). In the same way, self-esteem allows individuals to effectively manage stressful situations (Mur et al., 2023), predicts resilience (González-Arratia et al., 2022) and facilitates psychosocial adjustment in adolescents facing social vulnerability (Díaz & Morales, 2021).

One of the determinants of psychological adjustment is self-efficacy, which, according to Bandura (2001), is defined as the personal belief in one's own capabilities when dealing with specific tasks in different situations, which gives people the ability to organize and execute the coping actions necessary to achieve psychological adjustment.

Family social support is an interactive process that people experience with their family members, and it is contingent on how people perceive or experience being loved and valued; it has been reported that support from one's family and school is a source of satisfaction. Family social support is related to psychological adjustment and emotional well-being among children and adolescents (Gutiérrez & Pastor, 2021). It is a relevant contextual factor that affects the capacity for resilience and psychosocial adjustment, since it constitutes a protective factor against the demands of the environment (Leiva et al., 2013, Rodríguez-Fernández et al., 2015).

It has been reported that resilience and psychological adjustment have a positive relationship with each other; as resilience increases, well-being and psychological adjustment also increase (Ramos-Díaz, 2015; Cerezo & Rueda, 2020; Moreno-López et al., 2019). In terms of the differences between men and women, research has indicated that, during childhood and adolescence, men display greater behavioral problems compared to women, who are more likely to show emotional symptoms; it has also

been reported that the older an individual, the better their psychological adjustment (Kökönyei et al., 2015; Ansary et al., 2017).

During the last decade, resilience has been investigated with respect to indicators such as psychological adjustment, life satisfaction (Li et al., 2012), and the experience of positive emotions (Ong et al, 2006). Most of the research has been carried out in Europe and the United States and has been particularly focused on samples of people over 18 years of age and university students. Given the importance of sociocultural variables as determinants of individual patterns (Diaz-Loving, 2019), it is crucial to conduct research in Mexico where there is still little empirical evidence derived from studies that simultaneously include variables such as self-efficacy (Meneghel et al., 2021), subjective well-being (Gutiérrez & Romero, 2014), self-esteem, and social support, which will allow a better understanding of the interactions between them. In this context, the need to study these variables together is due to the multicausal nature of psychological adjustment, which has been previously documented by Gutiérrez and Romero (2014) and Ramos Ramos-Díaz (2015). Above all, it requires further research because psychological adjustment difficulties are among the main problems in family, educational, and health systems (Fonseca-Pedrero et al., 2023), especially during the transition from childhood to adolescence in contexts of poverty (Rodríguez & Uriol, 2023).

Based on the above, a model of resilience is proposed to explain psychological adjustment in childhood in conditions of risk such as economic precariousness. This model includes self-esteem, self-efficacy, and family social support, the relationships among which have been investigated separately in previous studies. Empirical evidence is needed to derive a joint explanation of the interactions between these variables in the case of Mexican children, allowing us to outline both the direction and the degree of contribution of each of the variables on indicators of psychological adjustment. Thus, the objectives are of this study are as follows: 1) to analyze possible differences in the levels of resilience based on the variables evaluated and psychological adjustment; 2) to describe the differences between boys and girls; 3) to analyze the relationships among the variables under study; and 4) to examine the role of self-efficacy, self-esteem, and family social support as determinants of resilience and their effect on various indicators of psychological adjustment, namely satisfaction with life, positive affect, and negative affect, using a structural equation model.

In accordance with the study objectives, the following research questions are addressed: Do the variables evaluated in this study differ according to the levels of resilience reported by the participants? Are there differences between boys and girls? Is there a relationship between the variables under study? Are self-esteem, self-efficacy, and family social support related to resilience and indicators of psychological adjustment? Although the literature includes the absence of behavioral problems as an indicator of adaptation, this study prefers to address positive adjustment factors, which facilitate positive development during childhood and adolescence.

Methods

Participants

This study was a cross-sectional study that was correlational in scope. Non-probabilistic convenience sampling was used to recruit 450 basic education students from different public institutions, including 229 (5.9%) boys and 221 girls (49.1%), who were considered to be at psychosocial risk due to their socially vulnerable contexts; these contexts can be understood as a condition that "alludes to a certain fragility in the potential of some social groups as a result of the influence of risk factors" (Morelato et al., 2019, p.207) and are based on the indicators set in the General Law of Social Development (or LGDS in Spanish) by the Consejo Nacional de Evaluación de la Política de Desarrollo Social (CONEVAL, 2022) in Mexico, an institution that establishes guidelines and criteria for the identification and measurement of poverty, considering per capita income, educational lag, access to health services, access to social security, quality and housing spaces, access to basic housing services, access to food, and degree of social cohesion. The participants in this study were living in poverty, defined as when a person does not have sufficient income to meet their needs and exhibits one or more social deficiencies (Rodríguez & Uriol, 2023).

The participants ranged in age from 9 to 12 years ($M = 1.70$, $SD = .67$). Considering the small effect size, a preliminary analysis ($t = 1.64$, $1\text{-}\beta = 1.00$) with 95% confidence indicated that the sample size was sufficient to carry out subsequent analyses. Regarding sociodemographic data, 72.9% of the participants reported living with both parents, followed by 22.7% living with only the mother, 2.4% living with only the father, and a small number of participants reporting that they lived with relatives other than their parents (2.0%). The inclusion criteria were being a student in the fourth to the sixth grade at a basic education institution and having the informed consent of the parents. Participants were excluded if they did not wish to participate or did not complete all the instruments.

Procedure

Questionnaires

1. A sociodemographic data card that asked for information on age, sex, education, and people with whom the participants lived.
2. *A resilience scale* (González-Arratia, 2016) with 32 items and response options ranging from 1 (never) to 5 (always) was used in this study. The scale has three dimensions: internal protective factors, external protective factors, and empathy. It was previously reported to explain 43.3% of the total variance and have a high reliability ($\alpha = .91$). In this study, the total explained variance was 46.31% and the Cronbach's alpha coefficient was .93.
3. Subjective well-being assessed with two scales. For the cognitive component, a version of the *Life Satisfaction* (SWLS) scale (Diener et al., 1985) developed by Atienza et al. (2000) was used, with five items and 7 response options; this scale was reported to explain 58.6% of the total variance and have a Cron-

bach's alpha coefficient of .87. For the affective component, the *PANAS scale* (Watson et al., 1988) was used; this scale measures positive affect (PA) and negative affect (AN), with 10 items for each dimension and 4 response options (0 = very slightly or not at all to 4 = extremely). It was reported to have a coefficient of reliability of .86 for AP and .84 for AN (Watson et al., 1988). In the present study, Cronbach's alpha coefficient was .83 for the SWLS scale, .81 for the PA subscale, and .86 for the NA subscale.

4. *The General Self-Efficacy Scale* (Baessler & Schwarzer, 1996) measures a stable feeling of personal competence in being able to effectively handle a variety of situations. It is a unifactorial scale composed of 10 items and 4 response options, and the authors reported a Cronbach's alpha coefficient of .87 for internal consistency. The Cronbach's alpha coefficient was .85 for this study.
5. *The Perceived Family Social Support Scale* (González-Ramírez & Landero-Hernández, 2014). The family subscale was applied, consisting of 7 items with 5 response options (1 = never, 5 = always); it was reported to have a Cronbach's alpha coefficient of .92 and an explained variance of 66.09%. A Cronbach's alpha coefficient of .86 was obtained for this study.
6. *A self-esteem scale* (González-Arratia, 2011) with 25 items and response options ranging from 4 (Always) to 1 (Never) was used in this study. It has four dimensions: self, family, intellectual work, and affective–emotional, with a reported explained variance of 55.75%. In this study, a Cronbach's alpha coefficient of .90 was obtained.

With prior authorization from the authorities of each institution, informed consent from the parents and/or guardians, and assent from the participants, various educational centers were visited to administer the study instruments in the respective classrooms according to the academic schedules. The questionnaires were administered through a Google form set up by the researchers, who explained the objectives of the study and addressed any questions or concerns; the duration to answer the questionnaires was one hour.

Descriptive statistics such as mean and standard deviation were analyzed. Univariate normality was checked using Mardia's (1970) K-S multivariate test for each of the variables, obtaining a significance level of $p<.001$ for all scales, thus showing that none of the variables had a normal distribution. Cronbach's alpha reliability was analyzed for each scale. A comparison of the levels of resilience was conducted using the Kruskal–Wallis test, and the Mann–Whitney U test was used to analyze differences according to gender. To determine the relationships among the variables, Spearman's Rho was used. The model was tested using the maximum likelihood method, and the fit of the model was considered using absolute and comparative goodness-of-fit indices according to the criteria of Abad et al. (2011) and Hu and Bentler (1998). According to the recommendations of Abad et al. (2011), different fit indices were considered to evaluate the model; as $\chi 2$ is sensitive to sample size, the following indices were therefore included: GFI, AGFI, NFI, CFI, and PGFI with values greater than .90, and the RMSEA index with a value less than .08. The analyses were performed with the IBM-SPSS and AMOS version 25 programs.

Results

To examine the first study objective, the levels of resilience were determined based on the total scores on this scale; cut-off points were determined considering the mean ± 1SD, in which four levels were obtained: group (1)'s scores ranged from 31 to 106 points, indicating very low resilience; group (2)'s scores ranged from 107 to 121 points, indicating moderate resilience; group (3)'s scores ranged from 122 to 135, indicating high resilience; and group (4) with scores higher than 136 could be interpreted as showing very high resilience. Based on the levels of resilience, an analysis of differences was carried out with the Kruskal–Wallis test. The post hoc analysis, using the Games–Howell test, indicated statistically significant differences between groups (1) and (4). In terms of family social support, participants in group 4 had higher scores than those in group 1 ($p < .001$; 95% CI [–9.03, –4.52]). Statistically significant differences were also observed for self-esteem (95% CI [–21.06, –11.79]) and self-efficacy (95% CI [–12.35, –9.18]). Participants in group 1 with very low resilience had lower PA scores compared to group 4 with very high resilience (95% CI [15.48, –9.06]), but the AN scores were higher for group 1 compared to group 4 (95% CI [2.50, 11.08]). Regarding satisfaction with life, group 4 obtained higher scores (95% CI [–1.76, –5.67]).

Table 1 shows that group 4 with a higher level of resilience had higher median scores on all variables, except for NA, indicating that they had higher self-esteem and self-efficacy, perceived greater family social support, and showed better psychosocial adjustment. The effect size was calculated based on Cohen's *d*, indicating a moderate effect for the NA variable and a large effect for the other variables.

Table 1

Analysis of differences in the evaluated variables according to the levels of resilience.

	G1 Very low, n = 67	**G2 Moderate, n = 118**	**G3 High, n = 203**	**G4 Very high, n = 62**			
	Mdn (Range)	**Mdn (Range)**	**Mdn (Range)**	**Mdn (Range)**	**H**	***P***	***Cohen´s d***
Social Support	31(26)	36(35)	40(31)	44(36)	11.49	.001	1.37
Self-esteem	73(49)	83.5(60)	87(35)	89(32)	11.49	.001	1.61
Self-efficacy	28(17)	32(27)	35(21)	40(15)	186.57	.001	3.10
PA	31(26)	36(35)	40(31)	44(36)	111.70	.001	1.75
NA	26(34)	2.5(38)	20(40)	17(40)	33.46	.001	.73
SWLS	26(29)	31(29)	32(30)	35(29)	102.58	.001	1.47

Note: PA (positive affect), NA (negative affect), and SWLS (satisfaction with life); $df = 3$, $p < .001$.

Regarding the second study objective, an analysis of the differences between boys and girls was carried out for each of the variables using the Mann–Whitney U test.

The mean ranges were slightly different between the two groups; however, the differences were not statistically significant, as shown in *Table 2*.

Table 2

Analysis of differences between boys and girls for each variable.

	Boys n = 229	**Girls n = 221**		
	Range	**Range**	**U of Mann–Whitney**	***p***
Social Support	236.21	214.40	22,851	.060
Self-esteem	23.32	22.51	24,201	.423
Self-efficacy	228.48	222.41	24,622	.620
PA	229.60	221.25	24,366	.496
NA	226.61	224.35	25,050	.853
SWLS	227.37	223.56	24,876	.754

Note: PA (positive affect), NA (negative affect), and SWLS (satisfaction with life).

Prior to testing the model corresponding to the third study objective, a Spearman's Rho correlation analysis was carried out, which indicated significant low-to-moderate positive or negative relationships for all variables, except for the relationship between PA and NA. *Table 3* shows that the correlation between resilience and self-efficacy is high (Rho = .67, $p = .001$), while the lowest correlation obtained is between resilience and negative affect (Rho = –.28, $p = .001$).

Table 3

Intercorrelations, averages, and standard deviations for the total scores of the evaluated variables.

	1	**2**	**3**	**4**	**5**	**6**	**7**	***M***	***SD***	***α***
1 Resilience	1							121.28	14.43	.931
2 Social Support	.52**	1						31.93	4.58	.865
3 Self-esteem	.50**	.57**	1					82.33	9.94	.903
4 Self-efficacy	.67**	.41**	.39**	1				33.17	5.01	.852
5 PA	.55**	.40**	.44**	.49**	1			37.37	7.52	.815
6 NA	–.28**	–.29**	–.34	–.21**	–.04	1		22.88	8.93	.867
7 SWLS	.49**	.53**	.51**	.44**	.42**	–.29**	1	29.90	5.72	.831

*Note: M (average), PA (positive affect), NA (negative affect), and SWLS (satisfaction with life); **p = .001*

In order to test the model, the next step was its specification, in which the relationships among the variables were established. For the identification phase, the parameters were estimated, and due to the non-normal distribution of the multivariate data, given the level of significance of $p = .05$, it could be concluded that the variables, as a whole, presented a significantly different kurtosis from that of a multivariate normal distribution (Mardia = 46.36, c.r. 43.80). The maximum likelihood method was used, since it is a method robust to deviations from normality (Abad et al., 2011). The model was configured with the interrelations between the latent variables and the indicators of psychological adjustment, namely positive affect, negative affect, and satisfaction with life. In the first model, the psychological adjustment indicators revealed that the model was generally acceptable; however, measures indicative of the quality of model fit were analyzed and modification indices were considered, which suggested including a covariance term between errors 1 and 2, which corresponded to PA and NA. Thus, we proceeded to perform this adjustment, which would improve the fit of the model (Sörbom, 1989) without losing the theoretical value.

The final model showed the following absolute fit indices: CMIN = 76.26, DF = 8, CMIN/DF = 9.53. However, other indices were also examined, since the model fit is usually affected by the sample size (Abad et al., 2011). The other absolute fit indices that were taken into account included GFI with a value of .955, which was greater than .90, indicating that the model had a good fit and was recommended, and AGFI with a value of .843, which was lower than the recommended value of .90 or higher. The mean square error indicated a bad fit, as RMSEA = .138, which was higher than the recommended value of .08. The RMR index was .0519, which was adequate (Arbuckle, 2012). The Comparative Adjustment Index (CFI = .937) and the Normative Adjustment Index (NFI = .931) were both higher than .90 (Bentler, 1990). The parsimony adjustment indices were within the magnitude considered acceptable (PGFI = .27 and IFI = .938). With the absolute fit indices and parsimony adjustment indices indicating a relatively adequate fit, the re-specified model was considered relevant (Hu & Bentler, 1998) (*Table 4*).

Table 4

Goodness-of-fit indices of the hypothesized model

	CMIN	DF	CMIN/DF	GFI	AGFI	RMSEA	RMR	CFI	NFI	PGFI	IFI
1	11.60	9	12.28	.939	.809	.159	.0530	.906	.900	.302	.907
2	76.26	8	9.53	.955	.843	.138	.0519	.937	.931	.270	.938

Figure 1 shows the final model with the standardized solution values, and all the interrelations were found to be significant. The model indicates that self-esteem, self-efficacy, and family social support are associated with resilience and affect the psychological adjustment indicators; in addition, family social support has a significant direct effect on the dependent variable.

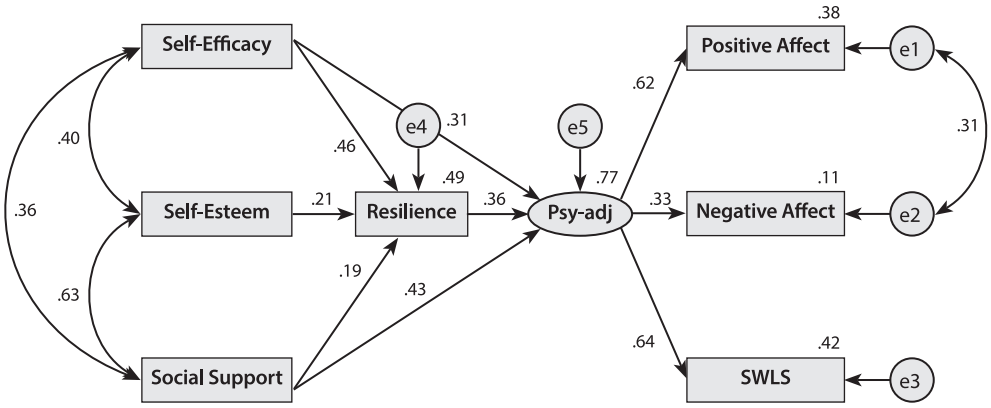

Figure 1. Structural equation model of the role of self-esteem, self-efficacy, and family social support in resilience and psychological adjustment

Discussion

This study had four objectives; the first was to verify differences in the variables under study according to the levels of resilience shown by the children. The results indicate that participants who show very high levels of resilience have higher scores in self-esteem, self-efficacy, and family social support, as well as better psychosocial adjustment. This is consistent with the findings reported in previous studies by Gutiérrez and Romero (2014), Ramos-Díaz (2015), and Gómez-Baya et al. (2019), as these are the characteristics of resilient people (González Arratia et al., 2022).

Regarding the second study objective, the findings indicate that there are no significant differences between boys and girls as hypothesized. Harter (1982) has also shown that levels of self-esteem are similar for boys and girls, particularly those between the ages of 10 and 11. The classic studies by Coopersmith (1967) indicated that differences in self-esteem according to sex mainly emerge from adolescence onwards. Similarly, according to the study by Alcaide-Risoto et al. (2017) with Spanish primary school children, there are no major differences between boys and girls in terms of self-esteem, which changes in adolescence. Another finding of the present study is that no significant differences were found between boys and girls with respect to self-efficacy; like self-esteem, adolescence is a transitional stage in which a decrease in self-efficacy can be expected, and a difference in self-efficacy between males and females may be seen (Carrasco Ortíz & Del Barrio Gándara, 2002; Maldonado et al., 2020). Nevertheless, there are still no conclusive data regarding the differences in levels of self-efficacy between males and females (Navarro et al., 2019). Although research on self-efficacy in children and adolescents has gained relevance, only global self-efficacy was investigated in the present study, so it would be pertinent to analyze self-efficacy in different domains (academic, social, and self-regulatory) to investigate whether there is a decrease and a change in self-efficacy from adolescence onwards. Regarding family social support, no significant differences were found, which is in line with the study by Rodríguez Espínola (2010).

Therefore, the results of this study suggest that variations in these variables according to sex require further analysis. In terms of resilience, there are also no differences between the sexes, indicating a need for further research on any differences in resilience between boys and girls. Regarding differences in psychological adjustment between males and females, several investigations have been conducted but have not reached an agreement on the matter. Authors such as Fernández-Daza and Fernández Parra (2017) found that boys show more problems related to psychological adjustment than girls. On the other hand, a study by Rodrigues et al. (2019) indicated the opposite. However, in the present research, there are no differences, and the reason for the presence or the lack of differences is an important future research direction.

The correlation analyses showed significant positive and negative relationships between the variables, with magnitude ranging from low to moderate (Rivera & García, 2012), which coincides with the findings of the study by González Arratia et al. (2020). It is necessary to point out that the magnitude of the relationship between social support and satisfaction with life obtained in this study is slightly higher than what has been reported by González Arratia et al. (2020), which suggests that although these variables are associated with each other, variations in the magnitude of the relationships may be due to factors such as the way the questionnaires were administered in the present study; this would have to be verified in future research.

With regard to the proposed model, which was verified, the data of the present study reveal that self-esteem, self-efficacy, and family social support predict resilience; in particular, self-efficacy is the variable that best explains resilience (Olivari & Urra, 2007), while perceived family social support has a significant direct effect on psychosocial adjustment, suggesting a determining role of social support in psychological adjustment (Ramos-Díaz, 2015). Given the significant relationships among the variables under study, it is evident that resilience plays an important role in psychological adjustment, which implies that children with higher self-esteem, self-efficacy, and family social support are more likely to experience greater satisfaction with life, greater positive affect, and lower negative affect; these results contribute to the evidence that they are indicators of psychological adjustment in childhood (Fuentes et al., 2011).

Conclusion

In general, the proposed model was found to be relatively acceptable, and the estimation of variances and covariances as accurately as possible in this study facilitated the explanation and prediction of the proposed theoretical model. The results of this study account for the complex interactions between the variables under study, but it is necessary to obtain further theoretical and empirical evidence, as well as to test other models, where personal and contextual variables are included to better understand the variables influencing resilience and psychological adjustment and identify key elements for the development of intervention from the perspective of positive psychology.

Limitations

A limitation of this study is the design of the study itself; since it was a cross-sectional study, the data were obtained from a specific time point, and because resilience is a dynamic construct, it is necessary to follow up with the sample in order to understand its complex interactions with other variables in explaining psychological adjustment in different moments of crisis, especially with the emergence of adolescence. Another limitation is that the sample was a non-random sample; therefore, it is necessary to analyze the study variables in an expanded sample, which will allow us to continue testing the proposed model and other plausible models for their explanation of psychological adjustment.

Ethics Statement

This project is registered (UAEM: code 6337/2021SF), and the protocol was approved by the Ethics Committee (IESU CEI: 2021/P05).

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

Permission was granted by the authorities of each institution, and informed consent was obtained from the parents and/or guardians. Different educational centers were visited and the Google form containing the study.

Conflicts of Interest

The authors declare no conflicts of interest.

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References

Abad, F.J., Olea, J., Ponsoda, V., & García, C. (2011). *Medición en ciencias sociales y de la salud* [Measurement in social and health sciences]. Síntesis.

Alcaide-Risoto, M., Aguilar-López, P., Cantero-Rodríguez, N. (2017). Influencia de la autoestima en niños de 6º de Primaria según la variable género [Influence of self-esteem in 6th grade children according to the gender variable]. *MLS-Educational Research, 1*(1), 85–110. https://doi.org/10.29314/mlser.v1i1.14

Ansary, N.S., McMahon, T.J., & Luthar, S.S. (2017). Trajectories of emotional-behavioral difficulty and academic competence: A 6-year, person-centered, prospective study of affluent suburban adolescents. *Development and psychopathology*, *29*(1), 215–234. https://doi.org/10.1017/S0954579416000110

Arbuckle, J.L. (2012). *IBM SPSS Amos 21 Users Guide*. IBM Software Group. https://www.sussex.ac.uk/its/pdfs/Amos_20_User_Guide.pdf

Atienza, F., Pons, D., Balaguer, I., & García-Merita, M. (2000). Propiedades psicométricas de la escala de satisfacción con la vida en adolescentes [Psychometric properties of the life satisfaction scale in adolescents]. *Psychotema*, *12*, 314–319.

Bandura, A. (2001). *Guía para la construcción de escalas de autoficacia* [Guide for the construction of self-efficacy scales]. http://des.emory.edu/mfp/effguideSpanish.html

Bentler, P. (199O). *EQS structural equations program manual*. Multivariate Software. https://www3.nd.edu/~kyuan/courses/sem/EQS-Manual6.pdf

Baessler, J., & Schwarzer, R. (1996). Evaluación de la autoeficacia: adaptación española de la Escala de Autoeficacia general [Measuring optimistic self-beliefs: A Spanish adaptation of the General Self-Efficacy Scale]. *Ansiedad y Estrés* [Anxiety and Stress], *2*(1), 1–8.

Bronfenbrenner, U. (1979). *The ecology of human development: Experiments by nature and design.* Harvard University Press.

Bonanno, G.A., & Mancini, A.D. (2008). The human capacity to thrive in the face of potential trauma. *Pediatrics*, *121*(2), 369–375. https://doi.org/10.1542/peds.2007-1648

Carrasco Ortiz, M. A., & Del Barrio Gándara, M. V. (2002). Evaluación de la autoeficacia en niños y adolescentes. [Assessing self-efficacy in children and adolescents]. *Psicothema*, *14*(2), 323–332. https://reunido.uniovi.es/index.php/PST/article/view/8022

Cerezo, M. V., & Rueda, P. (2020). Resiliencia y Cáncer: Una relación necesaria. [Resilience and Cancer: A Necessary Relationship]. *Escritos De Psicología* [Psychological Writings], *13*(2), 90–97. https://doi.org/10.24310/espsiescpsi.v13i2.10032

Cobos-Sánchez, L., Flujas-Contreras, J.M., & Gómez-Becerra, I. (2016). Inteligencia emocional y su papel en el ajuste psicológico en la adolescencia. [Emotional intelligence and its role in psychological adjustment in adolescence]. *Anales de Psicología* [Annals of Psychology], 33(1), 66–73. https://revistas.um.es/analesps/article/view/analesps.33.1.240181

Coopersmith, S. (1967). *The antecedents of self-esteem*. Freeman.

Consejo Nacional de Evaluación de la Política de Desarrollo Social (CONEVAL) (2022). *Medición de la pobreza*. [Measuring poverty]. http://conveval.org.mx/Medicion/MP/Paginas/Que-es-la-medicion-multidimensional-de-la-pobreza.aspx

Cyrulnik, B. (2001). *Los Patitos feos: la resiliencia: una infancia infeliz no determina la vida* [The Ugly Ducklings: Resilience: An unhappy childhood does not determine life]. Gedisa.

Davey, A., & Savla, J. (2010). *Statistical Power Analysis with Missing Data: A Structural Equation Modeling Approach*. Routledge.

Díaz, B.D., & Morales, R.M. (2021). Moduladores del bienestar psicológico en adolescentes en condición vulnerable: autoestima y autoeficacia. [Modulators of psychological well-being in adolescents in vulnerable conditions: self-esteem and self-efficacy]. *Revista electrónica sobre Cuerpos Académicos y Grupos de Investigación* [Electronic magazine on Academic Bodies and Research Groups], *8*(15), 1–16. https://www.cagi.org.mx/index.php/CAGI/article/view/231

Díaz Loving, R., González Arratia López Fuentes, N. I., Torres Muñoz, M. A., & Villanueva Bustamante, M. (2022). Determinantes del Bienestar Subjetivo en Adultos Mexicanos durante el Primer periodo de Confinamiento por Covid-19. [Determinants of Subjective Well-being in Mexican Adults during the First Period of Confinement due to Covid-19]. *Revista Iberoamericana de Psicología* [Ibero-American Journal of Psychology], *15*(1), 91–102. https://doi.org/10.33881/2027-1786.rip.15109

Diener, E., Emmons, R., Larsen, R., & Griffin, S. (1985). The Satisfaction with Life Scale. *Journal of Personality Assessment,* 49(1), 71–75. http://doi.org/10.1207/s15327752jpa4901_13

Fernández-Daza, M., & Fernández-Parra, A. (2017). Problemas de comportamiento, problemas emocionales y de atención en niños y adolescentes que viven en acogimiento residencial. [Behavioral problems, emotional problems and attention problems in children and adolescents living in residential care]. *Psychologia, 11*(1), 57–70. http://dx.doi.org/10.21500/19002386.3102

Fonseca-Pedrero, E., Díez-Gómez, A., Pérez-Albéniz, A., Lucas-Molina, B., Al-Halabí, S., & Calvo, P. (2023). Profesionales de la Psicología en contextos educativos. Una necesidad ineludible. [Psychology professionals in educational contexts. An unavoidable need]. *Papeles del Psicólogo* [Roles of the Psychologist]. *24*(3), 112–124.

Froxán, M.X. (2020). *Análisis funcional de la conducta humana. Concepto, metodología y aplicaciones* [Functional analysis of human behavior. Concept, methodology and applications]. Ediciones Pirámide.

Fuentes, M.C., García, F., Gracia, E., & Alarcón, A. (2015). Los estilos parentales de socialización y el ajuste psicológico. Un estudio con adolescentes españoles. [Parental socialization styles and psychological adjustment: A study with Spanish adolescents]. *Revista de Psicodidáctica* [Psychodidactic Magazine], *20*(1), 117–138. https://doi.org/10.1387/RevPsicodidact.10876

Gínez-Silva, M. J., Morán Astorga, C., & Urchaga-Litago, J. D. (2019). Resiliencia psicológica a través de la edad y el sexo. Revista INFAD de Psicología. [Psychological resilience across age and sex. INFAD Journal of Psychology]. *International Journal of Developmental and Educational Psychology., 4*(1), 85–94. https://doi.org/10.17060/ijodaep.2019.n1.v4.1513

González-Arratia, L.F.N.I. (2016). *Resiliencia y personalidad en niños y adolescentes. Cómo desarrollarse en tiempos de crisis* [Resilience and personality in children and adolescents. How to develop in times of crisis]. Eón-Universidad Autónoma del Estado de México.

González-Arratia, L.F.N.I. (2011). *Autoestima. Medición y estrategias de intervención para una reconstrucción del ser* [Self-esteem. Measurement and intervention strategies for a reconstruction of the self]. Universidad Autónoma del Estado de México.

González-Arratia, L.F.N.I. (2018). Autoestima, optimismo y resiliencia en niños en situación de pobreza. [Self-esteem, optimism and resilience in children living in poverty]. *Revista Internacional de Psicología* [International Journal of Psychology], *16*(1), 2–119. https://doi.org/10.33670/18181023.v16i01.261

González-Arratia, L.F.N.I., Torres, M.M.A. & Morelato, G. (2020). Apoyo social, autoestima y bienestar subjetivo en escolares. El caso de México y Argentina. [Social support, self-esteem and subjective well-being in schoolchildren. The case of Mexico and Argentina]. *Revista Acta de Investigación psicológica* [Psychological Research Act Magazine], *10*(2), 65–79. http://doi.org/10.22201/fpsi.200747119e.202.2.347

González-Arratia, L.F.N.I., Torres, M.M.A., Ruíz, M.A.O., & González, E.S. (2022). Estrés percibido, autoeficacia y resiliencia en docentes de educación básica durante la pandemia por Covid-19 [Perceived stress, self-efficacy and resilience in primary education teachers during the Covid-19 pandemic]. In A.L. Castillo, G.L. Maas & T.J. Telumbre (Eds.). *Psicología Social en México* [Social Psychology in Mexico] (pp. 125–132). Universidad Autónoma del Carmen.

González-Ramírez, M., & Landero-Hernández, R. (2018). Propiedades Psicométricas de la Escala de Apoyo Social Familiar y de Amigos (AFA-R) en una Muestra de Estudiantes. [Psychometric Properties of the Family and Friends Social Support Scale (AFA-R) in a Student Sample]. *Acta De Investigación Psicológica* [Psychological Research Act], *4*(2), 1469–148. https://doi.org/10.1016/S2007-4719(14)70387-4

Gavazzi, S.M. (2013). Theory and research pertaining to families with adolescents. In G.W. Peterson, & K.R. Bush (Eds.), *Handbook of marriage and the family* (pp. 303–327). Springer-Verlag. https://doi.org/10.1007/978-1-4614-3987-5_14

Gökmen, A. (2016). Psychological maltreatment, emotional and behavioral problems in adolescents: The mediating role of resilience and self-esteem. *Child Abuse & Neglect., 52*, 200–209. https://doi.org/10.1016/j.chiabu.2015.09.010

Gómez-Baya, D., Mendoza, R., Paíno, S., & Gilham, J.E. (2019). Respuestas al afecto positivo y ajuste psicológico en la adolescencia [Responses to positive affect and psychological adjustment in adolescence]. *Terapia psicológica* [Psychological therapy], *37*(1), 25–37. https://teps.cl/index.php/teps/article/view/245

Gutiérrez, M., & Romero, I. (2014). Resiliencia, bienestar subjetivo y actitudes de los adolescentes hacia el consumo de drogas. [Resilience, subjective well-being and adolescents' attitudes towards drug use]. *Anales de Psicología* [Annals of Psychology], *30*(2), 608–619. https://doi.org/10.6018/analesps.3.2.148131

Gutiérrez, M. T., & Pastor, A.M. (2021). Apoyo social de familia, profesorado y migos, ajuste escolar y bienestar subjetivo en adolescentes peruanos [Social support from family, teachers and friends, school adjustment and subjective well-being in Peruvian adolescents]. *Suma Psicológica* [Psychological Sum]*, 28*(1), 17–24. http://doi.org/10.14349/sumapsi.2021.v28.n1.3

Hu, L.T., & Bentler, P.M. (1998). Fit indices in covariance structure modeling: Sensitivity to underparameterized model misspecification. *Psychological Methods, 3*(4), 424–453. https://doi.org/10.1037/1082-989X.3.4.424

Harter, S. (1982). The Perceived Competence Scale for Children. *Child Development, 53*(1), 87–97. https://doi.org/10.2307/1129640

Kökönyei, G., Józan, A., Morgan, A., Szemenyei, E., Urbán, R., Reinhardt, M., & Demetrovics, Z. (2015). Perseverative thoughts and subjective health complaints in adolescence: Mediating effects of perceived stress and negative affects. *Psychology & Health, 30*(8), 969–986. https://doi.org/10.1080/08870446.2015.1007982

Leiva, L., Pineda, M., & Encina, Y. (2013). Autoestima y apoyo social como predictores de la resiliencia en un grupo de adolescentes en vulnerabilidad social. [Self-esteem and social support as predictors of resilience in a group of socially vulnerable adolescents]. *Revista de Psicología* [Psychology Magazine]*, 22*(2), 111–123. https://doi.org/10.5354/0719-0581.2013.30859

Li, B., Ma, H., Guo, Y., Xu, F., Yu, F., & Zhou, Z. (2014). Positive psychological capital: A new approach to social support and subjective well-being. *Social Behavior and Personality*, *42*(1), 135–144. https://doi.org/10.2224/sbp.2014.42.1.135

Maldonado Gelder, M.C., & Lugli Rivero, Z.M. (2020). Autoconcepto, autoeficacia y percepción de calidad de vida en niños y niñas con y sin déficit de procesamiento sensorial. [Self-concept, self-efficacy and perception of quality of life in children with and without sensory processing deficits]. *Revista Chilena de Terapia Ocupacional* [Chilean Journal of Occupational Therapy], *20*(2), 17–28. https://doi.org/10.5354/0719-5346.202.60535

Masten, A.S., & Reed, M.-G.J. (2002). Resilience in development. In C. R. Snyder & S. J. Lopez (Eds.), *Handbook of positive psychology* (pp. 74–88). Oxford University Press.

Madariaga, J.M., Arribillaga, A., & Zulaika, L.M. (2014). Componentes y relaciones de un modelo estructural del ajuste psicosocial en la adolescencia. [Components and relationships of a structural model of psychosocial adjustment in adolescence]. *International Journal of Development and Educational Psychology*, *6*(1), 303–331. https://doi.org/10.17060/ijodaep.2014.n1.v6.748

Mardia, K.V. (1970). Measures of multivariate skewness and kurtosis with applications. *Biometrika*, *57*, 519–53. https://doi.org/10.1093/biomet/57.3.519

Martínez-Cárdenas, A., & González-Sábado, R. (2017). Riesgos psicosociales de salud mental en niños de 0-10 años asistidos en el consultorio del Hospital Provincial de Bengo. Angola. [Psychosocial risks of mental health in children aged 0-10 years treated at the Bengo Provincial Hospital clinic. Angola]. *MULTIMED, 21*(2), 110–111. https://revmultimed.sld.cu/index.php/mtm/article/view/495

Meneghel, I., Boix-Altabás, Q., & Salanova, M. (2021). Resiliencia y autoeficacia como mecanismos psicológicos que favorecen el éxito académico. [Resilience and self-efficacy as psychological mechanisms that promote academic success]. *DEDiCA. Revista de Educação e Humanidades*, *18*, 153–171. https://doi.org/10.30827/dreh.vi18.18022

Morán-Astorga, M.C., Fínez-Silva, M.J., Menezes dos Anjos, E., Pérez-Lancho, M.C., Urchaga-Litago, J. D., & Vallejo-Pérez, G. (2019). Estrategias de afrontamiento que predicen mayor resiliencia. [Coping strategies that predict greater resilience]. *International Journal of Developmental and Educational Psychology*, *4*(1), 183–190. https://doi.org/10.17060/ijodaep.2019.n1.v4.1542

Moreno-López, N.M., Fajardo-Corredor, Á. P., González-Robles, A. C., Coronado-Bohórquez, A. E., & Ricarurte-Martínez, J.A. (2019). Una mirada desde la resiliencia en adolescentes en contextos de conflicto armado. [A look at resilience in adolescents in contexts of armed conflict]. *Revista de Investigación Psicológica* [Journal of Psychological Research], (21), 57–72.

Morelato, G., Korzeniowski, C., Greco, C., & Ison, M. (2019). Resiliencia infantil: Intervención para promover recursos en contextos vulnerables. [Childhood resilience: Intervention to promote resources in vulnerable contexts]. *Revista Costarricense de Psicología* [Costa Rican Journal of Psychology], *38*(2), 205–223. http://doi.org/10.225444/rcps.v38i02.05

Mur, A.M., Pereya, G.C.I., & Cirami, L. (2023). Asociación de la autoeficacia para el afrontamiento del estrés y la ansiedad cognitiva ante exámenes con la sintomatología del estrés de estudiantes universitarios. [Association of self-efficacy for coping with stress and cognitive anxiety before exams with the stress symptoms of university students]. *Liberabit*, *29*(2),1–15. https://doi.org/10.24265//liberabit.2023.v29n2.704

Navarro, S.G., Flores-Oyarzo, G. & González, N.M.G. (2019). Diferencias por sexo en el nivel de autoeficacia en una muestra de estudiantes de la Provincia de Concepción ¿qué papel juegan los roles de género en la educación? [Gender differences in the level of self-efficacy in a sample of students from the Province of Concepcion. What role do gender roles play in education?]. *Revista nacional e Internacional de Educación Inclusiva* [National and International Magazine of Inclusive Education], *12*(1), 205–224. https://revistaeducacioninclusiva.es/index.php/REI/article/view/389

Olivari, C., & Urra, M.E. (2007). Autoeficacia y conductas de salud. [Self-efficacy and health behaviors]. *Ciencia y Enfermería* [Science and Nursing], *13(*1), 9–15. http://dx.doi.org/1.4067/S0717-95532007000100002

Ong, A. D., Bergeman, C.S., Bisconti, T.L., & Wallace, K.A. (2006). Psychological resilience, positive emotions, and successful adaptation to stress in later life. *Journal of Personality and Social Psychology*, *91*(4), 730–749. http://doi.org/10.1037/0022-3514.91.4.730

Ramos-Díaz, E. (2015). *Resiliencia y ajuste psicosocial en la adolescencia*. [Resilience and psychosocial adjustment in adolescence]. Doctoral dissertation. Universidad del País Vasco-Euskal Herriko Unibertsitatea.

Rivera, S., & García, M. (2012). *Aplicación de la estadística a la Psicología* [Application of statistics to psychology]. Porrúa.

Rodríguez Espínola, S. (2010). Relación entre nivel socioeconómico, apoyo social percibido, género y depresión en niños. [Relationship between socioeconomic status, perceived social support, gender and depression in children]. *Interdisciplinaria*, *27*(2), 261–276.

Rodríguez, C.F., & Uriol, A.A. (2023). Caracterización psicosocial de riesgo en contextos de pobreza. [Psychosocial risk characterization in contexts of poverty]. *Revista Social Fronteriza* [Border Social Magazine], *3*(4), 1–15.

Rodrigues, S., Del Valle, J.F., & Barbosa-Ducharne, M. (2014). Differences and similarities in children's and caregiver's perspectives on the quality of residential care in Portugal -A first glance. *International Journal of Child and Family Welfare, 15*(1-2), 24–37. https://ugp.rug.nl/IJCFW/article/download/37855/35457

Rodríguez-Fernández, A., Ramos-Díaz, E., Ros, I., & Fernández-Zabala, A. (2015). Relaciones de la resiliencia con el autoconcepto y apoyo social percibido en una muestra de adolescentes. [Relationships of resilience with self-concept and perceived social support in a sample of adolescents]. *Acción Psicológica* [Psychological Action], *12*(2), 1–14. https://dx.doi.org/1.5944/ap.12.2.14903

Rolandi, E. (2023). Autoestima y resiliencia en niños y adolescentes. [Self-esteem and resilience in children and adolescents]. *Revista Científica Arbitrada de la fundación MenteClara* [Refereed Scientific Magazine of the MenteClara Foundation], *15*(8), 322. http://dor.org/1.32351/rca.v8.322_

Sanmarco-Vázquez, J., Camplá-Bolívar, X., Marcos-Martínez, V., & Novo-Pérez, M. (2019). El efecto mediador del ajuste psicológico en la relación entre victimización por acoso ecolar y el sentido de pertenencia escolar [The mediating effect of psychological adjustment in the relationship between bullying victimization and sense of school belonging]. *Publicaciones, 50*(1), 43–59. https://doi.org/10.308227/publicaciones.v50i1.9416

Steinberg, L., Dahl, R., Keating, D., Kupfer, D.J., Masten, A.S., & Pine, D. (2006). The study of developmental psychopathology in adolescence: Integrating affective neuroscience with the study of con-

text. In D. Cicchetti y D. Cohen (Eds.), *Handbook of developmental psychopathology* (pp. 710–741). Wiley.

Schoeps, K., Tamarit, A., González, R., & Montoya-Castilla, I. (2019). Competencias emocionales y autoestima en la adolescencia impacto sobre el ajuste psicológico [Emotional competencies and self-esteem in adolescence impact on psychological adjustment]. *Revista de Psicología Clínica con niños y adolescents* [Journal of Clinical Psychology with children and adolescents], *6*(1), 51–56. http://doi.org/10.21134/rpcna.2019.06.1.7

Sörbom, D. (1989). Model modification. *Psychometrika*, *54*(3), 371–384. http://doi.org/10.1007/BF02294623

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), 1063–107. https://doi.org/10.1037/0022-3514.54.6.1063

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DIFFERENTIAL PSYCHOLOGY

Fluid Intelligence in Children with Learning Disabilities

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Background. Fluid intelligence is an integral cognitive ability that involves solving new non-standard problems. It strongly predicts academic and professional achievement, whereas a low level of fluid intelligence is an important predictor of learning problems. Clinical studies of fluid intelligence are of interest for the development of training programs in various groups of children with special needs. This article presents a study on fluid intelligence in children with learning disabilities.

Objective. This study aimed to investigate characteristics of fluid intelligence and its relationships with other cognitive characteristics in children with learning disabilities.

Design. This study involved 93 children, divided into two groups: 55 typically developing children (control group) and 38 children with learning disabilities (clinical group). To assess intelligence characteristics, this study employed the Kaufman Assessment Battery for Children (KABC-II) and the Wechsler Intelligence Scale for Children Fifth Edition (WISC-V).

Results. A reduction was found in fluid intelligence, working memory, short-term memory, long-term memory, processing speed, visual-spatial abilities, and verbal abilities in the group of children with learning disabilities compared to the control group. In the clinical group, fluid intelligence was strongly associated with a greater number of cognitive parameters compared to the control group.

Conclusions. It is possible to assume that a close connection of fluid intelligence with the assessed cognitive characteristics in the group of children with learning disabilities may be due to general challenges in cognitive development.

Keywords: fluid intelligence, learning disabilities, children, WISC-V, KABC-II

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Introduction

Fluid intelligence is a complex cognitive ability that provides thought processes with the flexibility to solve new and non-standard problems (McGrew, 2009; Schneider, McGrew, 2012). It is determined mainly by innate factors and depends little on the cultural experience of the individual, while at the same time, it largely determines the speed and efficiency of acquiring knowledge and skills. This ability is an important element of cognitive development in general, ensuring children's acquisition of new cognitive skills and abilities (Cattell, 1987; Blair, 2006; Green et al., 2017). As an integral characteristic, fluid intelligence is involved in all cognitive processes and is considered one of the most important factors of learning. It has been found that it predicts academic and professional success, especially in tasks involving intellectual work (Alekseeva et al., 2021; Lynn et al., 2007; Otero, 2017). On the other hand, a low level of fluid intelligence is an important predictor of learning problems (Lynn et al., 2007; Nisbett, 2009).

In the most widely recognized theory of intelligence, the Cattell–Horn–Carroll hierarchical model, fluid intelligence is defined as the ability to approach current problems flexibly and adaptively which cannot be solved solely through previously learned schemes and algorithms (McGrew, 2009). This complex construct is primarily intended for finding solutions in unfamiliar, non-standard situations but is also involved in everyday, routine tasks when existing knowledge and skills are insufficient. Fluid intelligence is engaged in constructing logical reasoning, forming concepts and representations, classifying unfamiliar stimuli, constructing and testing hypotheses, identifying significant features of objects and phenomena, determining their properties, differences, and connections, comprehending new knowledge, and making inferences based on it, and making justified assumptions in uncertain situations (Schneider, McGrew, 2012).

Fluid intelligence consists of three specific abilities: induction, general sequential reasoning, and quantitative reasoning. Induction is the ability to explore phenomena and situations and to identify underlying principles and patterns. General sequential reasoning, sometimes also referred to as deduction, is defined as the capacity to utilize known principles and patterns for reasoning and problem-solving. Quantitative reasoning involves the ability to apply induction or general sequential reasoning to discern quantitative relationships and perform mathematical operations. Modern research methods in fluid intelligence are geared towards assessing these abilities (Schneider, McGrew, 2012).

The relationship between fluid intelligence and other cognitive characteristics continues to generate interest among scientists. The findings from existing research are quite contradictory, which is partly due to the theoretical problem of delineating the constructs under investigation. Additionally, the use of a wide range of diagnostic methods, not all of which align with current understandings of fluid intelligence, contributes to these inconsistencies.

Currently, there is consensus on the existence of a strong relationship between fluid intelligence and working memory (Brydges et al., 2021; Schroeders et al., 2016; Conway et al., 2002; Cowan et al., 2005). Nearly all studies that explore ways to enhance fluid intelligence suggest training specifically targeting working memory (Jaeggi et al., 2011; Rzhanova et al., 2020). However, the issue of identifying possible

mediators of the connection between fluid intelligence and working memory remains topical. Most frequently, cognitive characteristics such as short-term memory (Tillman et al., 2008; Hornung et al., 2011; Colom et al, 2006) and attention control (Engle, 2010; Schroeders et al., 2016;) are considered as mediators.

Researchers studying fluid intelligence also focus on other related cognitive characteristics, particularly visual-spatial and verbal abilities. A close interconnection between visual-spatial abilities and fluid intelligence has been demonstrated, despite some diagnostic challenges in distinguishing these cognitive constructs (Gizzonio et al., 2022). In cognitive research, verbal abilities are typically considered a component of crystallized intelligence, and their close relationship with fluid intelligence is attributed to the contribution of fluid intelligence to the formation of crystallized intelligence (Thorsen et al., 2014; Carpentier et al., 2022).

Clinical research findings are of particular interest in the study of fluid intelligence, providing material for a deeper understanding of cognitive impairments in various clinical groups. Such studies open new avenues for corrective interventions with children who have developmental peculiarities, as well as with adults whose cognitive functions have been impacted by various life events. These insights are crucial for developing tailored therapeutic strategies that can potentially improve or mitigate the cognitive deficits observed in these populations.

Fluid intelligence and its connections with other cognitive abilities have been extensively studied across various clinical groups, including individuals with Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorder (ASD), consequences of traumatic brain injuries, preterm infants, and others (Morgan et al., 2019; Brydges et al., 2021; Tamm, Juranek, 2012). According to psychometric data, the fluid intelligence index is significantly lower compared to control groups in children with developmental delays and in children with established risk factors for developmental issues, which include low birth weight and asphyxia at birth (Wechsler, 2014).

It should be noted that children and adults with Attention Deficit Hyperactivity Disorder (ADHD) are of particular interest in the context of studying fluid intelligence (Tamm, Juranek, 2012; Morgan et al., 2019; Brydges et al., 2021). This focus is primarily due to the fact that ADHD fundamentally involves impairments in executive functions (such as attention and working memory), which are closely linked to fluid intelligence (Schroeders et al., 2016; Conway et al., 2002; Cowan et al., 2005). The use of neuroimaging techniques during the performance of various cognitive tasks has revealed reduced activation in brain areas responsible for fluid thinking in children with attention deficits (Tamm, Juranek, 2012).

There is a well-founded assumption that in children with learning disabilities, fluid intelligence plays a leading role in the formation of difficulties in mastering new skills (Blair, 2004). Studies of the relationship between fluid intelligence and learning disabilities have demonstrated a significant influence of fluid intelligence on academic performance in reading and mathematics in elementary grades, with a gradual decrease in this influence with age (Evans et al., 2001).

Despite the broad interest in researching fluid intelligence and its impact on cognitive development and educational success, relatively few studies have been conducted with subjects who have learning disabilities. The availability of data suggesting the potential for improving fluid intelligence through specifically designed training

sessions makes the investigation of this construct in children with developmental delays particularly relevant.

The aim of this study is to explore the characteristics of fluid intelligence and its relationships with other cognitive characteristics in children of primary school age with learning disabilities. During the course of this research, the following questions were posed:

1. How do the cognitive indicators of children with learning disabilities differ from those of typically developing children?
2. What contribution does the measure of fluid intelligence make to the structure of cognitive functions in the two groups of children?

Methods

Participants

This study involved 93 children, divided into two groups: 55 typically developing children and 38 children with learning disabilities. The control group consisted of pupils from the 2nd to 4th grades of a general education school, comprising 27 boys and 28 girls. The age range was from 96 to 132 months, with an average age of 115.8 months and a standard deviation of 9.7 months.

The group of children with learning disabilities was recruited from pupils in the 1st to 4th grades of a special education school that follows the Federal State Educational Standard of the seventh type; prior to admission to this school, all children undergo a psychological/medical/pedagogical assessment, and each child's personal file contains a confirmed diagnosis of learning disabilities. This group comprised 22 boys and 16 girls. The age at the time of this study ranged from 97 to 144 months, with an average age of 124 months and a standard deviation of 13.6 months.

Procedure

To assess fluid intelligence, this study employed scales from the *Kaufman Assessment Battery for Children (KABC-II)* (Kaufman, Kaufman, 2004) and the *Wechsler Intelligence Scale for Children Fifth Edition (WISC-V)* (Wechsler, 2014). Other integral cognitive indicators included in these tests were also diagnosed.

The KABC-II test not only diagnoses the overall intelligence quotient but also provides assessments across four scales:

1. Short-term memory (Gsm); subtests include Number Recall and Word Order.
2. Visual processing (Gv); subtests include Rover and Triangles.
3. Fluid intelligence (Gf); subtests include Story Completion and Pattern Reasoning.
4. Long-term memory (Glr); subtests include Atlantis and Rebus.

The WISC-V test is designed to diagnose overall intelligence and five integral indicators:

1. Verbal Comprehension Index (VCI); subtests include Similarities and Vocabulary.
2. Visual Spatial Index (VSI); subtests include Block Design and Visual Puzzles.

3. Fluid Reasoning Index (FRI); subtests include Matrix Reasoning and Figure Weights, Picture Concepts, and Arithmetic.
4. Working Memory Index (WMI); subtests include Digit Span and Picture Span.
5. Processing Speed Index (PSI); subtests include Coding and Symbol Search.

In processing the collected data, both an analysis of variance (ANOVA) and a regression analysis were used. A statistical analysis was conducted using the SPSS software, version 19.

Results

Differences in Cognitive Abilities

In the initial stage of this study, a comparison of cognitive characteristics was conducted between children of primary school age with learning disabilities and their typically developing peers. A one-way Analysis of Variance (ANOVA) was used to assess these differences. The results are presented in *Figure 1*.

The calculated F-values clearly demonstrate significant differences across all assessed cognitive parameters, indicating that children with learning disabilities scored lower on the respective tests compared to their typically developing peers. Specifically, primary school-aged children from the study group exhibited poorer performance on tasks assessing fluid intelligence, working memory, short-term and long-term memory, processing speed, visual-spatial abilities, and verbal abilities.

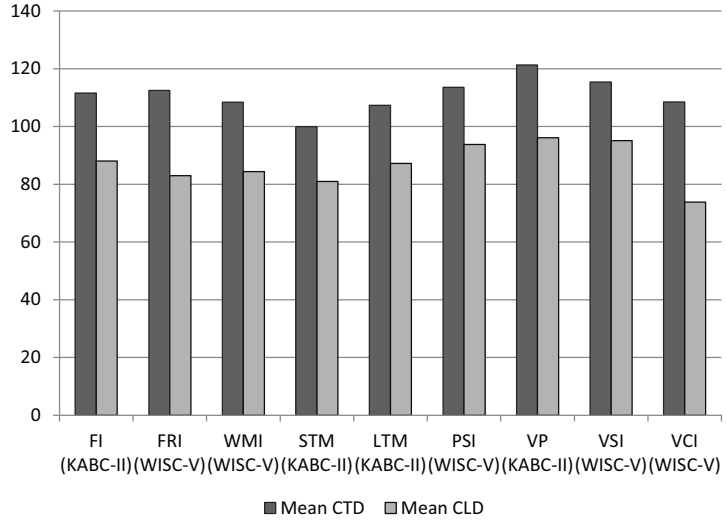

Figure 1. Differences in cognitive indices between children with learning disabilities and typically developing children

Notes. CTD—children with typical development; CLD—children with learning disabilities; FI—Fluid Intelligence; FRI—Fluid Reasoning Index; WMI—Working Memory Index; STM—Short-Term Memory; LTM—Long-Term Memory; PSI—Processing Speed Index; VP—Visual Processing; VSI—Visual Spatial Index; VCI—Visual Comprehension Index.

Contribution of Fluid Intelligence to Cognitive Performance

To assess the contribution of fluid intelligence to the cognitive characteristics being studied, a regression analysis was performed. Significant predictors were selected separately for the subtests and scales from three initial sets of variables: the subtests of WISC-V, the subtests of KABC-II, and the primary scales from both the WISC-V and KABC-II. The selection method used was stepwise regression. The analysis in this work presents regression models that explain the largest contribution in variance of the dependent variables.

The results of the regression models, with working memory as the dependent variable, are presented in *Tables 1 and 2*.

Table 1

Regression models for the dependent variable "Working Memory" (children with typical development)

	R^2	F	β	p
Model 1	.450	11.978		.000
Short-term memory			.436	.000
Processing Speed Index			.359	.003
Fluid intelligence (KABC-II)			.245	.041
Model 2	.505	14.989		.000
Similarities			.439	.000
Symbol Search			.291	.012
Word Order			.263	.022

Table 2

Regression models for the dependent variable "Working Memory" (children with learning disabilities)

	R^2	F	β	p
Model 1	.687	22.667		.000
Short-term memory			.468	.000
Visual processing			.321	.016
Fluid intelligence (KABC-II)			.308	.026
Model 2	.745	21.964		.000
Number Recall			.502	.000
Triangles			.334	.004
Triangles			.328	.011
Picture Concepts			.234	.039

According to the data presented, fluid intelligence is a significant predictor of working memory in both groups of subjects. In the group of typically developing children, the integral scale of fluid intelligence from KABC-II is one of three predictors of working memory; the other predictors include scales for short-term memory and processing speed. In the group of children with learning disabilities, the integral scale of fluid intelligence from KABC-II also appears as one of three predictors of working memory, alongside scales for short-term memory and visual-spatial abilities.

The regression models constructed from data obtained in the group of typically developing primary school children explain 45% and 51% of the variance in working memory when predictors are selected from the scales and subtests, respectively. For the group of primary school children with learning disabilities, the regression models, compiled in a similar manner, account for 69% and 75% of the variance in working memory.

The results of the regression analysis, with long-term memory as the dependent variable, are presented in *Tables 3 and 4*.

Table 3

Regression models for the dependent variable Long-Term Memory (children with typical development)

	R^2	F	β	p
Model 1	.240	14.488		.000
Verbal Comprehension Index			.489	.000
Model 2	.307	9.961		.000
Vocabulary			.454	.001
Number Recall			.268	.037

Table 4

Regression models for the dependent variable Long-Term Memory (children with learning disabilities)

	R^2	F	β	p
Model 1	.215	9.031		.005
Fluid intelligence (KABC-II)			.464	.005
Model 2	.182	7.326		.011
Pattern Reasoning			.426	.011

In the group of typically developing children, verbal abilities are the primary predictor of long-term memory. When selecting independent variables from the scales,

the Verbal Comprehension Index verbal index is the only significant predictor of long-term memory. When selecting independent variables from the subtests, in addition to the Vocabulary subtest, which is part of the Verbal Comprehension Index, the Number Recall subtest from KABC-II, which assesses short-term memory, also emerged as a significant predictor.

In the group of children with learning disabilities, the only significant predictors of long-term memory, when selecting independent variables from both the scales and the subtests, are the measures of fluid intelligence. Specifically, the integral scale of fluid intelligence from KABC-II and the Pattern Reasoning subtest, which is part of this scale, stand out. Clearly, it is possible to discuss the influence of fluid intelligence on long-term memory only in the group of primary school children with learning disabilities.

The results of the regression analysis, where the information processing speed index was considered as the dependent variable, are presented in *Tables 5 and 6*. In the group of typically developing children, working memory is the only significant predictor of information processing speed, explaining 19% of its variance. In the group of children with learning disabilities, fluid intelligence is the only predictor of processing speed, accounting for 24% of the variance of the dependent variable.

Table 5

Regression models for the dependent Variable Processing Speed (children with typical development)

	R^2	F	β	p
Model 1	.194	12.268		.001
Working Memory Index			.440	.001
Model 2	.180	11.232		.002
Picture Span			.425	.002

Table 6

Regression models for the dependent Variable Processing Speed (children with learning disabilities)

	R^2	F	β	p
Model 1	.239	11.296		.002
Fluid intelligence (KABC-II)			.489	.002
Model 2	.252	11.454		.002
Story Completion			.502	.002

The results of the regression analysis for the Visual-Spatial index are presented in *Tables 7 and 8*. In both groups of subjects, fluid intelligence is the only significant predictor of visual-spatial abilities. In the group of children with learning disabilities, fluid intelligence accounts for 44% of the explained variance of the dependent variable, while in the control group, it accounts for 54%.

Table 7

Regression models for the dependent variable Visual Spatial Index (children with typical development)

	R^2	F	β	p
Model 1	.394	33.151		.000
Fluid Reasoning Index			.628	.000
Model 2	.539	29.185		.000
Arithmetic			.509	.000
Matrix Reasoning			.373	.001

Table 8

Regression models for the dependent variable Visual Spatial Index (children with learning disabilities)

	R^2	F	β	p
Model 1	.340	18.530		.000
Fluid Reasoning Index			.583	.000
Model 2	.442	28.465		.000
Matrix Reasoning			.664	.000

The results of the regression analysis, where the verbal abilities index was considered as the dependent variable, are presented in *Tables 9 and 10*. In the group of typically developing children, fluid intelligence and long-term memory serve as predictors of verbal abilities when selecting independent variables from both the scales and subtests. The largest proportion of explained variance for the dependent variable is 48%. In the group of children with learning disabilities, fluid intelligence is the sole predictor of verbal abilities, with the largest proportion of variance explained by it being 21%.

Thus, fluid intelligence emerges as a predictor of verbal abilities in both groups studied. Similar to the case with visual-spatial abilities, it is not possible to say whether its contribution to the dependent variable is greater or less in one group compared to the other.

Table 9

Regression models for the dependent variable Verbal Comprehension Index (children with typical development)

	R^2	F	β	p
Model 1	.430	16.964		.000
Fluid Reasoning Index			.445	.000
Long-term memory			.402	.001
Model 2	.481	9.972		.000
Arithmetic			.323	.009
Rebus			.279	.018
Story Completion			.278	.019
Picture Concepts			.254	.033

Table 10

Regression models for the dependent variable Verbal Comprehension Index (children with learning disabilities)

	R^2	F	β	p
Model 1	.193	8.586		.006
Fluid Reasoning Index			.439	.006
Model 2	.210	9.586		.004
Fluid Reasoning Index			.459	.004

Thus, the conducted regression analysis demonstrated the influence of fluid intelligence on working memory, visual-spatial abilities, and verbal abilities in the group of typically developing children. In the group of children with learning disabilities, fluid intelligence is associated with a broader range of cognitive parameters and serves as a predictor of working memory, long-term memory, processing speed, visual-spatial abilities, and verbal abilities; the contribution of fluid intelligence to short-term memory is appropriately considered to be mediated through working memory. Moreover, the impact of fluid intelligence on working memory is notably stronger in the group of children with learning disabilities than in the group of typically developing children.

Discussion

During this study, an analysis was conducted on the characteristics of fluid intelligence and its associations with working memory, short-term memory, long-term memory, processing speed, visual-spatial abilities, and verbal abilities in children with typical development and those with learning disabilities. Using a one-way ANOVA,

a comparison was made between the clinical and control groups. Significant differences were found across all studied indicators between the two groups of primary school children, with the statistical significance of these differences being quite high. It can be confidently stated that there is a consistent reduction in fluid intelligence, working memory, short-term memory, long-term memory, processing speed, visual-spatial abilities, and verbal abilities in the group of children with learning disabilities compared to the control group. Most studies of children with learning disabilities have shown significant impairments in working memory and information processing speed compared to typically developing children (Cornoldi et al., 2014; Giofrè, Cornoldi, 2015). In our study, significant differences were found in all cognitive indices. This may be due to the specifics of the sample and the school system in Russia. Schools that educate children with learning disabilities generally recruit children who, in addition to specific academic difficulties, are at the lower limit of the intellectual norm. They can be classified as possessing borderline intellectual functioning. This term was used some time ago but was excluded from the DSM, since strictly speaking, it is still an intellectual norm. However, there is a well-founded opinion on the need to reintroduce this term into scientific and practical use (Wieland, Zitman, 2016).

The vast majority of cases of learning disabilities are associated with minimal cerebral/organic damage to the brain (Emelina, Makarov, 2018). Fluid intelligence is primarily determined by innate structural and functional features of the brain and is minimally influenced by cultural factors (Cattell, 1963; McGrew, 2009); its decline suggests lag in the development of other cognitive indicators, primarily due to its crucial role in the formation of overall intelligence during ontogeny.

To assess the connections between fluid intelligence and other cognitive abilities and clarify its contribution to cognitive development, a regression analysis was conducted. Fluid intelligence is a significant predictor of working memory in both groups of subjects. Along with fluid intelligence, short-term memory and visual-spatial abilities contribute to working memory in the clinical group, while in the control group, short-term memory and processing speed also play roles. Notably, the connections between fluid intelligence and working memory are significantly stronger in children with learning disabilities. This finding aligns with the literature. Theories on the development of fluid intelligence and working memory in ontogeny, which suggest a non-linear relationship between age and development pace (Detterman, Daniel, 1989; Fry, Hale, 1996; Siegel, 1994), and the activation of similar brain cortex areas during tasks involving fluid intelligence and working memory (Chai et al., 2018) explain these results. We believe that cognitive delays related to organic CNS damage result in a stronger connection between fluid intelligence and working memory in children with diagnosed learning disabilities compared to their typically developing peers.

Our investigation into the contribution of fluid intelligence to long-term memory showed that in the clinical group, fluid intelligence is the only significant predictor of long-term memory. In the control group, verbal abilities serve as the primary predictor of long-term memory, with short-term memory being less significant and only when selecting predictors from among the subtests. The results obtained in the group of children with learning disabilities are consistent with the notion that long-term

memory is a characteristic independently associated with fluid intelligence (Mogle et al., 2008). The principle of the inverse relationship between general intelligence and the strength of connections among cognitive ability indicators, identified by D. Detterman and M. Daniel, may explain the discrepancies observed between the clinical and control groups (Detterman, Daniel, 1989). This investigation into the contribution of fluid intelligence to processing speed revealed that fluid intelligence is a significant predictor of information processing speed only in the clinical group. In the control group, working memory serves as the predictor of processing speed.

The results of the regression analysis demonstrate a strong relationship between fluid intelligence and visual-spatial abilities, aligning with data presented in other studies (Gizzonio et al., 2022; Colom et al., 2009). Fluid intelligence significantly contributes to visual-spatial abilities in both children with typical development and those with learning disabilities. Fluid intelligence is also a significant predictor of verbal abilities in both groups of subjects, and it serves as the sole significant predictor in children with learning disabilities. Thus, the results of the regression analysis indicate that in children with learning disabilities, fluid intelligence is associated with a greater number of cognitive parameters compared to typically developing children.

Conclusions

A reduction was found in all measured cognitive parameters in the group of children with learning disabilities compared to the group of children with typical development. In the clinical group, fluid intelligence is strongly associated with a greater number of cognitive parameters compared to the control group. It is possible to assume that a close connection of fluid intelligence with the assessed cognitive characteristics in the group of children with learning disabilities may be due to general challenges in cognitive development.

Limitations

The limitations of this study are related to the available data. Although the children participating in this study lived in the same language region, we collected no data on the socio-demographic status of their families; therefore, it is not possible to conclude that the clinical and control groups were equal for this parameter.

Ethics Statement

Informed consent was obtained from the parents of the participating children before the commencement of this 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

I.E.R., O.S.A. and Y.A.B. conceived of the idea. Y.A.B. and I.E.R. developed the theory. V.S.B. and O.S.A. performed the computations and verified the analytical methods. All authors discussed the results and contributed to the final manuscript.

Conflicts of Interest

The authors declare no conflicts of interest.

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References

Alekseeva, O.S., Rzhanova, I.E., Britova, V.S., & Burdukova, Yu.A. (2021). Akademicheskaia uspeshnost' i kognitivnye sposobnosti u mladshikh shkol'nikov [Academic performance and cognitive abilities in primary school students]. *Vestnik RGGU. Seriia: Psikhologiia. Pedagogika. Obrazovanie* [RGGU Bulletin. Series: Psychology. Pedagogics. Education Series], *1,* 51–64. https://doi.org/10.28995/2073-6398-2021-1-51-64

Blair, C. (2004). Learning disability, intelligence, and fluid cognitive functions of the prefrontal cortex: A developmental neuroscience approach. *Learning Disabilities: A Contemporary Journal, 2(1),* 22–29.

Blair, C. (2006). How similar are fluid cognition and general intelligence? A developmental neuroscience perspective on fluid cognition as an aspect of human cognitive ability. *Behavioral Brain Science, 26,* 109–116. https://doi.org/10.1017/S0140525X06009034

Brydges, C.R., Ozolnieks, K.L., & Roberts, G.J. (2021). Working memory and intraindividual variability in response time mediate fluid intelligence deficits associated with ADHD symptomology. *Attention Disorders, 25(1),* 63–72. https://doi.org/10.1177/1087054718772143

Carpentier, P., Morneau-Vaillancourt, G., Aubé, S., Matte-Gagné, C., Denault, A.-S., Brendgen, M., ..., & Boivin, M. (2022). A sequential model of the contribution of preschool fluid and crystallized cognitive abilities to later school achievement. *PLoS ONE, 17(11).* https://doi.org/10.1371/journal.pone.0276532

Chai, W.J., Hamid, A.I., & Abdullah, J.M. (2018). Working memory from the psychological and neurosciences perspectives: A review. *Frontiers in Psychology, 9,* 401. https://doi.org/10.3389/fpsyg.2018.00401

Colom, R., Abad, F.J., Rebollo, I., & Shih, P.C. (2005). Memory span and general intelligence: A latent-variable approach. *Intelligence, 33(6),* 623–642. https://doi.org/10.1016/j.intell.2005.05.006

Colom, R., Haier, R.J., & Head, K. (2009). Gray matter correlates of fluid, crystallized, and spatial intelligence: Testing the P-FIT model. *Intelligence, 37(2),* 124–135. https://doi.org/10.1016/j.intell.2008.07.007

Conway, A.R., Cowan, N., Bunting, M.F., Therriault, D.J., & Minkoff, S.R. (2002). A latent variable analysis of working memory capacity, short-term memory capacity, processing speed, and general fluid intelligence. *Intelligence, 30(2),* 163–183. https://doi.org/10.1016/S0160-2896(01)00096-4

Cornoldi, C., Giofrè, D., Orsini, A., & Pezzuti, L. (2014). Differences in the intellectual profile of children with intellectual vs. learning disability. *Research in Developmental Disabilities, 35(9),* 2224–2223. https://doi.org/10.1016/j.ridd.2014.05.013

Cowan, N., Elliott, E.M., Saults, J.S., Morey, C.C., Mattox, S., & Hismjatullina, A. (2005). On the capacity of attention: Its estimation and its role in working memory and cognitive aptitudes. *Cognitive Psychology, 51(1),* 42–10. https://doi.org/10.1016/j.cogpsych.2004.12.001

Detterman, D.K., & Daniel, M.H. (1989). Correlations of mental tests with each other and with cognitive variables are highest for low IQ groups. *Intelligence, 13(4),* 349–359. https://doi.org/10.1016/S0160-2896(89)80007-8

Emelina, D.A., & Makarov, I.V. (2018). Zaderzhki psikhicheskogo razvitiia u detei (analiticheskii obzor) [Developmental delay in children (analitical review)]. *Obozrenie psikhiatrii i meditsinskoi psikhologii imeni V.M.Bekhtereva* [V.M. Bekhterev Review of Psychiatry and Medical Psychology], *1,* 4–12.

Engle, R.W. (2010). Role of working memory capacity in cognitive control. *Current Anthropology, 51(1),* 17–26. https://doi.org/10.1086/650572

Evans, J.J., Floyd, R., McGrew, K.S., & Leforgee, M.H. (2001). The relations between measures of Cattell-Horn-Carroll cognitive abilities and reading achievement during childhood and adolescence. *School Psychology Review, 31,* 246–262. https://doi.org/10.1080/02796015.2002.12086154

Fry, A.F., & Hale, S. (1996). Processing speed, working memory, and fluid intelligence: Evidence for a developmental cascade. *Psychological Science, 7(4),* 237–241. https://doi.org/10.1111/j.1467-928.1996.tb00366.x

Gizzonio, V., Bazzini, M.C., Marsella, C., Papangelo, P., Rizzolatti, G., & Fabbri-Destro, M. (2022). Supporting preschoolers' cognitive development: Short and mid-term effects of fluid reasoning, visuospatial, and motor training. *Child Development, 93(1),* 134–149. https://doi.org/10.1111/cdev.13642

Giofrè, D., & Cornoldi, C. (2015). The structure of intelligence in children with specific learning disabilities is different as compared to typically developed children. *Intelligence, 52,* 36–43. https://doi.org/10.1016/j.intell.2015.07.002

Green, C.T., Bunge, A.S., Chiongbian, V.B., Barrow, M., & Ferrer, E. (2017). Fluid reasoning predicts future mathematical performance among children and adolescents. *Journal of Experimental Child Psychology, 157,* 125–143. https://doi.org/10.1016/j.jecp.2016.12.005

Hornung, C., Brunner, M., Reuter, R., & Martin, R. (2011). Children's working memory: Its structure and relationship to fluid intelligence. *Intelligence, 39(4),* 210–221. https://doi.org/10.1016/j.intell.2011.03.002

Jaeggi, S.M., Buschkuehl, M., Jonides, J., & Shah, P. (2011). Short- and long-term benefits of cognitive training. *Proceedings of the National Academy of Sciences, 108,* 10081–10086. https://doi.org/10.1073/pnas.1103228108

Kaufman, A.S., & Kaufman, N.L. (2004). Kaufman Assessment Battery for Children (2nd ed.). Circle Pines: American Guidance Service.

Lynn, R., Meisenberg, G., Mikk, J., & Williams, A. (2007). National IQs predict differences in scholastic achievement in 67 countries. *Journal of Biosocial Science, 39(6),* 861–874. https://doi.org/10.1017/S0021932007001964

McGrew, K.S. (2009). CHC theory and the human cognitive abilities project: Standing on the shoulders of the giants of psychometric intelligence research. *Intelligence, 37(1),* 1–1. https://doi.org/10.1016/j.intell.2008.08.004

Mogle, J.A., Lovett, B.J., & Stawski, R. . (2008). What's so special about working memory? *Psychological Science, 19(11),* 1071–1077. https://doi.org/10.1111/j.1467-928.2008.02202.x

Morgan, J.E., Lee, S.S., & Loo, S.K. (2019). Fluid reasoning mediates the association of birth weight with ADHD symptoms in youth from multiplex families with ADHD. *Journal of Attention Disorders, 23(7),* 682–691. https://doi.org/10.1177/1087054716670006

Nisbett, R.E. (2009). *Intelligence and how to get it: Why schools and cultures count.* W. W. Norton & Company.

Otero, T.M. (2017). Brief review of fluid reasoning: Conceptualization, neurobasis, and applications. *Applied Neuropsychology: Child, 6(3),* 204–211. https://doi.org/10.1080/21622965.2017.1317484

Rzhanova, I.E., Alekseeva, O.S., & Burdukova, Yu.A. (2020). Uspeshnost' v obuchenii: vzaimosviaz' fluidnogo intellekta i rabochei pamiati [Successful learning: Relationship between fluid intelligence and working memory]. *Psikhologicheskaya nauka i obrazovanie* [Psychological Science and Education], *25(1),* 63–74. https://doi.org/10.17759/pse.2020250106

Schneider, W.J., & McGrew, K.S. (2009). The Cattell-Horn-Carroll model of intelligence. In D.P. Flanagan & P.L. Harrison (Eds.), *Contemporary intellectual assessment: Theories, tests, and issues* (pp. 99–144). The Guilford Press.

Schroeders, U., Schipolowski, S., Zettler, I., Golle, J., & Wilhelm, O. (2016). Do the smart get smarter? Development of fluid and crystallized intelligence in 3rd grade. *Intelligence, 59,* 84–95. https://doi.org/10.1016/j.intell.2016.08.003

Siegel, L.S. (1994). Working memory and reading: A life-span perspective. *International Journal of Behavioral Development, 17*(1), 109–124. https://doi.org/10.1177/016502549401700107

Tamm, L., & Juranek, J. (2012). Fluid reasoning deficits in children with ADHD: Evidence from fMRI. *Brain Research, 1465,* 48–56. https://doi.org/10.1016/j.brainres.2012.05.021

Thorsen, C., Cliffordson, C., & Gustafsson, J.E. (2014). The influence of fluid and crystallized intelligence on the development of knowledge and skills. *British Journal of Educational Psychology, 84*(4), 556–57. https://doi.org/10.1111/bjep.12041

Tillman, C.M., Nyberg, L., & Bohlin, G. (2008). Working memory components and intelligence in children. *Intelligence, 36*(5), 394–402.

Wechsler, D. (2014). *Wechsler Intelligence Scale for Children — Fifth Edition.* Pearson.

Wieland, J., & Zitman, F.G. (2016). It is time to bring borderline intellectual functioning back into the main fold of classification systems. *Psychiatric Bulletin, 40*(4), 204–206. https://doi.org/10.1192/pb.bp.115.051490

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Elusive Sources for Gender Differences in Spatial Ability: The Role of Personality, Spatial Interests, and Everyday Behaviours

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Background. After decades of research, gender differences in spatial abilities (SA) remain poorly understood. Among factors that may contribute to these differences are self-perceived SA, inclinations, everyday behaviour and interests in SA-related activities, and related personality characteristics. In order to understand these links, a multifactorial approach is needed.

Objective. This study explored the relationships among SA, spatial interests, and personality among adolescent boys and girls.

Design. The study recruited 660 participants (mean age = 15.04, SD = 1.08; 48% females) from public schools. Participants contributed data on a battery of SA tests; 8 personality traits: Big Five and Dark Triad; as well as SA-related activities: spatial interests and school commute information (mode and time) as a proxy for everyday spatial behaviour.

Results. Weak-to-moderate mean gender differences were observed: males scored higher on spatial ability, spatial interests, machiavellianism, and psychopathy; and females on agreeableness, openness to experience, and neuroticism. Hierarchical regression analyses revealed some gender differences in associations among personality traits and SA. In males, openness to experience and conscientiousness were significantly related to SA test performance. In females, openness to experience, extraversion, agreeableness, and machiavellianism contributed to SA performance. Although spatially-related interests were linked to SA, they were not significantly predicted by personality traits. Everyday spatial behaviour showed no relationship with personality traits or SA.

Keywords: Big Five, personality, Dark Triad, spatial ability; spatial interest

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Conclusion. The study replicated patterns of gender differences in spatial ability, spatial interests, and personality reported in previous literature. The results showed differential links between personality traits and spatial ability for males and females. However, the overall amount of variance explained in spatial ability was very small, suggesting that other factors are more prominent sources of gender differences in spatial ability.

Introduction

Spatial ability (SA) is the fundamental capacity to operate spatial information, and is an important concept in education, especially when it comes to STEM (Science, Technology, Engineering, and Mathematics) areas (Kell et al., 2013). SA has also been studied in the context of largely unexplained gender differences in STEM engagement and success (Stoet & Geary, 2018; Yoon & Mann, 2017). Among factors that may contribute to these differences are interest in SA-related activities and everyday behaviours, as well as personality characteristics. The aim of this study is to provide new insights into gender differences in spatial performance by exploring the relationships among SA, spatial interests, everyday spatial behaviours, and personality traits in males and females.

Personality-SA Links

Personality traits are defined as persistent patterns of behaviour and emotional reactions (Roberts et al., 2008). Personality traits are related to cognitive performance, for example, in general cognitive ability tests (Carretta & Ree, 2018; Kowalski et al., 2018; Rammstedt et al., 2018; Schaie et al., 2004; Soubelet & Salthouse, 2011; Stanek & Ones, 2023; Voronina et al., 2016); verbal reasoning tasks (Schaie et al., 2004; Sutin et al., 2019), and academic achievement (Chamorro-Premuzic & Furnham, 2003; Meyer et al., 2019). Studies also found associations between personality and both small-scale SA (mental operations with objects) and large-scale SA (processing egocentric spatial information, *e.g.*, during navigation) (Bryant, 1982; Carbone et al., 2019; Meneghetti et al., 2020; Pazzaglia et al., 2018; Stanek & Ones, 2023). For example, participants' personality traits (capacity for status, sociability, and self-acceptance, etc.) were linked with performance on a large-scale (egocentric) pointing task (Bryant, 1982).

The link between SA and personality could be driven by several mechanisms. For example, according to the investment theory developed by Cattel (Cattell, 1957), personality traits may be related to cognitive performance through motivation and aptitude for learning and exploration. Specifically, individuals high in openness to experience may seek new information more actively (Soubelet & Salthouse, 2011; von Stumm & Ackerman, 2013) and thus have higher cognitive ability. In line with this, two meta-analyses (Stanek & Ones, 2023; von Stumm & Ackerman, 2013) showed

that intelligence is linked to personality traits related to intellectual investment (need for cognition, openness to experience, etc.).

With regard to spatial ability, personality traits may contribute to spatial performance via its influence on spatially-related interests, attitudes, self-efficacy, and engagement in spatial activities. In support of this, one study found that the Big Five traits, with the exception of conscientiousness, were associated with attitudes towards spatial exploration (Meneghetti et al., 2020). Another study discovered weak to moderate correlations between all Big Five personality traits and spatial anxiety, pleasure in exploration, and self-efficacy (Pazzaglia et al., 2018). In Bryant (1982), personality traits were linked to the self-reported sense of direction and spatial anxiety of the participants.

A number of studies demonstrated that SA can be improved through various activities and experiences (Uttal et al., 2013), implying that engagement in everyday spatial activities affects SA. Consistent with this, higher levels of extraversion were linked with greater engagement in sports (Steca et al., 2018), which may indirectly enhance some aspects of SA (Habacha et al., 2014; Voyer et al., 2017). Other studies showed associations between personality traits and video games: for example, high extraversion and low neuroticism were associated with preferences for action video games (Braun et al., 2016) — a genre that was experimentally shown to increase SA (Bediou et al., 2018).

A number of studies suggested that individuals' styles of everyday engagement with the environment might be linked with accuracy of spatial representations (*e.g.*, Bryant, 1982). For example, commuting preferences, *e.g.*, walking or cycling vs. public transport, may indirectly impact everyday spatial experience and performance (Sattler et al., 2023).

Alternatively, the causal direction of these associations could be reversed or reciprocal. According to the PPIK theory (intelligence-as-process, personality, interests, and intelligence-as-knowledge) by Ackerman (1996), there is a reciprocal relationship between cognition, interests, and personality traits in adults. For instance, individuals with superior navigation skills (intelligence-as-process) may be more likely (interests) to actively explore their surroundings (intelligence-as-knowledge), thereby potentially enhancing their abilities. This explanation is supported by some evidence, including links from intelligence to personality (*e.g.*, sociability; Major et al., 2014) and from spatial ability to interests in STEM (Kell et al., 2013).

Furthermore, the link between personality and cognitive ability may reflect personality influence on performance rather than on actual ability. For instance, individuals with high levels of conscientiousness (associated with higher commitment and orderliness) or machiavellianism (associated with strategic thinking and planning) are likely to perform better on complex cognitive tasks, while high levels of neuroticism (*i.e.*, worry and depression) may have a negative impact on performance (Carbone et al., 2019; Carretta & Ree, 2018; Kowalski et al., 2018; Moutafi et al., 2006; Stanek & Ones, 2023). For example, people higher on neuroticism may perform worse under time pressure (Shaw et al., 2020).

Gender as a Moderator of Personality-SA Links

The links between personality, SA, and spatial interests may be moderated by gender, as gender differences in mean scores are found in personality traits (Likhanov et al., 2021), SA (Tsigeman et al., 2023; Yuan et al., 2019), navigation behaviour (Munroe et al., 1985), and interests (Hofer et al., 2024; Su et al., 2009). For personality, females scored higher on conscientiousness, openness to experience, neuroticism (Likhanov et al., 2021) and "humility" — a tendency to underestimate their ability and performance, *e.g.*, SA (Hofer et al., 2024; Repeykova et al., 2024). Males scored higher on machiavellianism, psychopathy, and narcissism (Likhanov et al., 2021; Luo et al., 2023).

For spatial ability, many studies have found males to have higher performance than females on spatial tests (Likhanov et al., 2023; Tsigeman et al., 2023; Yuan et al., 2019) and higher self-estimates of SA (which were closer to actual performance) (Hofer et al., 2024), as well as more spatial exploration behaviour (Munroe et al., 1985). Previous studies have also demonstrated gender differences in the links between these measures. For instance, one study found that years of formal education and everyday navigation routines had a stronger relation to SA in male than female children (Munroe et al., 1985). Research also suggested that the gender–ability link develops over time. For example, a recent meta-analysis by Lauer and collaborators (2019) demonstrated that the small male advantage in SA in childhood gradually increases by adolescence. It is possible that personality traits and interests contribute to these changes.

The current study explores the relationships among SA, spatial interests, and everyday behaviour and personality traits in adolescent males and females using a multifactorial approach. We examined the associations between spatial ability (measured with 10 tasks) and personality (Big Five and Dark Triad traits), as well as spatially-related interests and commuting behaviour (commuting mode and time to school).

Methods

Participants

Six-hundred and sixty adolescents from public schools in Russia participated in the study (314 females; age range 13–17, $M_{age} = 15.4$, $SD = 1.08$). Male and female participants were comparable in age ($t = .398$, $p = .69$).

Procedure

Participants completed a computerised socio-demographic inventory, personality questionnaires (Big Five and Dark Triad), and spatially-related behaviour items, and a battery of 10 SA tests in groups of up to 25 people. Description of each measure, example items, and reliability information are presented in *Table 1*. The testing session lasted approximately 1.5 hours.

Table 1

Questionnaires Used in the Study

Construct	Description	Scales	Example Item	Response Options	Validity
Spatial ability	Spatial ability was assessed using 10 tasks from a gamified online battery, "King's Challenge", previously adapted to Russian (Esipenko et al., 2018; Likhanov et al., 2018). The total score was calculated as an average percentage of correct answers in the 10 tests and was used to index general SA.	3D to 2D drawing, 2D to 3D drawing, cross-sections, Elithorn mazes, mazes, mechanical reasoning, paper folding, pattern assembly, perspective-taking, and shape rotation.	see Supplementary Materials, Table S1, for description of each test; and Rimfeld et al., 2017 for example items		10 tests were validated in an adolescent sample (Budakova et al., 2021) and showed split-half reliabilities from .56 to .86.
Spatially-related interests	1 item, tapping into spatially related interests. Drawn from Study for Mathematically Precocious Youth (Lubinski et al., 2014)	Spatially-related interests	"How often do you tinker with equipment, mechanical devices, gadgets, or participate in games involving construction?"	1 (Never) to 5 (Very frequently).	NA
Everyday spatial behaviour	2 items, tapping into everyday spatial behaviour, namely how students get to school and how long it takes. Drawn from Study for Mathematically Precocious Youth (Lubinski et al., 2014)	Commuting type	"How do you usually get to school?"	bus (1), underground (2), parents give me a ride (3), walk (4), bike (5).	NA
		Commuting time	"How long does it take you to get to school?".	Up to 10 min (1), 10-30 min (2), 30-60 min (3).	

Construct	Description	Scales	Example Item	Response Options	Validity
Big Five personality traits	The Russian adaptation of The Big Five Inventory (Shchebetenko & Wineshtein, 2010) consists of 44 items. Total scores for each trait were computed by averaging the scores of corresponding items.	BF: openness	I see myself as someone original, who comes up with new ideas.	1 (strongly disagree) to 5 (strongly agree).	Cronbach's α = .70-83 for subscales (Likhanov et al., 2021; Mishkevich, 2016)
		BF: conscientiousness	I see myself as someone who is a reliable worker.		
		BF: extraversion	I see myself as someone who is outgoing; likes to be with people.		
		BF: agreeableness	I see myself as someone who likes to cooperate; goes along with others.		
		BF: neuroticism	I see myself as someone who get nervous easily.	1 (strongly disagree) to 5 (strongly agree).	
Dark Triad	The Russian adaptation of The Short Dark Triad (Egorova et al., 2015) consists of 27 items. The score for each subscale was computed by averaging corresponding items	DT: narcissism	People see me as a natural leader.	1 (strongly disagree) to 5 (strongly agree).	Cronbach's α = .65-71 for subscales (Likhanov et al., 2021)
		DT: psychopathy	It's true that I can be mean to others.		
		DT: machiavellianism	I like to use clever manipulation to get my way.		

Statistical Approach

All statistical analyses were conducted using Jamovi (Version 1.6, The Jamovi Project, 2021) and R (R Core Team, 2017). All variables were standardised and screened for univariate outliers. Using the threshold of Z = 3.29 (Field, 2005), less than 5% of the sample were identified as univariate outliers and excluded from the analysis. No multivariate outliers were identified using Mahalanobis distance. Skewness and kurtosis of all variables varied within an acceptable range (below the cut-off of 2 recommended by Darren & Mallery, 2010).

Results

Descriptive statistics for the study variables are presented in *Table S2*.

Participants showed an uneven distribution between the categories of commuting mode and time to school (see *Table 2*). To adjust these categories for the analysis, we combined them into two groups: active mode (Walk and Bike options) and passive mode (Bus, Underground, and "Parents give me a ride").

Table 2

Frequency of Categorical Variables: Commuting Mode and Time to School

	Commuting mode	N	Total
Passive navigation	Bus	107	258
	Underground	8	
	Parents give me a ride	143	
Active navigation	Walk	383	387
	Bike	4	
	Commuting time		
	10 min	332	
	10–30 min	252	
	30–60 min	51	

Table S3 in Supplementary Materials presents the correlations between continuous study variables. All personality traits displayed significant intercorrelations with varying effect sizes. Strong intercorrelations were also observed among all SA tasks. There were negligible-to-weak correlations between all SA facets and some personality traits, namely conscientiousness, extraversion, openness and narcissism. Given largely uniform correlations between different SA facets and personality, we used spatial ability total score for further analysis.

Table 3 examines personality and spatial ability, interests and behaviour associations using the non-parametric Spearman correlations, as commuting modes are categorical/interval variables. Spatial ability total score correlated with some personality traits and spatial interests. Commuting behaviour showed minor correlations with other variables.

Table 3

Non-Parametric Correlation Matrix for Personality Traits, SA, Spatial Interests and Commuting Time

	1	2	3	4	5	6	7	8	9	10
1 Extraversion	–									
2 Agreeableness	.29***	–								
3 Conscientiousness	.47***	.37***	–							
4 Neuroticism	–.46***	–.32***	–.42***	–						
5 Openness	.39***	.26***	.26***	–.15***	–					
6 Machiavellianism	–.02	–.34***	–.03	.1*	.01	–				
7 Narcissism	.55***	.03	.27***	–.18***	.4***	.25***	–			
8 Psychopathy	–.02	–.54***	–.26***	.19***	–.09*	.42***	.19***	–		
9 Commuting time	.01	–.04	–.08*	–.03	.01	.03	.03	.1*	–	
10 Spatial ability	–.14***	.01	–.14***	–.02	.01	.12**	–.07	.02	.04	–
11 Spatial interests	.07	.03	.06	–.18***	.02	.09*	-.02	.06	.06	.17***

*Note: * $p < .05$, ** $p < .01$, *** $p < .001$*

Hierarchical Regressions: Spatial Ability, Spatial Interests, and Spatial Behaviours

Hierarchical linear regressions were conducted to investigate the unique contribution of personality traits in predicting SA and spatial interests. Additionally, binomial logistic regression was conducted for commuting mode, and multinomial regression was conducted for commuting time. The first step of each model included only age and gender (1 = male; 2 = female) as predictors. In the second step, personality traits were added to the model (see *Table 4* and *Table S4–S5* for all models).

For SA, the predictors explained 15% of the variance. In Step 1, age and gender accounted for 10% of the variance ($F(2, 639) = 36.05$, $p < .05$), with gender making a larger contribution. In Step 2, personality traits accounted for an additional 5% of the variance ($F(10, 631) = 11.46$, $p < .05$), with openness, conscientiousness, extraversion, agreeableness, and machiavellianism all making weak significant contributions.

For spatial interests, the predictors collectively accounted for 15% of the variance. Age and gender accounted for 13% of the variance in Step 1 ($F(2, 639) = 47.41$, $p < .001$), with gender making a larger contribution. In Step 2, personality traits accounted for an additional 2% of significant variance ($F(10, 631) = 11.43$, $p < .001$), with narcissism being the only trait that made a significant contribution.

For both commuting mode and time, neither model showed statistical significance (see *Tables S4–S5 in the Supplementary Materials*).

Table 4

Hierarchical Regression Analyses with Age, Gender, and Personality Traits as Predictors for Spatial Ability and Spatial Interests

	Spatial ability				Spatial interests			
	Model 1		Model 2		Model 1		Model 2	
Predictors	std. β	std. CI	std. β	std. CI	std. β	std. CI	std. β	std. CI
Age	.09 *	.02 – .17	.10 *	.02 – .17	–.08 *	–.16 – –.01	–.08 *	–.16 – –.01
Gender [a]	–.61 ***	–.76 – –.46	–.60 ***	–.76 – –.44	–.70 ***	–.84 – –.55	–.68 ***	–.83 – –.52
Openness			.13 **	.04 – .21			.08	–.01 – .16
Conscientiousness			–.14 **	–.23 – –.05			.06	–.03 – .15
Extraversion			–.13 *	–.23 – –.02			.06	–.05 – .16
Agreeableness			.10 *	.01 – .20			.04	–.06 – .13
Neuroticism			–.04	–.13 – .05			–.05	–.14 – .04
Machiavellianism			.11 *	.02 – .19			.06	–.02 – .15
Narcissism			–.05	–.14 – .05			–.12 *	–.22 – –.03
Psychopathy			–.02	–.12 – .07			.06	–.04 – .15
Observations	642		642		642		642	
R^2 / R^2 adjusted	.101 / .099 ***		.154 / .140 ***		.129 / .126 ***		.153 / .140 ***	
DR^2			.052				.024	
AIC	5608.392		5585.896		2039.184		2037.092	

*Note: * p < .05, ** p < .01, *** p < .001; [a] Gender was a dichotomous variable (1 = male; 2 = female)*

Gender Differences in Predictors of Spatial Ability and Spatial Interests

First, we assessed gender differences in SA and spatial interests in males and females (see *Table S2*). Figure 1 shows the distribution of spatial interests and SA by gender. Males demonstrated higher SA than females ($t = 8.09$, $p < .001$; Cohen's $d = .69$) and spatial interests ($t = 9.37$, $p < .001$; Cohen's $d = .74$).

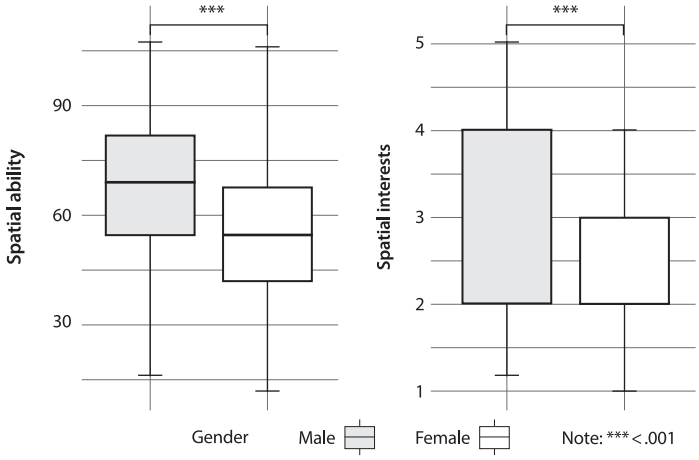

Figure 1. The distribution of SA and spatial interests in male and female participants

Additionally, we calculated correlations among personality traits, SA and spatial interests separately in males and females, showing negligible links between personality and SA variables (see Tables S6–S7).

Four separate hierarchical regressions were conducted to investigate the unique contribution of personality traits to SA and spatial interests in males and females (see Tables S8–S9 in Supplementary Materials).

The regression model for males with SA as the outcome showed that openness and conscientiousness significantly contributed to SA, accounting for 5% of the variance ($F(9, 326) = 2.151$, $p < .05$). The regression model for females showed that openness, extraversion, agreeableness, machiavellianism, and age accounted for 10.5% of the variance in SA ($F(9, 296) = 3.875$, $p < .001$), with personality traits adding 9% of explained variance. See Table S8 for details. The regression model with spatial interests as the outcome (Table S9) showed that personality had no contribution either for males ($F(9, 326) = 1.77$, $p = .07$) or for females ($F(9, 296) = 1.81$, $p = .06$).

Discussion

The study evaluated links among personality traits, SA, and spatial interests in a large sample of male and female adolescents, to shed new light on gender differences in spatial performance. Our results replicated the results of many previous studies (*e.g.*, Yuan et al., 2019), showing higher spatial ability and spatial interests in males. The study also replicated and extended previous findings of the links between "g" general intelligence and personality — showing links between personality and SA. The results showed some differential links between personality traits and spatial ability for

males and females. However, the overall amount of variance explained by personality in spatial ability was very small, suggesting that other factors are more prominent sources of gender differences in spatial ability. Specifically, eight personality traits explained 5% of the variance in SA above age and gender in the overall sample, which is consistent with previous research (Carbone et al., 2019; Schaie et al., 2004). Even less variance (2%) was explained by personality in spatial interests, with only narcissism as a significant predictor beyond age and gender in the overall sample.

The regression analysis in males showed that only openness to experience and conscientiousness significantly predicted SA test performance, together explaining 5% of variance. In contrast, in females more traits contributed to SA test performance: openness to experience, extraversion, agreeableness, machiavellianism, and age explained about 10% of variance. The positive link between SA and openness to experience found in both genders may be explained in the framework of the investment theory (Cattell, 1957): people scoring higher on openness may put more effort into exploring the environment (Rammstedt et al., 2018). Alternatively, people low on openness might be less motivated to explore the environment, and those with lower conscientiousness might be less motivated to complete complex cognitive tasks, thus demonstrating somewhat lower spatial ability.

The links that were identified in either males or females in the current study were previously found in samples that included both males and females. For example, the negative link between cognitive abilities and conscientiousness, found in males, was indicated in previous research (Friedrich & Schütz, 2023; Moutafi et al., 2004). This pattern is in line with the intelligence compensation hypothesis, which suggests that individuals can compensate for lower cognitive ability with higher conscientiousness (Rammstedt et al., 2018). The contribution of machiavellianism to SA, found in females, is in line with previous research and may be due to links between machiavellianism and planning and problem-solving (Carretta & Ree, 2018; Kowalski et al., 2018). The links between SA and extraversion and agreeableness, found in females, were also previously shown in both males and females (Carretta & Ree, 2018; Papageorgiou et al., 2020; Rammstedt et al., 2018; Soubelet & Salthouse, 2011). Furthermore, one recent study has found that openness was associated with positive attitudes toward exploring places in both genders, whereas extraversion was associated with attitudes toward exploring places among men. Higher levels of extraversion were also linked to lower spatial anxiety in both genders, and lower levels of emotional stability were associated with greater spatial anxiety among women (Muffato et al., 2024). Further research is needed to clarify why some of the links were present in males but not females, and vice versa. For example, some of the differences could be explained by differences in absolute levels of these traits — on average higher Big Five personality traits scores in females (Likhanov et al., 2021) and higher spatial ability scores in males (Esipenko et al., 2018; Tsigeman et al., 2023; Yuan et al., 2019).

Males also showed average greater engagement in spatially-related hobbies — consistent with previous studies that found greater engagement in STEM-related hobbies for males (Hofer et al., 2024; Levine et al., 2016). However, correlational analysis did not demonstrate the predicted link between spatial interests, spatial behaviours, and SA (Uttal et al., 2013). We also did not find an association between personality

traits and spatial interests in either males or females. The absence of these links may reflect limitations and restrictions that prevent children from acting on their inclinations. For example, their journey to school is often determined by their caregivers and their engagement with hobbies is often limited by availability of resources.

Limitations and Future Directions

The current study had several limitations:

1. It showed only a small link between spatial ability and spatial interests, presumably because we enumerated a limited number of spatially-related activities that students are engaged in now, in a single item tapping into spatial interests. Future studies in children and adolescents may consider collecting data on desired activities, hobbies, and commuting mode in addition to actual ones, to better understand the links among them and spatial ability (see, for example, some recent studies that explored links between personality, cognitive ability, and engagement with music) (Ruth et al., 2023; Silas et al., 2022). Moreover, we did not consider other activities that might affect spatial ability, and that may account for differences between males and females in spatial abilities, such as sports, videogames or vocational interests (Armstrong et al., 2018; Baerg MacDonald et al., 2023; Kuhn & Wolter, 2022; Tao et al., 2022).
2. The current study utilised a sample of adolescents. Future studies might also consider direct comparisons of the personality–SA links between children/adolescents and adults, to explore whether these links increase as a result of greater opportunities for adults to act on their inclinations.
3. The current study assessed only small-scale spatial ability in a laboratory setting. Research that documents behaviours in natural settings may shed light on the links between everyday behaviours, such as wayfinding, spatial ability levels, and personality (*e.g.*, one recent study on the links between eye movements during museum exploration and personality traits) (Tsigeman et al., 2024).
4. Longitudinal studies are needed to assess the causal effects of engagement in spatially-related activities on gender differences in spatial ability.
5. The correlational analysis of the links between 10 spatial tasks and 8 personality traits showed a consistent pattern of correlations between personality and spatial ability (*i.e.*, correlations with a specific personality trait was similar regardless of the facet of spatial ability used: there either were correlations with all spatial tasks or no correlations with any task). This suggests little to no specificity in these associations for a specific spatial facet (at least in this sample). Future research will benefit from creating a "general spatial factor", and loading this factor and residual variance from each spatial task to each individual personality trait, to investigate the specificity of each spatial facet with regards to personality (see a somewhat similar approach in a recent paper that showed specific contributions from a paper-folding task to math word problems, beyond the general intelligence factor; Likhanov et al., 2024).

Conclusion

Our data demonstrated that the observed gender differences in spatial ability could not be explained by links with personality, spatial interests, and everyday spatial behaviours.

Ethics Statement

The study was approved by the Ethics Committee of Interdisciplinary Research at Tomsk State University (ethical approval code 16012018-5).

Informed Consent from the Participants' Legal Guardians

Only students whose parents or legal guardians provided informed written consent forms were invited to participate. Verbal assent was obtained from adolescent participants before the testing session.

Conflict of Interest

The authors declare that there is no conflict of interest.

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References

Ackerman, P.L. (1996). A theory of adult intellectual development: Process, personality, interests, and knowledge. *Intelligence*, *22*(2), 227–257. https://doi.org/10.1016/S0160-2896(96)90016-1

Armstrong, S., Wong, C.A., Perrin, E., Page, S., Sibley, L., & Skinner, A. (2018). Association of physical activity with income, race/ethnicity, and sex among adolescents and young adults in the United States: Findings from the National Health and Nutrition Examination Survey, 2007-2016. *JAMA Pediatrics*, *172*(8), 732. https://doi.org/10.1001/jamapediatrics.2018.1273

Baerg MacDonald, K., Benson, A., Sakaluk, J.K., & Schermer, J.A. (2023). Pre-occupation: A meta-analysis and meta-regression of gender differences in adolescent vocational interests. *Journal of Career Assessment*, *31*(4), 715–738. https://doi.org/10.1177/10690727221148717

Bediou, B., Adams, D.M., Mayer, R.E., Tipton, E., Green, C.S., & Bavelier, D. (2018). Meta-analysis of action video game impact on perceptual, attentional, and cognitive skills. *Psychological Bulletin*, *144*(1), 77–110. https://doi.org/10.1037/bul0000130

Braun, B., Stopfer, J.M., Müller, K.W., Beutel, M.E., & Egloff, B. (2016). Personality and video gaming: Comparing regular gamers, non-gamers, and gaming addicts and differentiating between game genres. *Computers in Human Behavior*, *55*, 406–412. https://doi.org/10.1016/j.chb.2015.09.041

Bryant, K.J. (1982). Personality correlates of sense of direction and geographic orientation. *Journal of Personality and Social Psychology*, *43*(6), 1318–1324. https://doi.org/10.1037/0022-3514.43.6.1318

Budakova, A.V., Likhanov, M.V., Toivainen, T., Zhurbitskiy, A.V., Sitnikova, E.O., Bezrukova, E.M., & Kovas, Y. (2021). Measuring spatial ability for talent identification, educational assessment, and support: Evidence from adolescents with high achievement in science, arts, and sports. *Psychology in Russia: State of the Art*, *14*(2), 59–85. https://doi.org/10.11621/pir.2021.0205

Carbone, E., Meneghetti, C., & Borella, E. (2019). The influence of personality traits and facets on visuo-spatial task performance and self-assessed visuo-spatial inclinations in young and older adults. *PLOS ONE*, *14*(8), e0220525. https://doi.org/10.1371/journal.pone.0220525

Carretta, T.R., & Ree, M.J. (2018). The relations between cognitive ability and personality: Convergent results across measures. *International Journal of Selection and Assessment*, *26*(2–4), 133–144. https://doi.org/10.1111/ijsa.12224

Cattell, R.B. (1957). *Personality and motivation structure and measurement* (pp. XXVI, 950). World Book Co.

Chamorro-Premuzic, T., & Furnham, A. (2003). Personality predicts academic performance: Evidence from two longitudinal university samples. *Journal of Research in Personality*, *37*(4), 319–338. https://doi.org/10.1016/S0092-6566(02)00578-0

Egorova, M.S., Sitnikova, M.A., & Parshikova, O.V. (2015). Adaptaciya Korotkogo oprosnika Temnoj triady [Adaptation of the Short Dark Triad]. *Psikhologicheskie Issledovaniia* [Psychological Research], *8*(43), 1. DOI: https://doi.org/10.54359/ps.v8i43.1052

Esipenko, E.A., Maslennikova, E.P., Budakova, A.V., Sharafieva, K.R., Ismatullina, V.I., Feklicheva, I.V., …, & Malykh, S. B. (2018). Comparing spatial ability of male and female students completing humanities vs. technical degrees. *Psychology in Russia: State of the Art*, *11*(4), 37–49. https://doi.org/10.11621/pir.2018.0403

Field, A.P. (2005). *Discovering statistics using SPSS: (And sex, drugs and rock 'n' roll)*. SAGE.

Friedrich, T.S., & Schütz, A. (2023). Predicting school grades: can conscientiousness compensate for intelligence? *Journal of Intelligence*, *11*(7), 146. https://doi.org/10.3390/jintelligence11070146

George, D., & Mallery, P. (2010). *SPSS for Windows step by step: A simple guide and reference, 17.0 update* (10th ed.). Boston : Allyn & Bacon. http://lib.ugent.be/catalog/rug01:001424067

Habacha, Molinaro, & Dosseville. (2014). Effects of gender, imagery ability, and sports practice on the performance of a mental rotation task. *The American Journal of Psychology*, *127*(3), 313. https://doi.org/10.5406/amerjpsyc.127.3.0313

Hofer, G., Hünninghaus, M., Platzer, J., Grinschgl, S., & Neubauer, A. (2024). *Women's humility and men's lack of hubris: Gender biases in self-estimated spatial intelligence*. https://doi.org/10.31234/osf.io/fx8a7

Kell, H.J., Lubinski, D., Benbow, C.P., & Steiger, J.H. (2013). Creativity and technical innovation: Spatial ability's unique role. *Psychological Science*, *24*(9), 1831–1836. https://doi.org/10.1177/0956797613478615

Kowalski, C.M., Kwiatkowska, K., Kwiatkowska, M.M., Ponikiewska, K., Rogoza, R., & Schermer, J.A. (2018). The Dark Triad traits and intelligence: Machiavellians are bright, and narcissists and psychopaths are ordinary. *Personality and Individual Differences*, *135*, 1–6. https://doi.org/10.1016/j.paid.2018.06.049

Kuhn, A., & Wolter, S.C. (2022). Things versus people: Gender differences in vocational interests and in occupational preferences. *Journal of Economic Behavior & Organization*, *203*, 210–234. https://doi.org/10.1016/j.jebo.2022.09.003

Lauer, J.E., Yhang, E., & Lourenco, S.F. (2019). The development of gender differences in spatial reasoning: A meta-analytic review. *Psychological Bulletin*, *145*(6), 537–565. https://doi.org/10.1037/bul0000191

Levine, S.C., Foley, A., Lourenco, S., Ehrlich, S., & Ratliff, K. (2016). Sex differences in spatial cognition: Advancing the conversation. *WIREs Cognitive Science*, *7*(2), 127–155. https://doi.org/10.1002/wcs.1380

Likhanov, M., Bogdanova, O., Alenina, E., Kolienko, T., & Kovas, Y. (2023). No evidence of a positive effect of learning Chinese language as an L2 on spatial ability. *Scientific Reports*, *13*(1), 1262. https://doi.org/10.1038/s41598-022-26738-2

Likhanov, M.V., Ismatullina, V.I., Fenin, A.Y., Wei, W., Rimfeld, K., Maslennikova, E.P., …, & Kovas, Y. V. (2018). The factorial structure of spatial abilities in Russian and Chinese students. *Psychology in Russia: State of the Art*, *11*(4), 96–114. https://doi.org/10.11621/pir.2018.0407

Likhanov, M.V., Tsigeman, E.S., Papageorgiou, K.A., Akmalov, A.F., Sabitov, I.A., & Kovas, Y.V. (2021). Ordinary extraordinary: Elusive group differences in personality and psychological difficulties between STEM-gifted adolescents and their peers. *British Journal of Educational Psychology*, *91*(1), 78–100. https://doi.org/10.1111/bjep.12349

Likhanov, M., Wang, F., Lyu, J., Wang, L., & Zhou, X. (2024). A special contribution from spatial ability to math word problem solving: Evidence from structural equation modelling and network analysis. *Intelligence*, *107*, 101875. https://doi.org/10.1016/j.intell.2024.101875

Lubinski, D., Benbow, C.P., & Kell, H.J. (2014). Life paths and accomplishments of mathematically precocious males and females four decades later. *Psychological Science*, *25*(12), 2217–2232. https://doi.org/10.1177/0956797614551371

Luo, Y.L.L., Kovas, Y., Wang, L., Stalikas, A., Kyriazos, T.A., Gianniou, F.-M., …, & Papageorgiou, K.A. (2023). Sex differences in the Dark Triad are sensitive to socioeconomic conditions: The adaptive value of narcissism in the UK, Greece, and China. *Current Psychology*, *42*(26), 22436–22448. https://doi.org/10.1007/s12144-022-03302-9

Major, J.T., Johnson, W., & Deary, I.J. (2014). Linear and nonlinear associations between general intelligence and personality in Project TALENT. *Journal of Personality and Social Psychology*, *106*(4), 638–654. https://doi.org/10.1037/a0035815

Meneghetti, C., Grimaldi, F., Nucci, M., & Pazzaglia, F. (2020). Positive and negative wayfinding inclinations, choice of navigation aids, and how they relate to personality traits. *Journal of Individual Differences*, *41*(1), 45–52. https://doi.org/10.1027/1614-0001/a000302

Meyer, J., Fleckenstein, J., Retelsdorf, J., & Köller, O. (2019). The relationship of personality traits and different measures of domain-specific achievement in upper secondary education. *Learning and Individual Differences*, *69*, 45–59. https://doi.org/10.1016/j.lindif.2018.11.005

Mishkevich, A.M. (2016). Using the Russian version of the BFI in the study of adolescents. *Perm University Herald. Series "Philosophy. Psychology. Sociology"*, *1*, 92–101. https://doi.org/10.17072/2078-7898/2016-1-92-101

Moutafi, J., Furnham, A., & Paltiel, L. (2004). Why is conscientiousness negatively correlated with intelligence? *Personality and Individual Differences*, *37*(5), 1013–1022. https://doi.org/10.1016/j.paid.2003.11.010

Moutafi, J., Furnham, A., & Tsaousis, I. (2006). Is the relationship between intelligence and trait neuroticism mediated by test anxiety? *Personality and Individual Differences*, *40*(3), 587–597. https://doi.org/10.1016/j.paid.2005.08.004

Muffato, V., Miola, L., Pazzaglia, F., & Meneghetti, C. (2024). Differences in wayfinding inclinations among women and men: A matter of personality and affect, not just gender. *Current Psychology*. https://doi.org/10.1007/s12144-024-06628-8

Munroe, R.H., Munroe, R.L., & Brasher, A. (1985). Precursors of spatial ability: A longitudinal study among the Logoli of Kenya. *The Journal of Social Psychology*, *125*(1), 23–33. https://doi.org/10.1080/00224545.1985.9713505

Papageorgiou, K.A., Likhanov, M., Costantini, G., Tsigeman, E., Zaleshin, M., Budakova, A., & Kovas, Y. (2020). Personality, behavioral strengths and difficulties and performance of adolescents with high achievements in science, literature, art and sports. *Personality and Individual Differences*, *160*, 109917. https://doi.org/10.1016/j.paid.2020.109917

Pazzaglia, F., Meneghetti, C., & Ronconi, L. (2018). Tracing a route and finding a shortcut: The working memory, motivational, and personality factors involved. *Frontiers in Human Neuroscience*, *12*, 225. https://doi.org/10.3389/fnhum.2018.00225

R Core Team. (2017). *R: A language and environment for statistical computing.* (Version 4.3.2 (2023-10-31 ucrt)) [Computer software]. R Foundation for Statistical Computing. https://www.R-project.org/

Rammstedt, B., Lechner, C., & Danner, D. (2018). Relationships between personality and cognitive ability: A facet-level analysis. *Journal of Intelligence*, *6*(2), 28. https://doi.org/10.3390/jintelligence6020028

Repeykova, V., Toivainen, T., Likhanov, M., Van Broekhoven, K., & Kovas, Y. (2024). Nothing but stereotypes? Negligible sex differences across creativity measures in science, arts, and sports adolescent high achievers. *The Journal of Creative Behavior*, *58*(1), 47–65. https://doi.org/10.1002/jocb.623

Rimfeld, K., Shakeshaft, N.G., Malanchini, M., Rodic, M., Selzam, S., Schofield, K., …, & Plomin, R. (2017). Phenotypic and genetic evidence for a unifactorial structure of spatial abilities. *Proceedings of the National Academy of Sciences*, *114*(10), 2777–2782. https://doi.org/10.1073/pnas.1607883114

Roberts, B.W., Wood, D., & Caspi, A. (2008). The development of personality traits in adulthood. In O.P. John, R.W. Robins, & L.A. Pervin (Eds.), *Handbook of personality: Theory and research* (pp. 375–398). The Guilford Press.

Ruth, N., Tsigeman, E., Likhanov, M., Kovas, Y., & Müllensiefen, D. (2023). Personality and engagement with music: Results from network modeling in three adolescent samples. *Psychology of Music*, *51*(4), 1223–1242. https://doi.org/10.1177/03057356221135346

Sattler, M.C., Färber, T., Traußnig, K., Köberl, G., Paier, C., Dietz, P., & van Poppel, M.N.M. (2023). Correlates of active commuting in Austrian adults: Does personality matter? In S. Hummel, P. Assinger, C. Bauer, T. Brudermann, A. Jany, M. Jury, R. Rauter, & M. van Poppel (Eds.), *Shaping Tomorrow Today — SDGs from multiple perspectives* (pp. 89–115). Springer Fachmedien. https://doi.org/10.1007/978-3-658-38319-0_5

Schaie, K.W., Willis, S.L., & Caskie, G.I.L. (2004). The Seattle Longitudinal Study: Relationship between personality and cognition. *Aging, Neuropsychology, and Cognition*, *11*(2–3), 304–324. https://doi.org/10.1080/13825580490511134

Shaw, A., Elizondo, F., & Wadlington, P.L. (2020). Reasoning, fast and slow: How noncognitive factors may alter the ability-speed relationship. *Intelligence*, *83*, 101490. https://doi.org/10.1016/j.intell.2020.101490

Shchebetenko, S.A., & Wineshtein, S.V. (2010). Ob izmerenii chert lichnocti posredstvom vremeni reaksii (chact' II: rezyl'taty issledovaniya) [On the measurement of personality traits by means of reaction times (part II: Results of a study)]. *Perm University Herald. Series Philosophy. Psychology. Sociology, 4*, 52–72.

Silas, S., Müllensiefen, D., Gelding, R., Frieler, K., & Harrison, P.M.C. (2022). The associations between music training, musical working memory, and visuospatial working memory: An opportunity for causal modeling. *Music Perception*, *39*(4), 401–420. https://doi.org/10.1525/mp.2022.39.4.401

Soubelet, A., & Salthouse, T.A. (2011). Personality–cognition relations across adulthood. *Developmental Psychology*, *47*(2), 303–310. https://doi.org/10.1037/a0021816

Stanek, K.C., & Ones, D.S. (2023). Meta-analytic relations between personality and cognitive ability. *Proceedings of the National Academy of Sciences*, *120*(23), e2212794120. https://doi.org/10.1073/pnas.2212794120

Steca, P., Baretta, D., Greco, A., D'Addario, M., & Monzani, D. (2018). Associations between personality, sports participation and athletic success. A comparison of Big Five in sporting and non-sporting adults. *Personality and Individual Differences*, *121*, 176–183. https://doi.org/10.1016/j.paid.2017.09.040

Stoet, G., & Geary, D.C. (2018). The gender-equality paradox in science, technology, engineering, and mathematics education. *Psychological Science*, *29*(4), 581–593. https://doi.org/10.1177/0956797617741719

Su, R., Rounds, J., & Armstrong, P.I. (2009). Men and things, women and people: A meta-analysis of sex differences in interests. *Psychological Bulletin*, *135*(6), 859–884. https://doi.org/10.1037/a0017364

Sutin, A.R., Stephan, Y., Damian, R.I., Luchetti, M., Strickhouser, J.E., & Terracciano, A. (2019). Five-factor model personality traits and verbal fluency in 10 cohorts. *Psychology and Aging*, *34*(3), 362–373. https://doi.org/10.1037/pag0000351

Tao, C., Glosenberg, A., Tracey, T. J. G., Blustein, D. L., & Foster, L. L. (2022). Are gender differences in vocational interests universal? Moderating effects of cultural dimensions. *Sex Roles*, *87*(5–6), 327–349. https://doi.org/10.1007/s11199-022-01318-w

The jamovi project (2024). Jamovi (Version 2.5) [Computer Software]. Retrieved from https://www.jamovi.org

Tsigeman, E., Likhanov, M., Budakova, A., Akmalov, A., Sabitov, I., Alenina, E., …, & Kovas, Y. (2023). Persistent gender differences in spatial ability, even in STEM experts. *Heliyon*, *9*(4). https://doi.org/10.1016/j.heliyon.2023.e15247

Tsigeman, E., Zemliak, V., Likhanov, M., Papageorgiou, K.A., & Kovas, Y. (2024). AI can see you: Machiavellianism and extraversion are reflected in eye-movements. *PLOS ONE*, *19*(8), e0308631. https://doi.org/10.1371/journal.pone.0308631

Uttal, D.H., Meadow, N.G., Tipton, E., Hand, L.L., Alden, A.R., Warren, C., & Newcombe, N.S. (2013). The malleability of spatial skills: A meta-analysis of training studies. *Psychological Bulletin*, *139*(2), 352–402. https://doi.org/10.1037/a0028446

von Stumm, S., & Ackerman, P.L. (2013). Investment and intellect: A review and meta-analysis. *Psychological Bulletin*, *139*(4), 841–869. https://doi.org/10.1037/a0030746

Voronina, I., Fenin, A., Malykh, T., & Belova, A. (2016). Relationships of Big Five personality traits and nonverbal intelligence at high school age. *SHS Web of Conferences*, *29*, 02044. https://doi.org/10.1051/shsconf/20162902044

Voyer, D., Voyer, S.D., & Saint-Aubin, J. (2017). Sex differences in visual-spatial working memory: A meta-analysis. *Psychonomic Bulletin & Review*, *24*(2), 307–334. https://doi.org/10.3758/s13423-016-1085-7

Yoon, S.Y., & Mann, E.L. (2017). Exploring the spatial ability of undergraduate students: Association with gender, STEM majors, and gifted program membership. *Gifted Child Quarterly*, *61*(4), 313–327. https://doi.org/10.1177/0016986217722614

Yuan, L., Kong, F., Luo, Y., Zeng, S., Lan, J., & You, X. (2019). Gender differences in large-scale and small-scale spatial ability: A systematic review based on behavioral and neuroimaging research. *Frontiers in Behavioral Neuroscience*, *13*, 128. https://doi.org/10.3389/fnbeh.2019.00128

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Supplementary Materials

Table S1

Ten Tests of Spatial Ability

Task name	N of items	Time limit per item (sec)	Description	Split-half reliability in Russian sample (M. V. Likhanov et al., 2018)
3D to 2D drawing	5	45	sketching a 2D layout of a 3D object from a specified viewpoint	.78
2D to 3D drawing	7	70	sketching a 3D drawing from a 2D diagram	.80
Cross-sections	15	20	visualizing cross-sections of objects	.74
Elithorn mazes	10	7	joining together as many dots as possible from an array	.88
Mazes	10	25	searching for a way through a 2D maze	.60
Mechanical reasoning	16	25	multiple-choice naive physics questions	.56
Paper folding	15	20	visualizing where the holes are situated after a piece of paper is folded and a hole is punched through it	.85
Pattern assembly	15	20	visually combining pieces of objects together to make a whole	.69
Perspective-taking	15	20	visualizing objects from a different perspective	.86
Shape rotation	15	20	mentally rotating objects	.82

Table S2

Descriptive Statistics of Personality Traits, Total Spatial Ability, and Spatial Interests Score for Male and Female Subsamples

	Males						Females						
	N	Mean	SD	Min-Max	Skew	Kurtosis	N	Mean	SD	Min-Max	Skew	Kurtosis	t-test
Openness	345	3.67	.62	1.8-5	-.02	-.61	313	3.87	.62	2.1-5	-.28	-.42	-4.18**
Conscientiousness	345	3.63	.65	1.67-5	-.3	-.48	313	3.73	.67	1.89-5	-.21	-.54	-1.84
Extraversion	345	3.58	.76	1.38-5	-.44	-.34	313	3.59	.83	1.12-5	-.38	-.5	-.12
Agreeableness	345	3.69	.54	2.11-5	-.01	-.35	312	3.8	.55	2-5	-.1	-.2	-2.61*
Neuroticism	345	2.57	.74	1-5	.39	.04	313	2.96	.8	1-5	0	-.54	-6.43**
Machiavellianism	345	3.27	.55	1.78-4.89	.03	-.34	313	3.09	.56	1.56-4.56	.04	-.11	4.25**
Narcissism	346	2.99	.55	1.56-4.44	.2	-.2	313	2.98	.54	1.33-4.67	.05	.23	.26
Psychopathy	346	2.18	.48	1.22-3.67	.25	-.28	314	2.02	.5	1-3.56	.45	-.04	4.18**
Total SA score	345	66.74	20.38	16.37-107.46	-.39	-.48	313	54.72	17.72	11.98-106.54	.05	-.46	8.09**
Spatial interests	337	3.38	1.21	1-5	-.33	-.88	309	2.5	1.17	1-106.54	.3	-.95	9.37**

Note: * $p < .01$, ** $p < .001$

Table S3

Correlation Matrix for Age, Personality Domains, Ten Tests Of Spatial Ability, Total Spatial Ability Score, and Spatial Interests

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. Spatial interests	–																		
2. Spatial ability	.17***	–																	
3. Ma	.04	.58***	–																
4. PT	.2***	.66***	.26***	–															
5. SR	.11**	.74***	.41***	.39***	–														
6. 3D	.11**	.74***	.38***	.45***	.49***	–													
7. PF	.07	.75***	.4***	.36***	.45***	.56***	–												
8. MR	.16***	.68***	.32***	.39***	.46***	.46***	.43***	–											
9. EM	.17***	.55***	.35***	.33***	.35***	.37***	.34***	.34***	–										
10. PA	.09*	.67***	.38***	.35***	.45***	.47***	.44***	.35***	.3***	–									
11. CS	.12**	.68***	.29***	.33***	.41***	.46***	.45***	.47***	.37***	.34***	–								
12. Psychopathy	.06	.03	.04	.01	−.02	−.02	.01	.08*	.07	.01	.06	–							
13. Narcissism	−.01	−.07	.011	−.07	−.09*	−.07	−.06	−.05	−.05	−.07	.02	.19***	–						
14. Machiavellianism	.08*	.11**	.1**	.01	.07	.04	.03	.1**	.04	.1**	.13***	.42***	.25***	–					
15. Openness	.03	.01	.06	−.04	.01	.07	.04	−.03	−.02	−.02	.01	−.07	.4***	.01	–				
16. Neuroticism	−.17***	−.013	.04	−.1*	−.03	−.01	.03	−.03	.01	.01	.02	.21***	−.2***	.12**	−.15***	–			
17. Conscientiousness	.06	−.14***	−.02	−.12**	−.06	−.14***	−.07	−.11**	−.12**	−.1*	−.13**	−.27***	.27***	−.04	.26***	−.43***	–		
18. Agreeableness	.03	.01	.02	.01	02	.08*	−.02	−.02	−.08	.01	−.03	−.55***	.03	−.35***	.26***	−.33***	.36***	–	
19. Extraversion	.08*	−.13***	−.02	−.1*	−.09*	−.16***	−.12**	−.09*	−.12*	−.07	−.08*	−.02	.57***	−.04	.39***	−.47***	.46***	.29***	–
20. Age	−.09*	.08*	.09*	.04	.06	.02	.03	.08*	.1*	.01	.11**	−.05	.07	.07	.02	.01	.1*	.03	−.02

*Note: CS — Cross-sections, 2D — 3D to 2D drawing, PA — Pattern assembly, EM — Elithorn mazes, MR — Mechanical reasoning, PF — Paper folding, 3D — 2D to 3D drawing, SR — Shape rotation, PT — Perspective-taking, Ma — Mazes; * $p < .05$, ** $p < .01$, *** $p < .001$*

Table S4

Hierarchical Binomial Logistic Regression with Age, Gender, and Personality Traits as Predictors for Commuting Mode

	Commuting mode [a]			
	Model 1		**Model 2**	
Predictors	std. β	std. CI	std. β	std. CI
(Intercept)	.65 ***	.52 – .81	.61 ***	.49 – .77
Age	.92	.79 – 1.08	.93	.79 – 1.09
Gender [b]	1.05	.77 – 1.44	1.13	.80 – 1.61
Openness			1.05	.87 – 1.26
Conscientiousness			.90	.74 – 1.10
Extraversion			.91	.72 – 1.14
Agreeableness			1.21	.98 – 1.50
Neuroticism			.90	.73 – 1.10
Machiavellianism			1.03	.86 – 1.25
Narcissism			1.03	.83 – 1.29
Psychopathy			1.23	1.00 – 1.53
Observations	645		641	
R^2 Tjur	.002		.014	

Note: [a] *Commuting mode was a dichotomous variable (0 = active mode; 1 = passive mode);*
[b] *Gender was a dichotomous variable (1 = male; 2 = female)*

Table S5

Hierarchical Multinomial Regression Analyses with Age, Gender, and Personality Traits as Predictors for Commuting Time

	Commuting time [a]			
	Model 1		**Model 2**	
Predictors	std. β	std. CI	std. β	std. CI
(Intercept) x1	5.63 ***	3.81 – 8.32	6.71 ***	4.31 – 10.44
(Intercept) x2	4.45 ***	2.99 – 6.62	5.08 ***	3.24 – 7.96
Age x1	.92	.68 – 1.25	.89	.65 – 1.21
Age x2	.83	.61 – 1.12	.81	.59 – 1.11
Gender [b] [Female] x1	1.40	.77 – 2.54	1.11	.57 – 2.14
Gender [b] [Female] x2	1.28	.70 – 2.36	1.08	.55 – 2.11
Openness x1			.92	.65 – 1.31
Openness x2			.93	.65 – 1.33
Conscientiousness x1			1.09	.75 – 1.58
Conscientiousness x2			.84	.57 – 1.23
Extraversion x1			1.27	.82 – 1.97
Extraversion x2			1.36	.87 – 2.12
Agreeableness x1			.98	.66 – 1.46
Agreeableness x2			.99	.66 – 1.49
Neuroticism x1			1.40	.95 – 2.08
Neuroticism x2			1.34	.90 – 2.00
Machiavellianism x1			1.17	.83 – 1.65
Machiavellianism x2			1.22	.86 – 1.73
Narcissism x1			.91	.61 – 1.36
Narcissism x2			.99	.66 – 1.49
Psychopathy x1			.64 *	.43 – .96
Psychopathy x 2			.68	.46 – 1.02
Observations	635		632	

Note: [a] *Commuting time was a variable with 3 levels (1 = 10 min; 2 = 10-30 min; 3 = 30-60 min),* [b] *Gender was a dichotomous variable (1 = male; 2 = female)*

Table S6

Correlation Matrix for Personality Traits, SA, and Spatial Interests in Males

Variable	1	2	3	4	5	6	7	8	9
1. Spatial interests	–								
2. Spatial ability	.14**	–							
3. Psychopathy	.01	–.01	–						
4. Narcissism	.04	–.06	.11*	–					
5. Machiavellianism	.1	.04	.32***	.23***	–				
6. Openness	.11*	.09	–.01	.45***	.07	–			
7. Conscientiousness	.12*	–.09	–.29***	.27***	–.01	.23***	–		
8. Agreeableness	.05	.05	–.52***	.06	–.27***	.25***	.37***	–	
9. Extraversion	.13*	–.09	–.03	.6***	–.05	.41***	.43***	.27***	–
10. Neuroticism	–.07	–.02	.29***	–.14**	.16**	–.14*	–.42***	–.32***	–.44***

*Note: * p < .05, ** p < .01, *** p < .001*

Table S7

Correlation Matrix for Personality Traits, SA, and Spatial Interests in Females

Variable	1	2	3	4	5	6	7	8	9
1. Spatial interests	–								
2. Spatial ability	–.01	–							
3. Psychopathy	.01	–.03	–						
4. Narcissism	–.06	–.1	.28***	–					
5. Machiavellianism	–.06	.1	.5***	.27***	–				
6. Openness	.07	.03	–.09	.37***	–.01	–			
7. Conscientiousness	.05	–.16**	–.24***	.28***	–.04	.27***	–		
8. Agreeableness	.08	.01	–.57***	–.01	–.41***	.25***	.34***	–	
9. Extraversion	.05	–.2***	–.02	.55***	–.03	.39***	.5***	.31***	–
10. Neuroticism	–.11*	.17**	.24***	–.26***	.18**	–.26***	–.51***	–.41***	–.52***

*Note: * p < .05, ** p < .01, *** p < .001*

Table S8

Hierarchical Regression Analyses with Age and Personality Traits as Predictors for Spatial Ability in Males and Females

	Spatial ability								
	Males				Females				
	Model 1		Model 2		Model 1		Model 2		
Predictors	*std. β*	*std. CI*	*std. β*	*std. CI*	*std. β*	*std. CI*	*std. β*	*std. CI*	Fisher's z
Age	.08	–.03 – .18	.07	–.04 – .18	.12 *	.01 – .24	.12 *	.01 – .23	–.636
Openness			.13 *	.01 – .25			.14 *	.02 – .27	–.128
Conscientiousness			–.16 *	–.29 – –.03			–.12	–.25 – .02	.514
Extraversion			–.12	–.28 – .04			–.17 *	–.32 – –.01	–.643
Agreeableness			.09	–.05 – .22			.15 *	.01 – .30	–.767
Neuroticism			–.12	–.25 – .01			.06	–.08 – .20	.762
Machiavellianism			.08	–.04 – .20			.16 *	.02 – .29	-1.023
Narcissism			–.04	–.19 – .11			–.05	–.20 – .10	–.126
Psychopathy			–.02	–.15 – .12			–.02	–.17 – .13	0
Observations	336		336		306		306		
R^2 / R^2 adjusted	.006 / .003 *		.056 / .030 *		.016 / .012 *		.105 / .078 ***		
DR^2			.05				.09		
AIC	2977.463		2976.079		2628.843		2615.551		

*Note: * p < .05, ** p < .001*

Table S9

Hierarchical Linear Regression Analyses with Age and Personality Traits as Predictors for Spatial Interests in Males and Females

	Spatial interests								
	Males				**Females**				
	Model 1		**Model 2**		**Model 1**		**Model 2**		
Predictors	*std. β*	*std. CI*	*std. β*	*std. CI*	*std. β*	*std. CI*	*std. β*	*std. CI*	Fisher's z
Age	–.04	–.15 – .07	–.04	–.15 – .07	–.14 *	–.26 – –.03	–.11	–.22 – .01	.887
Openness			.08	–.05 – .20			.08	–.04 – .21	0
Conscientiousness			.08	–.05 – .21			.04	–.10 – .18	.506
Extraversion			.14	–.02 – .30			.01	–.15 – .17	1.649
Agreeableness			.00	–.13 – .14			.07	–.08 – .22	–.883
Neuroticism			–.01	–.14 – .12			–.09	–.24 – .05	1.011
Machiavellianism			.14 *	.02 – .26			–.03	–.16 – .11	2.153 *
Narcissism			–.14	–.29 – .01			–.16 *	–.31 – –.00	.258
Psychopathy			0	–.13 – .14			.15	–.01 – .31	-1.904 *
Observations	336		336		306			306	
R^2 / R^2 adjusted	.002 / –.001		.047 / .020		.021 / .017			.052 / .023	
AIC	1081.569		1082.016		959.387			965.366	

Note: * $p < .05$ ** $p < .01$ *** $p < .001$

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Intelligence Types Predict Different Domains of Emotional Creativity Through Self-Assessed Creativity and Intelligence

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Background. This study is based on the idea of unity between affect and intelligence. It explores how different types of intelligence (fluid, verbal, self-assessed, and emotional) contribute to emotional creativity and implicit theories of creativity and emotion.

Objective. To identify the contributions of various types of intelligence to emotional creativity and the implicit theories of creativity and emotion.

Design. Linear regression and mediation analyses were conducted on a sample of 244 students. These analyses aimed to uncover the relationships between different types of intelligence, emotional creativity, and related components of self-awareness (at the levels of self-assessment and implicit theories).

Results. The findings demonstrated the intricate connections between various forms of intelligence-fluid, crystallized, emotional, emotional creativity, and self-awareness components such as self-assessment of intelligence and creativity. Specifically, the impact of intelligence on emotional intelligence traits and emotional creativity was mediated by measures of self-esteem in intelligence and creativity. To test specific hypotheses, we conducted a series of regression analyses and developed two structural models. The first model included linear regression equations with each emotional creativity (EC) scale as the dependent variable and both types of intelligence, as well as self-assessments — SAI and SAC — as predictors. The second model demonstrated the mediation effect of implicit theories of emotions (ITE) in the influence of emotional intelligence (EI) on emotional creativity.

Conclusion. This study highlights the complexity of the interplay between different types of intelligence and emotional creativity. It reveals the mediating role of self-esteem in these relationships and underscores the distinct nature of emotional creativity domains. Additionally, it establishes the link between implicit theories of emotions and creativity, with emotional intelligence and self-esteem, offering valuable insights for further research.

Keywords: intelligence, emotional intelligence, emotional creativity, implicit theories, self-assessed intelligence, self-assessed creativity, TEIQue-SF, ECI

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Introduction

Recent studies of emotional intelligence, emotional creativity, and implicit theories (of intelligence, creativity, and emotions) highlight the idea of unity between intelligence and emotion (B. Spinoza, L. S. Vygotsky), not only in their cognitive and personality components, but also on the different levels of mental processes. Self-assessments reflect the self-awareness level of an individual, where cognitive processes interact with those pertaining to emotions and personality, while the deeper levels of mental organization are represented by implicit theories. Implicit theories are a person's subjective ideas about their intellect, personality, creativity, family, etc., which are less conscious, since they are formed and developed spontaneously in individual experience and manifest themselves in personal beliefs (mindset) and behavioral regulation (Dweck, 2006; Petrides et al., 2016; Sternberg et al., 2000).

Reviewing the latest meta-analysis of the relationship between intelligence and creativity (Gerwig et al., 2021), a meta-analysis of the relationship between emotional intelligence (EI) and creativity (Xu et al., 2019), and other works in this area, has revealed that the role of both types of intelligence — academic (IQ) and emotional (EQ) — in emotional creativity (EC) is not discussed. Emotional creativity is left out when considering possible moderators of creative achievements. In our opinion, the confirmed connections between intelligence and creative achievements cannot be automatically transferred to those between intelligence and creativity in generation of emotions. Therefore, it becomes relevant to identify the role of both types of intelligence in emotional creativity (EC), as well as their common relationships with individual characteristics at the metacognitive level of an individual's self-awareness (specifically, with self-assessment of intelligence and creativity).

What has been overlooked in the debate about general or domain-specific creativity, the four or seven C's, is the system of interconnected multi-level processes that contribute to emotional creativity. The authors of a recent meta-analysis on emotional creativity note that "EC has been found to be related to various constructs across different fields of psychology during the past 30 years, but a comprehensive examination of previous research is still lacking" (Kuška et al., 2020, abstract).

Since there is no consensus on whether EC should be understood as an ability or a trait, and given that EC is assessed using a questionnaire, we considered it appropriate to use a questionnaire to assess emotional intelligence as well. This choice led us to approach the components of EI as personality traits, though distinct from the traits covered in the Big Five model (Petrides, 2009).

The purpose of this paper was to perform a comprehensive analysis of links among academic intelligence — both crystallized and fluid, self-assessed intelligence, self-assessed creativity, emotional intelligence, emotional creativity, implicit theories of creativity, and emotions. Given the multiplicity of possible connections, our focus was primarily on elucidating how traits of emotional intelligence, self-assessed intelligence, self-assessed creativity, and implicit theories of creativity and emotions contribute to emotional creativity.

Emotional Intelligence — Ability or Trait?

While some authors question the theoretical basis of the emotional intelligence construct (Hughes & Evans, 2016), this construct has become integrative for building bridges between intelligence and personality research. Both public and academic interest in emotional intelligence (EI) have been rising since the 1990s, leading to the development of two main approaches to conceptualizing, defining, and measuring EI: as an ability — within the four-branch model by J. Mayer, P. Salovey, and D. Caruso (Mayer et al., 2016) — or as a personality trait.

There are studies that correlate EI ability with crystallized and fluid intelligence in different ways. MacCann (2010) found stronger associations of EI with crystallized intelligence ($r = .71$) than with fluid intelligence ($r = .45$). Some authors (Davies et al., 1998) understood EI as part of the fluid intelligence associated with the operational capabilities of the human cognitive system, while others (Farrelly & Austin, 2007), on the contrary, understood EI as part of crystallized intelligence, reflecting the ability to use knowledge. However, the negative relationship between EI and intelligence indicated that EI could not represent a new kind of intelligence (Husin Wan et al., 2013).

R. Bar-On proposed a model of emotional and social intelligence as emotional competence and introduced the 'emotional quotient' (EQ) index by analogy with cognitive IQ (Bar-On, 2007). Over the past decade, the understanding of EI as a personality trait began to be considered in the context of research by A. Furnham and K. Petrides. They substantiated the understanding of EI as a trait and insisted that this additional dimension does not fit either the model of H. Eysenck's Big Three traits (extraversion, neuroticism, psychoticism) or the Big Five model (Petrides et al., 2016; Petrides & Furnham, 2003). Unlike other personality traits, EI traits are relegated to lower levels of awareness, but are reflected in emotion-related self-perceptions and personality predispositions regarding emotional regulation (Petrides, 2009; Petrides et al., 2018; Petrides & Furnham, 2003).

D. Van der Linden and co-authors showed in their meta-analysis that EI as a trait demonstrated significantly stronger associations with the General Factor of Personality (GFP) than with measures of EI as an intellectual ability, and this finding became one of the reasons for considering EI mostly as a trait (van der Linden et al., 2017).

Nevertheless, EI measured as ability, but not EI as a trait, is positively associated with performance of 'hot' cognitive tasks (Gutiérrez-Cobo et al., 2016); it seems to particularly contribute to cognitive processes when emotions are involved in the problem solving (Checa & Fernández-Berrocal, 2019). Such evidence allowed J.M. Mestre and colleagues to consider including EI ability in the Cattell-Horn-Carroll model, which is currently the most comprehensive and psychometrically validated model of the structure of cognitive abilities (Mestre et al., 2016). However, the proposal to include EI trait as a moderator of the relationship between EI ability and emotion regulation to provide greater subtlety in understanding emotion-related behavior (Hughes & Evans, 2016) was not supported. Mestre highlights the problematic term "EI trait": both theory and empirical evidence show that EI trait assessment tools measure personality rather than intelligence.

The process in which abilities and personality traits converge in the context of EI is emotional regulation. The study by M. Bucich & C. MacCann (2019) found no relationship between of EI as an ability and everyday emotion regulation. However, as a trait, emotional intelligence is associated with various emotion regulation strategies such as social sharing, direct situation modification, and reappraisal. The results of the meta-analysis showed that emotional regulation is more strongly associated with trait-based measures of EI than with ability-based measures (Peña-Sarrionandia et al., 2015).

Emotional Creativity

The term "creativity" refers to both cognitive abilities and personality traits, creating the same dichotomy as in EI. Previous research that examined relationships among EI, intelligence (divergent thinking), and creativity indicated that cognitive abilities positively, but not significantly, correlated with creative abilities and creative achievements (Kim, 2008; Said-Metwaly et al., 2022; Weiss et al., 2021); however, both academic intelligence and creativity significantly negatively correlated with EI trait estimates (Furnham, 2016).

Currently, the assessment of EC traditionally relies on the questionnaire developed by J. Averill, who introduced the concept using a constructivist approach (Averill, 1999, 2000). He considered the interaction of cognitive and emotional processes as integral emotional syndromes that vary depending on the culture (Averill, 2005). A social constructionist view reveals a new aspect of emotion regulation — the process of construction as a moment of creativity and invention of a new, effective, and authentic emotional reaction. In this approach, we can observe similarities with the development of the L.S. Vygotsky's idea about the mediating function of self-regulation (Vygotsky, 1980). We believe that the stimuli-tools necessary for emotional self-regulation are not the words themselves (or the rules set by society), but the active manifestation of a person's creative potential. The term "emotional creativity" refers to a novel form of creativity, where the outcome is a new emotional reaction.

In Averill's model, EC included three components: cognitive skills, emotions, and creativity. Emotional schemes assimilated in society belong to the cognitive component in the EC. For empirical studies of EC, the Emotional Creativity Inventory (ECI) was developed (Averill, 1999). The revealed connections of EC with academic and emotional intelligence support its interpretation as an emotional ability (Averill, 2000). Research has shown that women demonstrated significantly higher levels of EC on all scales than men (Kuška et al., 2020).

EC correlates with different types of creative activity: writing, drawing, performing a dramatic role, composing music, and home improvement (Trnka et al., 2016). In addition, the works of participants with higher EC scores are rated as more creative. Emotional creativity is also associated with the Big Five "openness to experience", including the "aesthetic" facet (Averill, 1999).

In our previous study, the modified Russian version of the ECI revealed five latent factors (Kornilova et al., 2020). The first two factors — Novelty and Emotional Preparedness — were similar to those identified by Averill. The Effectiveness and Authenticity of emotional reactions formed two factors (instead of one in the original

version), indicating greater differentiation in Russian-speaking samples. Finally, the fifth factor was unique for the Russian sample and included items not only about the variety of emotions experienced, but also about the complexity of their expression (Emotional Diversity).

Implicit Theories of Emotions

Implicit Theories (IT), or Lay Theories, are understood as preconscious or partially conscious ideas about various phenomena, which, based on developing internal schemes (for example, tacit knowledge), set the possible ranges of the subject's reaction to a specific event and attitudes to specific situations. Implicit personality theory is not a theory in the scientific sense, but rather a set of ideas about one's own personality and the personalities of others. Similarly, the Implicit theory of intelligence refers to everyday ideas about intelligence, as contrasted by R. Sternberg with the explicit theories of professionals (Sternberg et al., 2000).

In the context of clarifying the connection between emotional intelligence and emotional creativity, we are primarily interested in implicit theories of emotion (ITE), which reflect a person's everyday ideas about whether emotions help or hinder in achieving goals and whether a person can control their emotions (Karnaze & Levine, 2020).

The division of implicit theories into incremental and constant (Dweck, 2006) has been extended to the field of study of implicit theories of emotion. M. Tamir and her colleagues developed the ITE diagnostic scale (Tamir et al., 2007). Studies have shown that adhering to incremental ITE (as opposed to constant ITE) is linked to greater effectiveness in emotional self-regulation. This includes the use of productive strategies, for example, cognitive reformulation and cognitive reappraisal, and the rejection of unproductive strategies, like the suppression of emotions (De France & Hollenstein, 2021). Incremental ITE is also associated with greater motivation to make efforts to self-regulate emotions, with less negative emotions and pathological distress (Kneeland et al., 2016), as well as with greater levels of positive emotions, social support, and subjective well-being (De France & Hollenstein, 2021; Ford & Gross, 2019; Kneeland et al., 2016; Romero et al., 2014).

However, despite active research into IT, we have not found any studies on the association of ITE with EC scores. Based on previous research, it can be assumed that adherence to incremental ITE is linked to higher levels of emotional intelligence and emotional creativity.

Self-Assessed Intelligence (SAI) and Self-Assessed Creativity (SAC)

Studies examining self-assessed intelligence and self-assessments of cognitive ability across various samples have shown significant, albeit moderately sized, correlations between self-evaluations and performance-based indicators of constructs associated with intelligence (Howard & Cogswell, 2018). Although intellectual ability is one of the major predictors of SAI, the mapping between the two is far from perfect. Part of this measurement error or inaccuracy is likely due to the effects of IT. Differences between IT types corresponding with SAI inaccuracy are captured

by a more integrative concept of the mindset: whether or not the person tends to view their and others' intelligence as a relatively fixed or a malleable trait (Dweck & Yeager, 2019).

Creative self-esteem correlates with a positive prediction of creative self-regulation, which is a major factor in creative activity, achievement, and future participation in creative endeavors (Zielińska et al., 2022). Self-reporting tools can provide insightful detailed information about a person's perception of creativity, including their own (*e.g.*, the J. Kaufman Domains of Creativity Scale K-DOCS (McKay et al., 2017)). We share Kaufman's position that different components are included in the self-assessment of creativity: actions, evaluation, process, and beliefs (Kaufman, 2019). General self-assessment of creativity reflects how a person perceives their creative thoughts and processes (Silvia et al., 2012).

Creative self-esteem is based on a creative self-concept, but to a greater extent includes emotional components and a value attitude towards oneself. Thus, creative self-esteem should be viewed as a mediating variable between the domains of cognition and personality ("affect" and "intelligence").

The connections between SAI and SAC with a person's ideas about the ability to control emotions (preferences to incremental or constant ITE) are the least studied.

The Research Problem Statement

The present study was motivated by the lack of data on the contribution of creative self-esteem, ITE, and intelligence to emotional creativity (EC). While previous research has explored the links between IQ and EI, as well as between intelligence, EI and EC, links between intelligence and SAI, links between EI and emotional regulation (Geher et al., 2017; Gutiérrez-Cobo et al., 2016; Furnham, 2016; Howard & Cogswell, 2018; Hughes & Evans, 2016; Kornilova et al., 2009; et al.), most studies have mainly examined pairwise combinations of these constructs or included the third construct as a moderator. But it is difficult to find a study that integrates the relationship between the measurements of these constructs on the same sample.

Also, the basis for our study lies in the inconsistency of associations between intelligence and emotional intelligence reported in the literature. Variations in data are observed depending on the country and the methods employed (Husin et al., 2013; Sanchez-Ruiz et al., 2011). Therefore, it is necessary to reassess these relationships each time when discussing the impacts of these variables on emotional creativity.

Another important motivation for us was to distinguish between studies of EC in the context of the paradigm proposed by Averill and studies of the influence of mood and emotions on creativity in the context of creative performance (*e.g.*, Baas, 2019). The susceptibility of creativity to contextual affective factors has already been studied. For emotional creativity, the key research question is formulated not about the influence of emotions on it, but about the contribution to the generation of emotions from multiple processes of both cognitive and personal regulation. In this case, the level of self-assessments can be understood as a higher level of regulation in comparison with EI, and the level of implicit theories as a lower one. An important aspect of regulation at the level of self-assessments is a more pronounced saturation of SAC

with personality components, as suggested by other authors (Beghetto & Karwowski, 2017; Kaufman, 2019; et al.). Accordingly, we can expect the closest relationship between SAC and EI as a personality trait, and not as an ability.

We are not aware of works where intelligence, EI, EC, and ITE, and SAI and SAC are considered in a comprehensive manner on the same sample, which would help clarify the regulatory role of both cognitive and personality processes combined. Our general assumptions were that the variables of intelligence and emotional intelligence contribute to emotional creativity; that both the level of self-concepts and the level of implicit theories involve processes that mediate emotional creativity. Generalization of the available data on the relationships of the studied constructs allowed us to formulate the following hypotheses:

Hypothesis 1. Intelligence is positively associated with emotional intelligence (EI), with self-assessed intelligence (SAI) and creativity (SAC), and both types of intelligence predict emotional creativity (EC) and self-assessed intelligence and creativity;

Hypothesis 2. SAI and SAC are connected with each other and directly predict EC;

Hypothesis 3. SAI and SAC mediate intelligence impact on EC;

Hypothesis 4. Implicit Theories of Emotions (ITE) mediate the impact of EI on EC;

Hypothesis 5. An integrative model of the impact of different types of intelligence on emotional creativity, including the mediator effects of implicit theories of emotions and self-assessments of intelligence and creativity, more accurately reflects the structure of relationships between the studied constructs compared to a complex regression model.

Methods

Participants

A total of 244 students (203 females) majoring in psychology at Lomonosov Moscow State University aged from 17 to 47 were recruited for the study. Our sample turned out to be quite young ($M = 20.01$; $SD = 2.71$) and predominantly female. At the same time, we found a medium-sized effect of age differences between males and females ($M_f = 19.76$, $SD_f = 2.31$; $M_m = 21.22$, $SD_m = 4.00$; Hedges' $g = .55$).

All the participants were administered a set of questionnaires and self-assessment inventories; 155 respondents also completed an intelligence assessment.

The model was built based on the data from 127 women and 25 men (excluding participants with missing data).

Procedure

Fluid Intelligence (FIQ) was assessed using two subtests from the freely distributed test battery ICAR (International Cognitive Ability Resource; Condon & Revelle, 2014) in the Russian-language approbation (Kornilova et al., 2019). The subtests contain 24 3D shapes that require mental rotation and 11 matrices that require problem solving. The 3D figures per rotation are cubes, and participants are asked to determine which of the six suggested answers is a possible rotation of the cube presented.

The task with matrices is similar to Raven's progressive matrices. Stimuli are geometric figures of 3 x 3 elements with one of the nine elements missing. Respondents must identify which of the six suggested elements would best complete the figure. FIQ test score was calculated as a weighted sum of correct answers for both subtests.

The Assessment of Verbal Intelligence (VIQ) was conducted using two subtests developed as a part of the ROADS battery (Kornilov & Grigorenko, 2010). The first subtest is an analogue of the Mill-Hill test and includes 34 tasks to determine, among the six proposed words, the closest in meaning to the given word. The second subtest — Analogies — includes 30 tasks to establish synonyms / antonyms between pairs of words. The VIQ score was calculated by summing the equally weighted scores for these subtests.

Trait EI was assessed by the TEIQue-SF (Petrides, 2009) in Russian adaptation (Kornilova, 2023). The Cronbach's α coefficients for TEIQue-SF scales: α = .87 for the Well-Being scale, α = .79 for the Decreased Self-Control scale, α = .66 for the Emotionality scale, and α = .75 for the Sociality scale.

EC was assessed by Averill's Emotional Creativity Inventory (ECI) in Russian adaptation (Kornilova et al., 2020). The Cronbach's α for all scales exceeded .70.

We included subtest scores on the TEIQue-SF and ECI questionnaires (rather than a single score on EI or EC) in our data analysis, as they reflect specifically focused domains in the constructs measured by the questionnaires.

To assess *ITE*, we used the M. Tamir scale with four questions, two of which refer to the constant implicit theory of emotions, about the impossibility of controlling them, and the other two refer to the incremental ITE, suggesting the possibility of voluntary control of emotions (Tamir et al., 2007). The one-factor solution of the constructed questionnaire with a positive pole for the incremental theory and the Cronbach coefficient α = .69.

SAI and *SAC* were assessed through the direct self-assessment procedure described by A. Furnham (Chamorro-Premuzic & Furnham, 2006). It involved presenting a bell curve with a range of scores from 55 to 145 and instructing the participant to score themselves.

Data processing. The study tested the hypotheses using a combination of correlational and multivariate regression analyses, and structural equation modelling (SEM) using R programming language, an open-source language used for statistical computing or graphics (R Core Team, 2022), implemented in RStudio Version 2023.03.0+386.

Results

Descriptive Statistics

Descriptive statistics showed that in our sample, both intelligence scores were slightly higher in men who were older. Indices on the emotional intelligence scales of Well-Being and Sociality were slightly higher in women, and the Emotionality index was slightly higher in men. For the Novelty EC scale, the scores for women were slightly higher, and for the Emotional Diversity scale, they were moderately higher. No differences were obtained for ITE, SAI, and SAC.

Table 1

Descriptive Statistics for Assessed Scales with Effect Size for Gender Differences

Scale	Male		Female		Hedges' *g*	Effect
	M	*SD*	*M*	*SD*		
Intelligence						
FIQ	10.20	14.07	96.53	12.98	.28	Little higher in men
VIQ	97.12	14.02	91.69	15.02	.37	Little higher in men
Emotional Intelligence						
Well-being	4.00	8.35	42.44	8.80	.28	Little higher in women
Emotionality	17.68	4.42	16.53	5.55	.21	Little higher in men
Decreased Self-Control	2.29	5.21	2.72	6.17	.07	No effect
Sociality	44.07	7.21	45.62	7.27	.21	Little higher in women
Emotional Creativity						
Authenticity	13.00	1.81	12.93	2.51	.03	No effect
Effectiveness	21.30	4.52	21.43	4.50	.03	No effect
Emotional Preparedness	22.48	3.19	22.50	3.07	.01	No effect
Novelty	17.90	5.69	19.57	5.34	.31	Little higher in women
Emotional Diversity	18.98	4.56	21.82	4.99	.58	Moderately higher in women
Implicit Theories of Emotions						
ITE	3.84	.65	3.74	.77	.13	No effect
Self-Assessments						
SAI	111.72	11.01	11.77	14.65	.07	No effect
SAC	109.90	18.82	106.65	2.07	.16	No effect

We performed a series of linear regression analyzes with Benjamini-Hochberg correction for Type I error in the significance of the F-statistics. In every regression model one variable was the dependent variable, and gender, age, and their interaction were included as predictors. The results presented in *Appendix Table A* show that the regression models for FIQ, VIQ, EI, ITE, SAI, and SAC did not fit the data: all p-values for F-statistics were significantly higher than .05 and all adjusted R^2 were close to or less than .

Four of five EC scales were independent of gender and age impacts. However, we obtained those impacts for Emotional Diversity ($F(df) = 7.80(3/239)$, $p(F) < .001$, adjusted $R^2 = .08$): females demonstrated higher scores and age was a significant negative predictor of scale scores.

To avoid mixing the described effects of age and gender with the interaction between the studied variables, in further analysis of Emotional Diversity we used re-

gression residuals from the constructed regression model instead of scale scores[1]. Other variables were recalculated using z-transformation to ensure the uniformity of measurements.

Correlation Analysis

We performed a correlation analysis using Pearson's correlation coefficient with Benjamini-Hochberg correction for Type I error. The matrix is presented in *Appendix Table B.*

Intelligence and Emotional Intelligence

VIQ was positively associated with FIQ (r = .26, p = .006), FIQ with SAI (r = .25, p = .007), SAI was positively associated with SAC (r = .43, p < .001), but SAC was not significantly associated with intelligence domains. We can accept Hypothesis 1 regarding the relationship between intelligence and self-assessments, but only for SAI, and not for SAC. The relationship between intelligence and emotional intelligence, assumed in Hypothesis 1, was not confirmed.

Intelligence was not associated with EC in most of its dimensions: only a negative correlation of VIQ with the Novelty scale was found ($r = -.22$, $p = .019$). Whereas all scales of EI were significantly correlated to the EC scale of Effectiveness. We obtained positive correlations for Well-Being ($r = .41$, $p < .001$) and Sociality ($r = .39$, $p < .001$) and negative correlations for Emotionality ($r = -.29$, $p < .001$) and Decreased Self-Control (*i.e.*, positive with increased self-control) ($r = -.27$, $p < .001$). The EC scale of Novelty was positively correlated with Sociality ($r = .17$, $p < .001$).

Implicit Theories of Emotions

Adherence to the incremental ITE correlated with two scales of EI: positively with Sociality (r = .21, $p = .006$) and negatively with Decreased Self-Control (r = –.27, $p < .001$). Also, ITE was related to the EC scale of Effectiveness (r = .19, $p = .010$).

Self-Assessments Relations with EI, ITE, and EC

SAC positively correlated with EI scales of Sociality (r = .22, $p = .002$) and EC — Novelty (r = .19, $p = .010$). SAI was also associated with the EI scales of Well-Being (r = .16, $p = .046$) and Sociality (r = .23, $p = .001$) and negatively with the Decreased self-control (r = –.16, p = .046). Also, SAI was positively associated with two of the five EC scales: Emotional Preparedness (r = .18, $p = .019$) and Emotional Diversity (r = .16, $p = .033$).

Intelligence and Emotional Intelligence Predict Emotional Creativity and Self-Assessment

To test more complex hypotheses, we reduced measurement dimensions for the EI data using exploratory factor analysis. KMO test for EI scales showed high suitability

[1] The basis for such a data transformation was the understanding of regression residuals as a fraction of the variance of the corresponding variables not related to the variability of model predictors. Thus, when evaluating associations between variables for which gender and age effects have been established, the use of regression residuals allows us to analyze variances adjusted for general demographic effects.

for factor analysis (overall MSA = .79, MSA for scales varied from .77 to .81). We performed maximum likelihood factor analysis to extract one factor that unified the TEIQue scales (TLI = 1.024, 47% of variance explained) and calculated factor scores for each participant as an integral measure of the EI trait.

We performed a series of linear regression analyses with Benjamini-Hochberg correction for Type I error in the significance of the F-statistics. In every regression model, EC scales, SAI, and SAC were the dependent variables, and FIQ, VIQ, and the integral measure of the EI trait were included as predictors. The results presented in *Appendix Table C* showed that the regression models for Authenticity, Emotional Preparedness, Novelty, and Emotional Diversity did not fit the data.

We obtained a significant positive effect of Emotional Intelligence on the EC Effectiveness scale ($\beta = .51$, $t = 5.96$, $p(t) < .001$), a significant positive effect of fluid intelligence on SAI ($\beta = .22$, $t = 2.80$, $p(t) = .006$), and a significant positive impact on SAC of both verbal ($\beta = .17$, $t = 2.08$, $p(t) = .040$) and emotional ($\beta = .22$, $t = 2.50$, $p(t) = .014$) intelligence. We can accept Hypothesis 1 with limitations concerning the relationship between Emotional Intelligence and Emotional Creativity, as well as between types of IQ and Self-Assessed Intelligence.

Self-Assessments Predict Emotional Creativity

We performed a series of linear regression analyses with Benjamini-Hochberg correction for Type I error in the significance of the F-statistics. In each regression model, each of the EC scales was the dependent variable, and SAI, SAC, and their interaction were included as predictors. The results presented in *Appendix Table D* showed that a significant effect of SAI and SAC was found only for the EC Novelty scale. *Figure 1* demonstrates the direction of obtained effects. For participants with medium and high self-assessed intelligence, Novelty scores increased in proportion to SAC scores, whereas for participants with low SAI, we obtained the opposite effect.

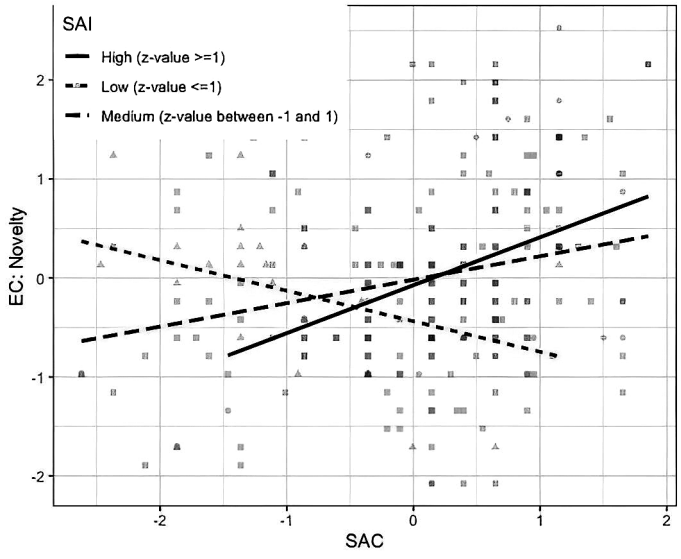

Figure 1. SAI and SAC effects on EC Novelty scale

SAI and SAC Mediate Intelligence Impact on Emotional Creativity

Path analysis was performed using structural equation modeling implemented in the lavaan package in R (Rosseel, 2012). We used maximum likelihood estimation with the NLMINB optimization method. Missing values in the data were listwise deleted. The model tested included linear regression equations with each of the EC scales as the dependent variable and both types of intelligence, SAI and SAC, as predictors. Additionally, we specified in the tested model expected covariations between different types of intelligence and between self-esteem. The tested model demonstrated satisfactory fit indices: $\chi 2(df) = .924$ (2), $p = .63$. In *Figure 2* we report only significant estimations for obtained effects.

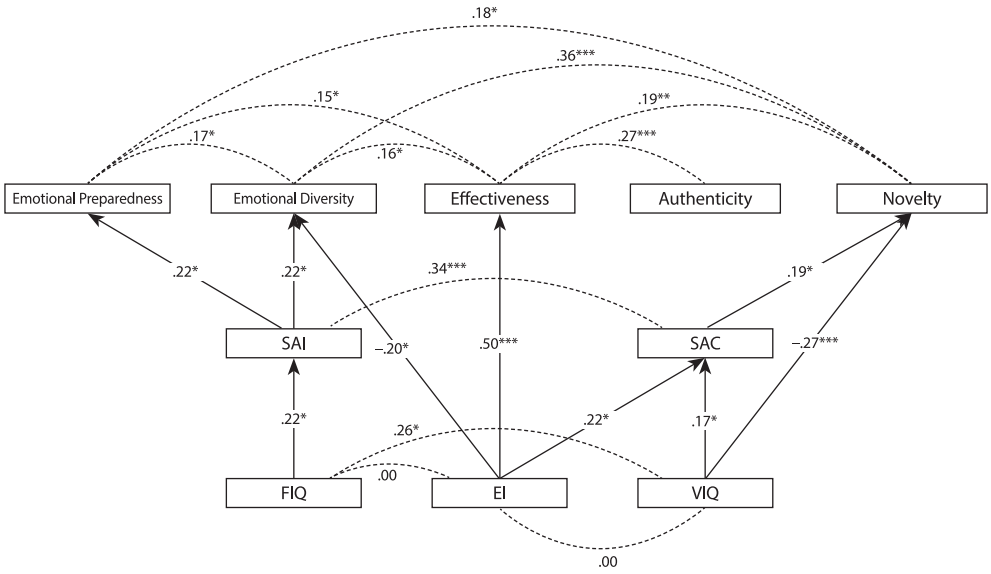

Figure 2. SAI and SAC mediate Intelligence impact on Emotional Creativity

Our results showed that in a complex model that included both the levels of various types of intelligence and the levels of self-esteem, new specific relationships between the studied variables were revealed. First, we verified the effect of FIQ on SAI, the effect of VIQ and EI on SAC, and the effect of EI on the EC Effectiveness scale. Second, we verified the effect of SAC on the EC Novelty scale. The new findings compared to the previous analysis results were positive SAI effects to EC scales of Emotional Preparedness and Emotional Diversity. In addition, our analysis showed that verbal intelligence had a negative direct effect on the EC Novelty scale, but a positive indirect effect on scores on this scale through SAC, which was also positively affected by EI. Thus, we confirmed Hypothesis 3 about the mediation effect of self-assessments of intelligence and creativity on the contribution of Intelligence to Emotional Creativity. We can argue that the Emotional Intelligence trait and Verbal Intelligence had both direct and indirect effects on Emotional Creativity, while Fluid Intelligence had only an indirect effect on Emotional Creativity through the level of Self-Esteem.

Implicit Theories of Emotions Mediate Emotional Intelligence Impact on Emotional Creativity

We performed path analysis using the same technique as in the previous analysis. Additionally, we specified in the tested model expected covariations between different types of intelligence.

The tested model demonstrated satisfactory fit indices: $c^2(df) = 1.124\ (2)$, $p = .57$. In *Figure 3,* we report only significant estimations for obtained effects. Our analysis revealed no significant mediation effects of ITE. However, we obtained expected positive EI effect for the Effectiveness scale and positive EI effect for the ITE scores. Thus, we can reject Hypothesis 4.

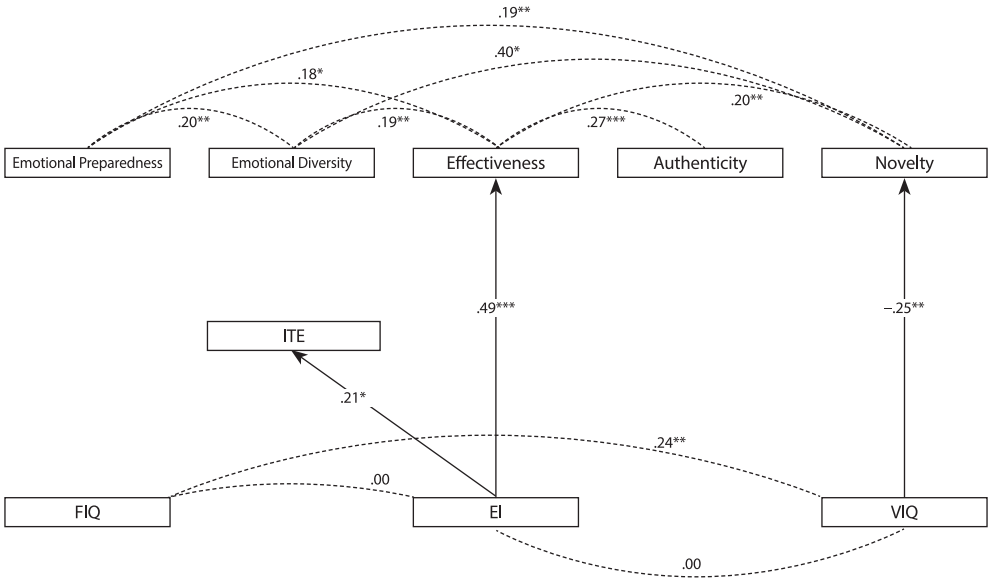

Figure 3. Implicit Theories of Emotions (ITE) mediate EI impact on Emotional Creativity

Pathway Model vs. Regression Model

In our previous analysis, we found that ITE had no direct effect on EC scores. Thus, it can be assumed that implicit theories of controllability of emotions were not involved in the system of relations of the studied variables. To test Hypothesis 5, we constructed two competing models with EC scales as dependent variables and Intelligence and Self-Esteem scores as predictors.

We reduced both models to structural relations with significant coefficients obtained in the first step and evaluated the fit indices for both reduced models. Analysis results are presented in *Table 2.* The reduced pathway model demonstrated better fit indices for both c^2-statistics and information criteria than the reduced regression model. Thus, we can assume that our Hypothesis 5, about more accurate reflection of the structure of relationships between the studied constructs by the model, with the inclusion of mediator effects of self-assessments, has been verified. The reduced pathway model with significant effects is presented in *Figure 4.*

Table 2

Pathway Model vs. Regression Model

Index	Regression full / Pathway full	Regression significant	Index delta for Regression significant model	Pathway significant	Index delta for Pathway significant model
c^2	.924	42.28		36.458	
df(c^2)	2	28		28	
p(c^2)	.630	.041		.106	
AIC	4059.005	4048.361	-1.644	4044.539	-14.466
BIC	4247.829	4159.257	-88.572	4158.433	-89.396
SABIC	4048.458	4042.166	-6.292	4038.177	-1.281

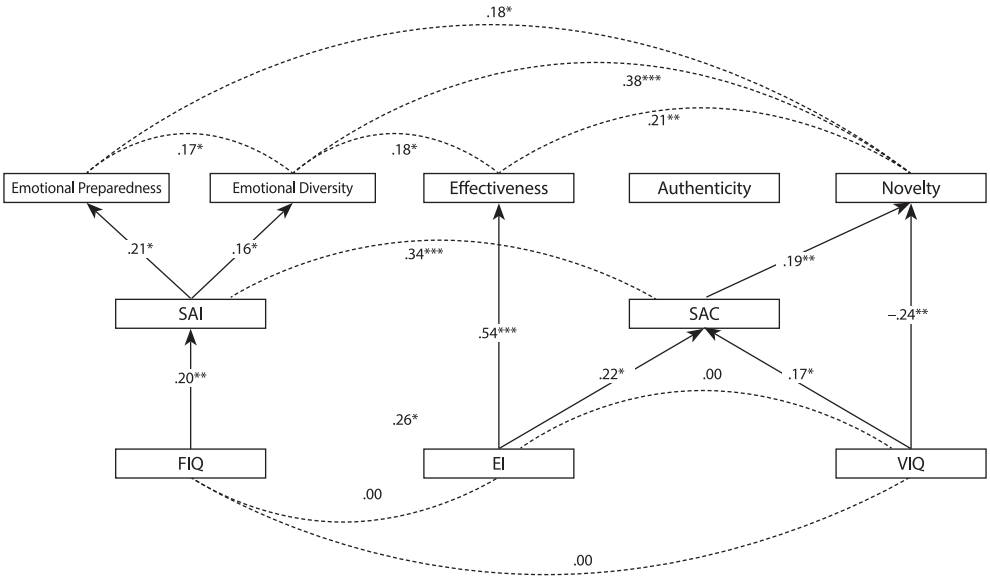

Figure 4. Intelligence, Emotional Intelligence, and Self-Assessed Intelligence and Creativity predict different domains of Emotional Creativity

Discussion

This is the first comprehensive study of the relationship among Intelligence, Self-Assessment of Intelligence and Creativity, Emotional Creativity, and Implicit Theories of Emotions. Unlike other works, we were able to establish not only the direct contributions of both types of intelligence to EC, but also their contribution, through mediation of Self-Assessments of Intelligence and Creativity.

We found fewer associations of cognitive abilities with personality traits than expected. We do not support the allegedly closer relationship of crystallized (verbal) intelligence with personality, established using other questionnaires — in particular,

the Big Five questionnaire (Rammstedt et al., 2020). Supporting Stankov's (Stankov, 2018) move beyond the lexical approach in defining personality traits to establish connections between intelligence and personality and supporting the trend towards including EI in this connection (Colom et al., 2019), we implemented a transition to different levels of regulation — self-esteem and implicit theories.

Existing research suggests that EI should be associated with increased intelligence in problem solving — more active situation modification, reappraisal, and distraction control, but with less rumination (Bucich & MacCann, 2019; Peña-Sarrionandia et al., 2015). In our study, we did not find a significant increase in EI scores with an increase in intelligence. Additionally, we have not found any direct correlations between intelligence and EC scales except for the single negative correlation between VIQ and the Novelty scale. This finding corresponds to the assumption that people with high verbal intelligence may experience fewer new emotions (or distinguish them worse, which is manifested in questionnaire responses).

We accept Hypothesis 1 in terms of intelligence impact on self-assessed intelligence and creativity. Our data indicate that direct SAC, although associated with SAI, has its own domain specificity: SAI was predicted by fluid intelligence, while SAC was predicted by verbal and emotional intelligence.

We accept Hypothesis 2 — about the role of self-assessments as predictors of EC.

Our analysis of the indirect influence of intelligence on emotional creativity via SAI and SAC showed that self-esteem significantly mediates this relationship; thus, Hypothesis 3 is accepted. Moreover, SAI and SAC correspond to different domains of emotional creativity. Self-assessment of intelligence provided the association of Fluid Intelligence with Emotional Preparedness and Emotional Diversity, while self-assessment of creativity mediated the association between Verbal and Emotional Intelligence and Novelty in the emotion creation process. We also found that SAC provided a positive pathway from Verbal Intelligence to Novelty in Emotional Creativity, as opposed to a negative direct effect of Verbal Intelligence on the same Emotional Creativity component. This finding supports the assumption of the integrative role of a person's self-awareness in the regulation of creative processes. It is the reflection of one's intellectual abilities at the level of a person's self-awareness that regulates Emotional Creativity to a greater extent than directly intellectual abilities and personality traits.

Our Hypothesis 4 about a mediation effect of Implicit Theories of Emotions in relationships between Emotional Intelligence and Emotional Creativity was rejected. We could not show any additional indirect effects of Emotional Intelligence on EC scales through implicit theories. Thus, the trait EI is an essential independent component of emotional Creativity manifestation in its effectiveness domain.

An Integrative Model for the Regulation of Emotional Creativity by Different Types of Intelligence Allowed for a Clearer Understanding of the Relationships between Multi-Level Processes

The main theoretical assumption of the study was the inclusion of the level of self-awareness, represented by self-assessments of intelligence and creativity and implicit theories of emotions in the system of connections between different types of intelligence and emotional creativity.

In Emotional Creativity, we can distinguish domains with different levels of connection with different types of intelligence. The effectiveness of Emotional Creativity shows the closest direct relations with Emotional Intelligence. The authenticity of emotion creation seems to be the most independent from the Intelligence–Emotional Creativity domain. The novelty of the created emotions can be suppressed by higher levels of Verbal Intelligence, but at the same time can be maintained by higher Verbal Intelligence combined with Emotional Intelligence through self-assessment of creativity. Emotional preparedness, which is the capacity to understand and learn about one's own and others' emotions, and emotional diversity are linked to fluid intelligence through intelligence and self-esteem.

Thus, we can assume that the emotion creation process should be considered as a complex integrative phenomenon, with different domains regulated simultaneously by different types of intelligence through their reflection at the level of self-consciousness.

Conclusion

We showed that the intelligence impact of emotional creativity was mediated by self-esteem in intelligence and creativity.

In relation to unity of intelligence and affect, we have given a strong argument for a multilevel integration of processes behind the interactions between cognitive and emotional spheres, as well as between more conscious and less conscious processes. We empirically supported the idea of the need for a multiple component analysis in each of the concepts under consideration — emotional intelligence, emotional creativity, implicit theories, and self-assessments of intelligence and creativity.

Limitations

The main limitation of our study was the general participants' interest in psychology due to their majoring in this field. Thus, further investigation on different samples is needed.

The obtained model indicators are not sufficiently strong, and improvements may be possible by expanding the samples. At the same time, these models help clarify inter-level transitions within the diversity of the studied processes, which conventional correlation analysis does not allow.

Data on the effects of direct self-assessments of intelligence and creativity on other studied variables allow us to consider them as a link between intellectual abilities, emotional creativity, and belief in the controllability of emotions. However, in our study, not all the participants took the ICAR intelligence test. And perhaps we would get more reliable results with the full design.

Ethics Statement

The study was conducted in accordance with the ethical standards of the Russian Psychological Society.

Authors' Contributions

The research idea and theoretical rationale were developed by T. V. Kornilova. Model development and statistical analysis were carried out by M. A. Chumakova. Data collection was conducted by T. V. Kornilova and L. B. Maksarova. All authors discussed the results and contributed to the final version of the manuscript.

Conflict of Interest

The authors declare no conflict of interest.

References

Averill, J.R. (1999). Individual differences in emotional creativity: structure and correlates. *Journal of Personality, 67*(2), 331–371. https://doi.org/10.1111/1467-6494.00058

Averill, J.R. (2000). Intelligence, emotion, and creativity: From trichotomy to trinity. In R. Bar-On & J.D.A. Parker (Eds.), *Handbook of emotional intelligence: Theory, development, assessment, and application at home, school, and in the workplace* (pp. 363–376). Jossey-Bass.

Averill, J.R. (2005). Emotions as mediators and as products of creative activity. In J. C. Kaufman & J. Baer (Eds.), *Creativity across domains: Faces of the muse* (pp. 225–244). Lawrence Erlbaum Associates, Inc.

Baas, M. (2019). In the mood for creativity. In J. C. Kaufman & R. J. Sternberg (Eds.), *The Cambridge handbook of creativity* (pp. 257–272). Cambridge University Press. https://doi.org/1.1017/9781316979839.014

Bar-On, R. (2007). The Bar-On model of emotional intelligence: a valid, robust and applicable EI model. *Organisation & People, 14*(2), 27–34.

Beghetto, R.A., & Karwowski, M. (2017). Toward untangling creative self-beliefs. In M. Karwowski & J. Kaufman (Eds.), *The creative self* (pp. 3–22). Academic Press. https://doi.org/10.1016/B978-0-12-809790-8.00001-7

Bucich, M., & MacCann, C. (2019). Emotional intelligence and day-to-day emotion regulation processes: Examining motives for social sharing. *Personality and Individual Differences, 137*, 22–26. https://doi.org/10.1016/j.paid.2018.08.002

Chamorro-Premuzic, T., & Furnham, A. (2006). Personality and self-assessed intelligence: Can gender and personality distort self-assessed intelligence? *Educational Research and Reviews, 1*(7), 227–233.

Checa, P., & Fernández-Berrocal, P. (2019). Cognitive control and emotional intelligence: Effect of the emotional content of the task. Brief reports. *Frontiers in Psychology*, *1*. https://doi.org/10.3389/fpsyg.2019.00195

Colom, R., Bensch, D., Horstmann, K.T., Wehner, C., & Ziegler, M. (2019). Special Issue "The ability–personality integration". *Journal of Intelligence, 7*(2), 13. https://doi.org/10.3390/jintelligence7020013

Condon, D.M., & Revelle, W. (2014). The international cognitive ability resource: Development and initial validation of a public-domain measure. *Intelligence, 43*, 52–64. https://doi.org/10.1016/j.intell.2014.01.004

Davies, M., Stankov, L., & Roberts, R.D. (1998). Emotional intelligence: In search of an elusive construct. *Journal of Personality and Social Psychology, 75*, 989–1015. https://doi.org/10.1037/0022-3514.75.4.989

De France, K., & Hollenstein, T. (2021). Implicit theories of emotion and mental health during adolescence: The mediating role of emotion regulation. *Cognition and Emotion, 35*(2), 367–374. https://doi.org/10.1080/02699931.202.1817727

Dweck, C.S. (2006). Mindset: The new psychology of success. Random House Publications.

Dweck, C.S., & Yeager, D.S. (2019). Mindsets: A view from two eras. *Perspectives on Psychological Science, 14*(3), 481–496. https://doi.org/10.1177/1745691618804166

Farrelly, D., & Austin, E.J. (2007). Ability EI as an intelligence? Associations of the MSCEIT with performance on emotion processing and social tasks and with cognitive ability. *Cognition and Emotion, 21*(5), 1043–1063. https://doi.org/10.1080/02699930601069404

Ford, B.Q., & Gross, J.J. (2019). Why beliefs about emotion matter: An emotion-regulation perspective. *Current Directions in Psychological Science, 28*(1), 74–81. https://doi.org/10.1177/0963721418806697

Furnham, A. (2016). The relationship between cognitive ability, emotional intelligence and creativity. *Psychology, 7*(2), 193–197. https://doi.org/10.4236/psych.2016.72021

Geher, G., Betancourt, K., & Jewell, O. (2017). The link between emotional intelligence and creativity. *Imagination, Cognition and Personality,* 37(1), 5–22. https://doi.org/10.1177/0276236617710029

Gerwig, A., Miroshnik, K., Forthmann, B., Benedek, M., Karwowski, M. & Holling, H. (2021). The relationship between intelligence and divergent thinking — a meta-analytic update. *Journal of Intelligence, 9*(23). https://doi.org/10.3390/jintelligence9020023

Gutiérrez-Cobo, M.J., Cabello, R., & Fernández-Berrocal, P. (2016). The relationship between emotional intelligence and cool and hot cognitive processes: A systematic review. *Frontiers in Behavioral Neuroscience, 10*, 101. https://doi.org/10.3389/fnbeh.2016.00101

Howard, M.C., & Cogswell, J.E. (2018). The "other" relationships of self-assessed intelligence: A meta-analysis. *Journal of Research in Personality, 77*, 31–46. https://doi.org/10.1016/j.jrp.2018.09.006

Hughes, D.J., & Evans, T.R. (2016). Comment: Trait EI moderates the relationship between ability EI and emotion regulation. *Emotion Review, 8*(4), 331–332. https://doi.org/10.1177/1754073916650502

Husin, W.N.I.W., Santos, A., Ramos, H.M., & Nordin, M.S. (2013). The place of emotional intelligence in the 'intelligence' taxonomy: Crystallized intelligence or fluid intelligence factor? *Procedia-Social and Behavioral Sciences, 97*, 214–223. https://doi.org/10.1016/j.sbspro.2013.1.225

Karnaze, M.M., & Levine, L.J. (2020). Lay theories about whether emotion helps or hinders. *Frontiers In Psychology,* 11, 183. https://doi.org/10.3389/fpsyg.202.00183.

Kaufman, J.C. (2019). Self-assessments of creativity: Not ideal, but better than you think. *Psychology of Aesthetics, Creativity, and the Arts, 13*(2), 187–192. https://doi.org/10.1037/aca0000217

Kim, K.H. (2008). Meta-analyses of the relationship of creative achievement to both IQ and divergent thinking test scores. *The Journal of Creative Behavior, 42*, 106–13. https://doi.org/10.1002/j.2162-6057.2008.tb0129.x

Kneeland, E.T., Nolen-Hoeksema, S., Dovidio, J.F., & Gruber, J. (2016). Beliefs about emotion's malleability influence state emotion regulation. *Motivation and Emotion, 40*(5), 740–749. https://doi.org/10.1007/s11031-016-9566-6

Kornilov, S.A., & Grigorenko E.L. (2010). Procedural complex for assessment of academic, creative and practical abilities. *Psikhologicheskii zhurnal,* [Psychological Journal], *31*(2), 90–103.

Kornilova, T.V. (2023). Features of emotional intelligence (by TEIQue) as predictors of style regulation of decision making]. *Psikhologicheskii zhurnal,* [Psychological Journal], *44*(4), 72–82. https://doi.org/10.31857/S020595920027095-0

Kornilova, T.V., Kornilov, S.A., Zirenko, M.S., & Chumakova, M.A. (2019). Psychometric properties of the modified International Cognitive Ability Resource (ICAR) test battery. *Natsional'nyi psikhologicheskii zhurnal*, [National Psychological Journal], *12*(3), 32–45.

Kornilova, T.V., Kornilov, S.A., & Chumakova, M.A. (2009). Subjective evaluations of intelligence and academic self-concept predict academic achievement: Evidence from a selective student population. *Learning and Individual Differences, 19*(4), 596–608. https://doi.org/10.1016/j.lindif.2009.08.001

Kornilova, T.V., Shestova, M., & Pavlova, E.M. (2020). Emotsional'naia kreativnost' v sisteme sviazei s emotsional'no-lichnostnoi sferoi i implitsitnymi teoriiami kreativnosti [The relationship of emotional creativity with implicit theories and emotional-personal sphere]. *Psikhologicheskii zhurnal,* [Psychological Journal], *41*(4), 19–31. https://doi.org/10.31857/S020595920010388-2

Kuška, M., Trnka, R., Mana, J., & Nikolai, T. (2020). Emotional creativity: A meta-analysis and integrative review. *Creativity Research Journal, 32*(2), 151–16. https://doi.org/1.1080/10400419.202.1751541

MacCann, C. (2010). Further examination of emotional intelligence as a standard intelligence: A latent variable analysis of fluid intelligence, crystallized intelligence, and emotional intelligence. *Personality and Individual Differences, 49*(5), 490–496. https://doi.org/10.1016/j.paid.201.05.010

Mayer, J.D., Caruso, D.R., & Salovey, P. (2016). The ability model of emotional intelligence: Principles and updates. *Emotion Review, 8*(4), 290–30. https://doi.org/10.1177/1754073916639667

McKay, A.S., Karwowski, M., & Kaufman, J.C. (2017). Measuring the muses: Validating the Kaufman domains of creativity scale (K-DOCS). *Psychology of Aesthetics, Creativity, and the Arts, 11*(2), 216–23. https://doi.org/10.1037/aca0000074

Mestre, J.M., MacCann, C., Guil, R., & Roberts, R.D. (2016). Models of cognitive ability and emotion can better inform contemporary emotional intelligence frameworks. *Emotion Review, 8*(4), 322–33. https://doi.org/10.1177/1754073916650497

Peña-Sarrionandia, A., Mikolajczak, M., & Gross, J. (2015). Integrating emotion regulation and emotional intelligence traditions: A meta-analysis. *Frontiers in Psychology*, *6*, 16. https://doi.org/10.3389/fpsyg.2015.00160

Petrides, K.V. (2009). Psychometric properties of the Trait Emotional Intelligence Questionnaire (TEIQue). In J.D.A. Parker, D.H. Saklofske, & C. Stough (Eds.), *Assessing emotional intelligence: Theory, research, and applications* (pp. 85–101). Springer US. https://doi.org/10.1007/978-0-387-88370-0_5

Petrides, K.V., & Furnham, A. (2003). Trait emotional intelligence: Behavioural validation in two studies of emotion recognition and reactivity to mood induction. *European Journal of Personality, 17*(1), 39–57. https://doi.org/10.1002/per.466

Petrides, K.V., Mikolajczak, M., Mavroveli, S., Sanchez-Ruiz, M.-J., Furnham, A., & Pérez-González, J.-C. (2016). Developments in trait emotional intelligence research. *Emotion Review, 8*(4), 335–341. https://doi.org/10.1177/1754073916650493

Petrides, K.V., Sanchez-Ruiz, M.-J., Siegling, A.B., Saklofske, D.H., & Mavroveli, S. (2018). Emotional intelligence as personality: Measurement and role of trait emotional intelligence in educational contexts. In K.V. Keefer, J.D.A. Parker, & D.H. Saklofske (Eds.), *Emotional intelligence in education: Integrating research with practice* (pp. 49–81). Springer International Publishing. https://doi.org/10.1007/978-3-319-90633-1_3

R Core Team (2022). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/

Rammstedt, B., Danner, D., Soto, C.J., & John, O. P. (2020). Validation of the short and extra-short forms of the Big Five Inventory-2 (BFI-2) and their German adaptations. *European Journal of Psychological Assessment, 36*(1), 149–161. https://doi.org/10.1027/1015-5759/a000481

Romero, C., Master, A., Paunesku, D., Dweck, C.S., & Gross, J.J. (2014). Academic and emotional functioning in middle school: The role of implicit theories. *Emotion, 14*(2), 227–234. https://doi.org/10.1037/a0035490

Rosseel, Y. (2012). lavaan: An R Package for structural equation modeling. *Journal of Statistical Software*, *48*(2), 1–36. https://doi.org/10.18637/jss.v048.i02

Said-Metwaly, S., Taylor, C.L., Camarda, A., & Barbot, B. (2022). Divergent thinking and creative achievement—How strong is the link? An updated meta-analysis. *Psychology of Aesthetics Creativity and the Arts.* https://doi.org/10.1037/aca0000507

Sánchez-Ruiz, M.J., Hernández-Torrano, D., Pérez-González, J.C. et al. (2011). The relationship between trait emotional intelligence and creativity across subject domains. *Motivationa and Emotion, 35*, 461–473 (2011). https://doi.org/10.1007/s11031-011-9227-8

Silvia, P.J., Wigert, B., Reiter-Palmon, R., & Kaufman, J.C. (2012). Assessing creativity with self-report scales: A review and empirical evaluation. *Psychology of Aesthetics, Creativity, and the Arts, 6*(1), 19–34. https://doi.org/10.1037/A0024071

Stankov, L. (2018). Low correlations between intelligence and Big Five personality traits: Need to broaden the domain of personality. *Journal of Intelligence, 6*(2), 26. https://doi.org/10.3390/jintelligence6020026

Sternberg, R.J., Forsythe, G.B., Hedlund, J., Horvath, J.A., Wagner, R.K., Williams, W.M., …, & Grigorenko, E. (2000). *Practical intelligence in everyday life.* Cambridge University Press.

Tamir, M., John, O.P., Srivastava, S., & Gross, J.J. (2007). Implicit theories of emotion: Affective and social outcomes across a major life transition. *Journal of Personality and Social Psychology, 92*(4), 731–744. https://doi.org/10.1037/0022-3514.92.4.731

Trnka, R., Zahradnik, M., & Kuška, M. (2016). Emotional creativity and real-life involvement in different types of creative leisure activities. *Creativity Research Journal*, *28*(3), 348–356. https://doi.org/10.1080/10400419.2016.1195653

van der Linden, D., Pekaar, K.A., Bakker, A.B., Schermer, J.A., Vernon, P.A., Dunkel, C.S., & Petrides, K.V. (2017). Overlap between the general factor of personality and emotional intelligence: A meta-analysis. *Psychological Bulletin, 143*(1), 36–52. https://doi.org/10.1037/bul0000078

Vygotsky, L.S. (1980). Mind in Society: The Development of higher psychological processes. Harvard University Press. https://doi.org/10.2307/j.ctvjf9vz4

Weiss, S., Steger, D., Kaur, Y. , Hildebrandt, A., Schroeders, U., & Wilhelm (2021). On the trail of creativity: Dimensionality of relation with cognitive abilities, personality, and insight. *European Journal of Personality*, 35(3), 291–314. https://doi.org/10.1002/per.2288

Xu, X., Liu, W., & Pang, W. (2019). Are emotionally intelligent people more creative? A meta-analysis of the emotional intelligence-creativity link. *Sustainability, 11*(21), 6123. https://doi.org/10.3390/su11216123

Zielińska, A., Lebuda, I., & Karwowski, M. (2022). Simple yet wise? Students' creative engagement benefits from a daily intervention. *Translational Issues in Psychological Science, 8*(1), 6–23. https://doi.org/10.1037/tps00002

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Appendix

Table A. *Regression analysis by gender and age*

Scale	F (df)	adj.p (F)*	adj. R^2	Intercept			Gender=Males			Age			Age X Gender		
				ß	t	p (t)	ß	t	p (t)	ß	t	p (t)	ß	t	p (t)
Intelligence															
FIQ	0.59 (3/148)	.966	< 0												
VIQ	2.38 (3/147)	.337	.03												
Emotional Intelligence															
Well–Being	1.01 (3/240)	.875	<.001												
Emotionality	0.68 (3/240)	.966	< 0												
Decreased Self-ontrol	0.40 (3/240)	.994	< 0												
Sociality	0.91 (3/240)	.875	< 0												
Emotional Creativity															
Authenticity	1.39 (3/239)	.858	.005												
Effectiveness	0.16 (3/239)	.994	< 0												
Emotional Preparedness	0.02 (3/239)	.997	< 0												
Novelty	2.82 (3/239)	.278	.02												
Emotional Diversity	7.80 (3/239)	<.001	.08	0.07	1.10	.274	– 0.51	– 2.97	.003	–0.25	–3.32	.001	0.16	1.16	.246
Implicit Theories of Emotions															
ITE	0.24 (3/231)	.994	< 0												
Self–Assessments															
SAI	0.26 (3/236)	.994	< 0												
SAC	1.07 (3/233)	.875	.001												

*Note: * Benjamini-Hochberg correction for Type I error*

Table B. *Correlation analysis results*

Scale		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Intelligence															
1	FIQ	1.00													
2	VIQ	.26** (.006)	1.00												
Emotional Intelligence															
3	Well-Being	.00 (.982)	−.15 (.154)	1.00											
4	Emotionality	−.03 (.827)	−.05 (.673)	−.46** (5.33E−13)	1.00										
5	Decreased Self-Control	−.03 (.854)	−.02 (.886)	−.50** (.000)	.43** (4.80E−11)	1.00									
6	Sociality	−.11 (.314)	−.12 (.265)	.53** (.000)	−.45** (2.01E−12)	−.47** (2.37E−13)	1.00								
Emotional Creativity															
7	Authenticity	.10 (.363)	−.01 (.953)	.08 (.348)	−.11 (.172)	.10 (.223)	.01 (.933)	1.00							
8	Effectiveness	−.10 (.348)	−.15 (.154)	.41** (5.02E−05)	−.29** (5.02E−05)	−.27** (1.34E−04)	.39** (3.64E−09)	.26** (2.02E−04)	1.00						
9	Emotional Preparedness	.06 (.617)	.09 (.439)	.04 (.710)	−.05 (.598)	−.13 (.117)	.14 (.084)	−.02 (.858)	.24** (8.41E−04)	1.00					
10	Novelty	−.05 (.630)	−.22* (.019)	.07 (.442)	.02 (.819)	.04 (.720)	.17* (.024)	−.01 (.956)	.27** (1.48E−04)	.28** (8.95E−05)	1.00				
11	Emotional Diversity	−.08 (.495)	.00 (.995)	−.04 (.665)	.05 (.568)	.12 (.125)	.03 (.758)	.09 (.302)	.21** (.005)	.25** (4.82E−04)	.54** (.000)	1.00			
Implicit Theories of Emotions															
12	ITE	−.01 (.933)	−.15 (.154)	.12 (141)	−.07 (.434)	−.27** (1.46E−04)	.21** (.006)	−.03 (.749)	.19* (.010)	.04 (.665)	.08 (.348)	−.03 (.765)	1.00		
Self-Assessments															
13	SAI	.25** (.007)	.10 (.363)	.16* (.046)	−.04 (.665)	−.16* (.046)	.23** (.001)	.04 (.710)	.11 (.182)	.18* (.019)	.13 (.115)	.16* (.033)	−.01 (.953)	1.00	
14	SAC	.13 (.224)	.18 (.083)	.11 (.175)	−.07 (.434)	−.12 (.137)	.22** (.002)	.02 (.878)	.10 (.262)	.09 (.314)	.19** (.010)	.14 (.083)	−.02 (.886)	.43** (8.55E−11)	1.00

*Note: the corrected for Type I error p-value of the Pearson correlation coefficient is presented in parentheses; * indicates p-value < 0.05, ** indicates p-value < 0.01*

Table C. *Intelligence and Emotional Intelligence predict EC, SAI, and SAC*

Scale	F (df)	adj.p (F)*	adj. R^2	Intercept			FIQ			VIQ			EI		
				ß	t	p (t)	ß	t	p (t)	ß	t	p (t)	ß	t	p (t)
Emotional Creativity															
Authenticity	0.90 (3/147)	.515	< 0												
Effectiveness	13.37 (3/147)	6.44E-07	.20	-0.03	-0.41	.685	-0.07	-0.84	.403	-0.10	-1.27	.207	.51	5.96	1.93E-08
Emotional Preparedness	0.63 (3/147)	.594	< 0												
Novelty	2.80 (3/147)	.074	.03												
Emotional Diversity	1.30 (3/147)	.389	.01												
Self-Assessments															
SAI	4.44 (3/146)	.018	.06	0.02	0.28	.777	0.22	2.80	.006	0.05	.061	.540	0.16	1.97	.051
SAC	4.03 (3/144)	.020	.06	-0.01	-0.16	.872	0.08	0.94	.351	0.17	2.08	.040	0.22	2.50	.014

*Note: * Benjamini-Hochberg correction for Type I error*

Table D. *SAI and SAC predict EC*

Scale	F (df)	adj.p (F)*	adj. R^2	Intercept			SAI			SAC			SAI X SAC		
				ß	t	p (t)	ß	t	p (t)	ß	t	p (t)	ß	t	p (t)
Emotional Creativity															
Authenticity	1.61 (3/231)	.189	.01												
Effectiveness	2.48 (3/231)	.078	.02												
Emotional Preparedness	2.61 (3/231)	.078	.02												
Novelty	4.87 (3/231)	.013	.05	-0.05	-0.71	.478	0.08	1.17	.243	0.177	2.50	.013	0.140	2.21	.028
Emotional Diversity	3.20 (3/231)	.060	.03												

*Note: * Benjamini-Hochberg correction for Type I error*

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SPORT PSYCHOLOGY

Athletic Identity and Performance Anxiety among University Athletes: Moderating Role of Perceived Coaching Styles

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Background. In the competitive world of emerging athletes, performance is crucial; in sports, it is essential. However, under the spotlight of competition, performance anxiety lurks as the unseen rival every athlete must conquer. Two important factors are fundamental to this dynamic—athletic identity and perceived coaching styles. Athletic identity becomes an athlete's armor, while the coaching styles catalyze transformation. Their alliance can either elevate performance or diminish it.

Objective. To investigate the relationship between athletic identity, perceived coaching styles, and performance anxiety among university athletes.

Design. Using a correlational research design, 353 university athletes (191 men, 162 women, aged 18-25, M= 20.8, SD= 1.78) were recruited through non-probability purposive sampling from various universities. The athletic identity measurement scale (AIMS), leadership scale for sports (LSS), and sport anxiety scale-2 (SAS-2) were used to measure the constructs; the athletes also completed a demographic information sheet and provided informed consent.

Results. The Pearson product moment correlation results indicated a significant negative correlation between athletic identity and performance anxiety, while perceived coaching styles were significantly positively correlated with performance anxiety. The moderation analyses revealed that training and instruction, social support, democratic behavior, and positive feedback significantly moderated the relationship between self-identity and performance anxiety. Additionally, training and instruction and autocratic behavior significantly moderated the relationship between negative affectivity and performance anxiety.

Conclusion. This study underscores the importance of understanding the dynamics between athletic identity, perceived coaching styles, and performance anxiety to optimize athletic performance and reduce performance anxiety among university athletes.

Keywords: athletic identity, perceived coaching styles, performance anxiety, university athletes, sports psychology

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Introduction

In the competitive world of emerging athletes, the significance of performance in sports cannot be understated; as Weinberg and Gould (2014) proposed, in the world of competitive sports, performance is everything. It is the driving force behind an athlete's quest for greatness, and it is the ultimate measure of their abilities. Performance serves as the foundation upon which athletes build their achievements and accomplishments and is the result of their dedication, hard work, and persistent effort to achieve excellence (Chelladurai, 1980). The impact of anxiety in sports has long captivated the attention of coaches, athletes, and researchers. Performance anxiety can cast a shadow of doubt over even the most talented and dedicated athletes, creating a hurdle that can hinder their ability to showcase their true potential (Smith & Smoll, 1990). The research seeks to uncover the crucial role of perceived coaching styles in influencing performance anxiety among athletes and to change the nature of the relationship between athletic identity and performance anxiety.

The interaction between athletic identity, perceived coaching styles, and performance anxiety can be understood through the lens of self-determination theory. It can help to make sense of how athletes' athletic identity and their perception of different coaching styles may impact levels of performance anxiety. The self-determination theory (Deci & Ryan, 2000) focuses on intrinsic motivation and three basic psychological needs — autonomy, competence and relatedness. In the context of sports, the fulfillment of these needs boosts athletes' performance and wellbeing. When athletes feel autonomous, confident in their competence, and connected to others, they are intrinsically motivated, which increases engagement and decreases worry about performance (McDonough & Crocker, 2007; Vallerand & Losier, 1999). Athletic identity is the degree to which an athlete identifies with their sport, and it also plays a major role in motivation. Athletes who strongly identify with their athletic role are more likely to pursue sports for enjoyment and not as an obligation, enhancing their intrinsic motivation and performance. Coaching styles play a key role in the fulfilment of athletes' psychological needs. A coaching style that supports autonomy leads to independence and positive reinforcement, which fulfills the needs for autonomy, competence, and relatedness. However, a style that controls autonomy pressurizes athletes, leading to burnout and performance anxiety by changing their motivation from intrinsic to controlled (Schutte & McNeil, 2015). This theory illustrates how athletic identity and coaching styles influence the performance and anxiety levels of athletes in sports. With the understanding of these dynamics, the athletes' performance and overall wellbeing can be enhanced in the competitive sports environment.

The performance of athletes is influenced by both extrinsic and intrinsic factors (Almagro et al., 2020). Athletic identity, an intrinsic factor, plays a fundamental role in an athlete's self-identity and connection to their sport. How they identify themselves as athletes, their sense of belonging, and their investment in their sport can impact their susceptibility to performance anxiety. On the other hand, coaching styles, as an extrinsic factor, can greatly influence an athlete's performance and ultimately their level of performance anxiety. The way coaches interact with athletes, provide support, and create a positive and empowering environment can significantly alleviate or exacerbate performance anxiety. When coaches provide harsh feedback to

the athletes who are afraid of failure and rejection, it can pose a threat to the athletic environment and provoke high levels of unpleasant emotions, which can increase the athletes' level of performance anxiety (Passer, 1988; Roberts, 1986). On the other hand, athletes who perceive that their coaches support their efforts, enjoy sports more than those who have less favorable relationships with their coaches (Scanlan & Lewthwaite, 1986; Smoll et al., 1993).

Athletic identity is the degree of personal connection to sports (Edison et al., 2021). When a person truly embraces the athlete's position and begins to identify with it, it starts to affect their participation in sport, their definition of themselves as athletes, and their pursuit of the sport; eventually, the meaning that that identification offers to their life is also affected (Haslam et.al, 2021). This was first conceptualized and rigorously examined by Brewer et al. (1993), who proposed that athletic identity can be defined as the extent to which an individual identifies with the athletic role. Ronkainen et al. (2016) suggested that athletic identity can be best understood as a multidimensional construct. Additionally, athletic identity can also function as a cognitive framework for coping mechanisms, information interpretation, and behavior that supports the athletic role (Heird & Steinfeldt, 2013). Brewer et al. (1993) explained athletic identity according to its social, cognitive, and behavioral components and in terms of self-identity, social identity, exclusivity, and negative affectivity. The self-identity of an athlete refers to the definition of who they are as a person; it builds their general self-concept (Chen et al., 2010). Social identity can be defined as the social role of an athlete, indicating that this identity is mostly generated through critiques by others, such as parents, coaches, teammates, and spectators and is affected by the perceptions of significant others (Brewer et al., 1993). Exclusivity refers to how heavily athletes rely on their athletic position relative to other roles, *e.g.*, as a friend, in their occupation, etc. (Brewer et al., 1993). Negative affectivity refers to the degree to which one feels negative emotions because of the undesired results in sports, *e.g.*, when an athlete is unable to train or compete (Brewer et al., 1993). According to Vallerand and Losier (1999), the motivational environment fostered by the coach also impacts the thoughts, feelings, and behaviors of athletes. An individual's level of athletic identity becomes stronger with their level of motivation.

The role of the coach is critical for an athlete in terms of their performance, as the coach provides guidance, support, and structure for an athlete and helps the athlete to reach their maximum potential (Davis et al., 2018). Coaches use different styles when leading, motivating, and mentoring athletes, and these styles can vary according to the sport, the level of competition, and the athlete's needs. Different coaching styles will have different effects on the athletes, and the coach must know which style to use in which situation and how these styles are being perceived by the athletes (O'Neil & Hodge, 2019). The concept of perceived coaching styles refers to the way in which coaches are perceived by the players in terms of how they coach and/or the environment in which they coach. Enhancing the athlete's performance level is considered to be one of the most essential roles of a coach. Training and instruction can be viewed as a type of coaching behavior that focuses on assisting with intense and rigorous training; teaching athletes the skills and strategies of the sport; and explaining the dynamics among the teammates and organizing and arranging their ac-

tivities to help them perform better. Democratic behavior can be viewed as a type of coaching behavior that is defined by the extent to which the coach permits athletes to be involved in decision making, practice methods, and game strategies and tactics. Autocratic behavior can be defined as a type of coaching behavior that is focused on independent decision making and emphasizes personal authority. Social support can be characterized as a type of coaching behavior in which the coach is concerned with the wellbeing of each and every athlete, a harmonious team environment, and friendly connections with the team members. Positive feedback can be defined as a type of coaching behavior which reinforces athletes, in which the coach recognizes and rewards their good performance (Chelladurai & Saleh, 1980).

The different coaching styles used by the coaches can greatly influence an athlete's experience of anxiety. The way coaches interact with athletes and create a positive environment can significantly alleviate or exacerbate performance anxiety (Tsai & Chen, 2009). Performance anxiety is the mental state experienced when a person feels anxious and tense before, during, or after an event or performance. It is experienced by an individual who is apprehensive and afraid of failure and affects those who are typically susceptible to anxiety, particularly in scenarios involving public disclosure and competitive examination (Wilson & Roland, 2002). Sports performance anxiety can be typically defined as a negative emotional condition that arises in response to the stress of having to perform a task under pressure. It is experienced by athletes at any stage of performance and is frequently thought of as a normal reaction when an athlete's performance and abilities are being evaluated (Smith & Smoll, 1990). According to Smith and Smoll (1990), sports-related anxiety is a distressing response that is linked with the stress of participating in sport and is made up of somatic components, such as the intensity of physical activity. It is a negative reaction that is commonly associated with the pressure of engaging in sports and involves cognitive factors, such as anxious thoughts and concerns. The difficulties faced by athletes in focusing on task-relevant cues, such as instructions by the coach, changing game situations, and cues related to performance, can also lead to performance anxiety (Smith et al., 2006).

Literature Review

Numerous studies have been conducted in the field of sports psychology, including those on sports identity, perceived coaching styles, and performance anxiety in sports. Previous studies have explored athletic identity, perceived coaching styles, and performance anxiety, but have not examined the association between these three variables among Pakistani university athletes.

Performance Anxiety

A research study conducted by Mercader-Rubio et al. (2023) investigated the relationship between levels of somatic anxiety, cognitive anxiety, and self-efficacy and the basic psychological needs of university athletes. The main findings revealed a consistent and significant relationship between self-efficacy and basic psychological needs. However, when considering cognitive anxiety, somatic anxiety, and autonomy, a similar relationship was not observed. Another study was conducted by Jooste et

al. (2023) to explore the relationship between emotional intelligence and competitive anxiety in a sample of senior-level South African female hockey players. According to the findings, athletes who are more adept at controlling their own emotions as well as those of others are more likely to observe a decrease in cognitive anxiety and somatic anxiety. Moreover, research to explore sports-related anxiety in athletes was conducted by Ahmad and Safdar (2020), where the goal of the study was to examine the connections between competitive anxiety, goal orientation, and motivation in Pakistani domestic cricket players. According to the findings, ego orientation had a close connection with competitive anxiety when the athletes believed their abilities were sufficient to meet the demands of the circumstances.

Athletic Identity

A study conducted by Hayes et al. (2023) examined the relationship between athletic identity and psychological distress and the moderating role of social support and self-compassion in this relationship among college athletes. The findings suggested that self-compassion and social support help to improve the negative effects on psychological wellbeing when athletic identity is disrupted. Ballesteros et al. (2022) conducted a study in which the goal was to examine the relationships between a student athlete's academic and athletic identities and their overall wellbeing (*e.g.*, optimism and happiness levels) and athletic wellbeing (*e.g.*, satisfaction with one's performance in a sport). Unexpectedly, athletic identity and sports wellbeing were found to be negatively correlated. Moreover, Haq and Kamran (2022) conducted research to investigate the relationship between athletic identity and life satisfaction in Pakistani athletes. The study's goal was to find out whether athletic identity predicts life satisfaction among athletes or not. The results showed that there was no variation found in life satisfaction scores regardless of the type of sports or the level of competition.

Perceived Coaching Styles

To understand how coaching styles are perceived by players and how achievement motivation is related to it among Pakistani basketball players, Atta et al. (2021) conducted extensive research on these athletes. The findings showed that a strong link was observed between the perceived coaching styles and achievement motivation. A study conducted by Keatlholetswe and Malete (2019) explored the relationship between coaching, perceived coaching styles, and team performance. This study looked at how players perceived coaches' leadership styles, team environment, and the performance of their team throughout a soccer season. The results demonstrated that player opinions/perceptions of the coaches' usage of all six leadership styles (democratic behaviors, positive feedback, training and instruction, situation consideration, social support, and autocratic behaviors) were predicted when the coaches rated themselves higher in technical efficacy. Another study was conducted by Kao and Tsai (2016) to investigate the relationship between transformational leadership and athletes' satisfaction. The study also focused on investigating the mediating role of coaching competency between coaches' transformational leadership and the athlete's satisfaction (participation, performance, treatment, and training satisfaction). The

results revealed that the coaches' transformational leadership showed positive effects on coaching competency. Coaching competency was also proven to have a mediating effect between the positive effects of the coaches' transformational leadership and the athlete's satisfaction. The present research was conducted to address these gaps by investigating how athletic identity correlates with performance anxiety and how perceived coaching styles can play a role in changing the nature of this relationship in a sample of Pakistani university athletes.

Hypotheses

1. There is a relationship between athletic identity (self-identity, social identity, exclusivity, and negative affectivity), perceived coaching styles (training instruction, democratic behavior, autocratic behavior, social support, and positive feedback behavior), and performance anxiety (somatic anxiety, worry, and concentration disruption) among university athletes.
2. Perceived coaching styles moderate the relationship between athletic identity and performance anxiety in university athletes.
3. Demographic variables (gender, experience, duration, type, and categories of played sport, etc.) are likely to have an impact on performance anxiety among university athletes.

Methods

Participants

The present study used a correlational (cross-sectional) research design. A sample comprising 353 athletes, calculated using G* power (Faul et al., 2009) and consisting of both men=191 and women=162 in the age range of 18-25 (M=20.8, SD=1.78) years, was recruited from different public and private institutes in Pakistan, using a nonprobability purposive sampling technique. The study included athletes who played their respective sports at the college level and were selected for the university's sports team based on trials conducted by sports coaches. However, athletes who played at the international or national levels, alumni athletes, and physically handicapped athletes were excluded from the study.

Procedure

The study plan was approved by the university's research committee. Data collection involved visiting public and private universities, where the participants received informed consent forms and were briefed on the research. All 353 participants completed paper questionnaires with a 100% response rate. For the statistical analysis, the PROCESS macro was utilized for moderation analysis and interaction effects. The data were analyzed using IBM SPSS version 26 (Statistical Package for Social Sciences).

Questionnaires

Athletic Identity Measurement Scale (AIMS). This scale was developed by Brewer et al. (1993) and is used to measure athletic identity. It comprises 10 items scored on a

7-point scale (1= strongly disagree, 7= strongly agree) and consists of four subscales (self-identity, social identity, exclusivity, and negative affectivity), which represent the social, cognitive, and affective aspects of athletic identity. According to the evidence obtained by Brewer et al. (1993), the Cronbach's alpha calculation for the AIMS shows internal reliability, α= .93.

Leadership Scale for Sports (LSS). This scale was developed by Chelladurai and Saleh (1980) to measure the athletes' preferences for particular leadership behaviors exhibited by their coaches and their perceptions of the actual coaching behaviors of their coaches. It can also be used to measure a coach's perception of their own coaching behavior. This questionnaire comprises 40 items scored on a 5-point scale (1 = never, 5 = always) that consists of 5 subscales (training and instruction, autocratic behavior, democratic behavior, social support, and positive feedback behavior). The Cronbach's alpha calculation shows internal consistency for training and instruction, α = .93; autocratic behavior, α = .79; democratic behavior, α = .87; social support, α = .86; and positive feedback behavior, α = .92.

Sport Anxiety Scale 2 (SAS-2). This scale was developed by Smith et al. (2006) to measure cognitive and somatic trait anxiety in sport performance settings. It comprises 15 items scored on a 4-point scale (1 = not at all, 4 = very much) that consists of three subscales (somatic anxiety, worry, and concentration disruption). Each subscale consists of five items. The Cronbach's alpha calculation for SAS-2 shows internal consistency, α = .91.

Results

Initially, descriptive statistics and reliability analyses were conducted for demographic characteristics, athletic identity, perceived coaching styles, and performance anxiety. The Pearson product moment correlation coefficients were calculated to explore the relationships among these variables, including demographic factors. Finally, moderation analysis was performed to evaluate the moderating effect of perceived coaching styles on the relationship between athletic identity and performance anxiety.

The sample consisted of 353 university students with an average age of 20.8 years (SD = 1.78). Their mean CGPA was 3.2 (SD = .36). The athletes in the sample had an average playing duration of 15.99 months (SD = 9.84) at their current institute and a total professional playing experience of 51.78 months (SD = 16.62). They played an average of 2.63 hours per day (SD = 1.13). Among the participants, 191 (54.11%) were male, and 162 (45.89%) were female. A majority, 288 (81.59%), were from public universities, while 65 (18.41%) were from private institutions. Regarding living arrangements, 237 (67.14%) were day scholars, and 116 (32.86%) were hostel residents. Most (263, 74.5%) reported an urban background, while 90 (25.5%) came from rural areas. Sports participation varied: 142 (40.23%) played badminton, 70 (19.83%) cricket, 44 (12.46%) football, 34 (9.63%) basketball, 26 (7.37%) table tennis, 19 (5.38%) volleyball, 11 (3.12%) futsal, 4 (1.13%) chess, and 3 (0.85%) tennis. Most of the athletes (254, 71.95%) played team sports, 30 (8.5%) played individual sports, and 69 (19.55%) played both.

Table 1

Descriptive statistics of the demographic characteristics of the sample (N=353)

Variable	f	(%)	M	S D
Age (years)			20.8	1.78
CGPA			3.2	.36
Current Playing Duration (Months)			15.99	9.84
Professional Playing Experience (Months)			51.78	16.62
Daily Playing Hours			2.63	1.13
Gender				
Women	162	45.89		
Men	191	54.11		
Type of University				
Public	288	81.59		
Private	65	18.41		
Living Arrangement				
Hostel Resident	116	32.86		
Day Scholar	237	67.14		
Living Status				
Rural	90	25.5		
Urban	263	74.5		
Played Sports				
Basketball	34	9.63		
Badminton	142	40.23		
Football	44	12.46		
Volleyball	19	5.38		
Cricket	70	19.83		
Table tennis	26	7.37		
Tennis	3	0.85		
Chess	4	1.13		
Futsal	11	3.12		
Sports Type				
Individual sports	30	8.5		
Team sports	254	71.95		
Both	69	19.55		

Notes: f=frequencies of demographic variables, % = percentage, M= mean, and SD= standard deviations

Table 2

Descriptive statistics and reliability analysis of athletic identity (social identity, self-identity, negative affectivity, exclusivity), perceived coaching styles (training and instruction, democratic behavior, autocratic behavior, social support, positive feedback), and performance anxiety (somatic anxiety, worry, concentration disruption) (N=353).

Variables	*k*	*M*	*SD*	Range		*α*
				Actual	Potential	
Athletic Identity	10	–	–	–	–	–
Social Identity	2	8.61	3.21	2–14	2–14	.70
Self-Identity	3	13.03	4.51	3–21	3–21	.75
Negative Affectivity	2	9.12	3.33	2–14	2–14	.76
Exclusivity	3	12.32	4.56	3–21	3–21	.79
Perceived Coaching Style	40	–	–	–	–	–
Training and Instruction	13	31.90	9.14	13–56	13–65	.82
Democratic Behavior	9	22.69	6.14	9–39	9–45	.71
Autocratic Behavior	5	14.49	4.27	5–25	5–25	.75
Social Support	8	22.16	5.50	9–40	8–40	.73
Positive Feedback	5	11.88	3.98	5–22	5–25	.72
Performance Anxiety	15	29.50	8.36	15–52	15–60	.84

Notes: k= number of items, M = mean, SD = standard deviation, and α = Cronbach alpha reliability

Table 3

Bivariate correlation between athletic identity (social identity, self-identity, negative affectivity, exclusivity), perceived coaching styles (training and instruction, democratic behavior, autocratic behavior, social support, positive feedback), and performance anxiety (somatic anxiety, worry, concentration disruption) (N=353)

Variables	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Athletic Identity									
1. Social Identity	.67***	.31***	.35***	–.06	–.05	–.01	–.06	–.06	–.20***
2. Self-Identity	–	.37***	.43***	–.15**	–.095	–.014	–.07	–.15**	–.28***
3. Negative Affectivity		–	.32***	–.13*	–.17**	–.02	–.09	–.18**	–.06
4. Exclusivity			–	.00	–.06	–.10*	–.14**	.02	–.09
Perceived Coaching Style									
5. Training and Instruction				–	.72***	.27***	.54***	.72***	.36***
6. Democratic Behavior					–	.38***	.57***	.63***	.29***
7. Autocratic Behavior						–	.43***	.24***	.10
8. Social Support							–	.40***	.16**
9. Positive Feedback								–	.31***
10. Performance Anxiety									–

**p<.05, **p<.01, ***p<.001*

The Cronbach's alpha reliabilities for the athletic identity subscales ranged from .70 to .79, and for the coaching style subscales, they ranged from .71 to .82; for performance anxiety, the reliability was .84.

The Pearson product moment correlation in *Table 3* shows that social identity was found to be negatively correlated with performance anxiety. Self-identity showed a negative association with training and instruction, positive feedback, and performance. Negative affectivity was found to be negatively correlated with training and instruction, democratic behavior, and positive feedback. Exclusivity was found to be negatively related to autocratic behavior, social support, somatic anxiety, and worry. Training and instruction, democratic behavior, autocratic behavior, social support, and positive feedback were found to be positively correlated with performance anxiety.

Table 4

Regression analysis examining the interaction effect of athletic identity (social identity, self-identity, negative affectivity, exclusivity) and perceived coaching style (training and instruction, democratic behavior, autocratic behavior, social support, positive feedback) on performance anxiety (somatic anxiety, worry, concentration disruption) (N=353)

Variables	Performance Anxiety		
	β	*SE*	95 % CI
Athletic Identity	–	–	–
Social Identity	–.79	.60	[–.1.97, .39]
Self-Identity	–.34***	.09	[–.58, –.21]
Negative Affectivity	.93	2.43	[–5.71, .03]
Exclusivity	.41	2.56	[–4.63, 5.46]
Perceived Coaching Style	–	–	–
Training and Instruction	.25***	.04	[.01, .31]
Democratic Behavior	.32***	.06	[.19, .45]
Autocratic Behavior	.16*	.09	[.02,.35]
Social Support	.16*	.07	[.07, .31]
Positive Feedback	.46***	.10	[.25, .66]
Interaction			
Self-Identity x Training and Instruction	–.01*	.01	[–.03, –.001]
Self-Identity x Democratic Behavior	–.03*	.01	[–.05, –.001]
Self-Identity x Social Support	–.04**	.01	[–.07, –.01]
Self-Identity x Positive Feedback	–.04*	.02	[–.09, –.001]
Negative Affectivity x Training and Instruction	–.02*	.01	[–.05, –.001]
Negative Affectivity x Autocratic Behavior	.04*	.02	[–.01, .10]
R^2	.259		
F	3.88***		

p<.05,p<.01, ***p<.001*

The results of the moderation analysis showed that the main effect of athletic identity, including its subscale (self-identity), was found to be a positive predictor of performance anxiety. Furthermore, the main effects of perceived coaching styles, including its subscales (training and instruction, democratic behavior, autocratic behavior, social support, and positive feedback), were found to be positive predictors of performance anxiety.

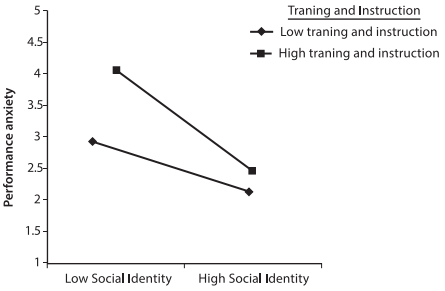

Figure 1. Interaction plot of self-identity and training and instruction on performance anxiety

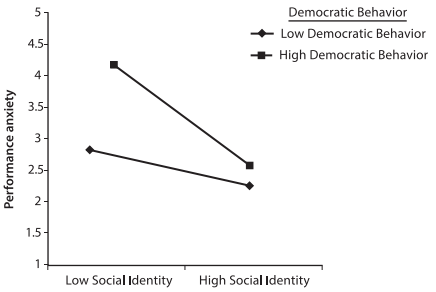

Figure 2. Interaction plot of self-identity and social support on performance anxiety

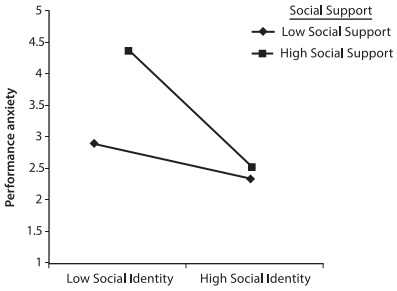

Figure 3. Interaction plot of self-identity and positive feedback on performance anxiety

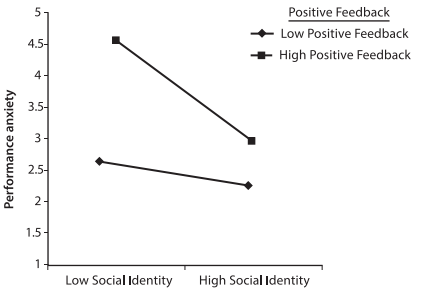

Figure 4. Interaction plot of self-identity and democratic behavior on performance anxiety

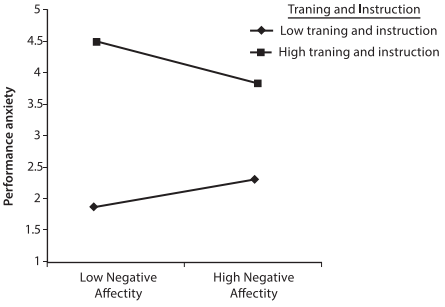

Figure 5. Interaction plot of negative affectivity and training and instruction on performance anxiety

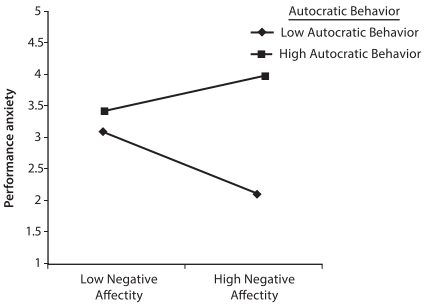

Figure 6. Interaction plot of negative affectivity and autocratic behavior on performance anxiety

For further analysis, the effects of the interactions between athletic identity (social identity, self-identity, negative affectivity, exclusivity) and perceived coaching styles (training and instruction, democratic behavior, autocratic behavior, social support, positive feedback) on performance anxiety (somatic anxiety, worry, concentration disruption) were examined; it was found that effect of the interaction between self-identity and training and instruction on performance anxiety was significant.

The interaction plots show that the relationship between self-identity and performance anxiety is increasingly negative at low, moderate, and high levels of training and instruction, social support, positive feedback, and democratic behavior, with a stronger negative relationship at high levels of these coaching styles. Additionally, the relationship between negative affectivity and performance anxiety is negative at high levels of training and instruction and positive at low levels. Conversely, this relationship is positive at high levels of autocratic behavior and negative at low levels.

Table 5

Independent sample t-test comparing performance anxiety (somatic anxiety, worry, concentration disruption) across genders (N=353)

Variables	*Men* (n=191)		Women (n=162)		t (351)	P	Cohen's d
	M	SD	M	SD			
Performance Anxiety	26.81	7.82	32.68	7.87	7.00	.000	.74
Somatic Anxiety	8.57	2.97	10.69	3.14	6.53	.000	.69
Worry	9.44	3.43	11.26	3.22	5.11	.000	.54
Concentration Disruption	8.81	2.85	10.73	3.27	5.90	.000	.63
Athletic Identity							
Self–Identity	14.34	4.10	11.48	4.50	–6.22	.000	4.29
Social Identity	9.17	3.06	7.95	3.27	–3.62	.000	3.15
Exclusivity	13.12	4.53	11.37	4.42	–3.64	.000	4.48
Negative Affectivity	9.68	3.32	8.45	3.23	–3.49	.000	3.28
Perceived Coaching Style							
Training and Instruction	30.17	8.45	33.93	9.53	3.92	.000	8.96
Democratic Behavior	21.87	6.02	23.64	6.15	2.72	.007	6.08
Autocratic Behavior	14.40	4.33	14.59	4.21	.41	.679	4.27
Social Support	21.22	5.35	23.25	5.47	3.50	.000	5.41
Positive Feedback	11.15	3.72	12.74	4.10	3.81	.000	3.90

Notes: M=mean, SD= standard deviation, p= significance level

There were significant differences found in terms of performance anxiety and its subscales (somatic anxiety, worry, and concentration disruption) between men and women, as performance anxiety and its subscales were found to be higher in women

compared to men, with a medium effect size. Furthermore, there were significant differences found in terms of athletic identity subscales (self-identity, social identity, exclusivity, and negative affectivity) between the men and women, as these variables were found to be higher in men compared to women, with a large effect size. The results showed that there were significant differences found in terms of the perceived coaching style subscales (training and instruction, democratic behavior, social support, and positive feedback); these variables were found to be higher in women compared to men, with a large effect size, whereas the results showed that there were non-significant differences in terms of autocratic behavior between the men and women.

Discussion

The study aimed to investigate the relationship between athletic identity, perceived coaching styles, and performance anxiety among university athletes. The discussion included a presentation of the previous research that may have an impact on the findings.

Firstly, it was hypothesized that a relationship exists between athletic identity (social identity, self-identity, negative affectivity, exclusivity) and performance anxiety (somatic anxiety, worry, concentration disruption) among university athletes. The findings indicated that athletic identity was negatively correlated with performance anxiety. Specifically, social identity and self-identity were negatively correlated with somatic anxiety, worry, and concentration disruption, with self-identity being a negative predictor of performance anxiety. These results align with those of O'Connor et al. (2018), who found that a decline in athletic identity increased anxiety symptoms, and Hanton et al. (2003), who reported lower anxiety levels in athletes with a strong sense of self-identity and team identification. Exclusivity, defined as how strongly an individual relies on their athletic identity relative to other roles (*e.g.*, friend or occupation), was found to have a non-significant relationship with performance anxiety. This finding aligns with that of Masten et al. (2006), who stated that the weak definition of oneself in other roles does not significantly impact performance anxiety. Additionally, negative affectivity was negatively correlated with perceived coaching styles (training and instruction), supporting Chelladurai and Saleh (1980), who found that athletes with high negative affectivity perceived less benefit from coach instruction.

The study hypothesized that a relationship exists between perceived coaching styles and performance anxiety among university athletes. The findings revealed that positive feedback was positively correlated with worry and predicted higher performance anxiety; thus, they were consistent with the findings of John and Schweitzer (2021). Additionally, it was hypothesized that coaching styles would moderate the relationship between athletic identity and performance anxiety. The study found that high levels of training and instruction made the relationship between self-identity and performance anxiety negative; this supports the findings of Masten et al. (2006) and Price and Weiss (2000), who found that increased training and instruction enhances athletes' skills and confidence by making them think they are capable enough and reduces their anxiety. High levels of social support also made the relationship between self-identity and performance anxiety negative, aligning with Bum and Shin (2015), who found that social support reinforces the athlete's sense of belonging and validation and reduces cognitive anxiety before a game.

Furthermore, the study also found that high levels of positive feedback made the relationship between self-identity and performance anxiety negative, supporting Hong (2008), who found that positive feedback reduces cognitive anxiety (worry) because positive feedback allows athletes to embrace their identity with confidence and not fear, leading to a more positive self-concept. High levels of democratic behavior also made the relationship between self-identity and performance anxiety negative; this is consistent with Solstad (2018), who found that promoting athletes' autonomy increases self-perceived ability and reduces fear of failure, thereby reducing performance anxiety. Lastly, it was hypothesized that demographic variables (gender, experience, duration, type, categories of played sport, etc.) are likely to have an impact on performance anxiety among university athletes. The findings of this study indicated that were differences found in performance anxiety between genders, where women had higher performance anxiety compared to men. This finding coincides with research conducted by Martinez-Gallego et al. (2022), which showed that female tennis players had higher levels of somatic anxiety than male tennis players. This could be due to the societal pressures women often face regarding performance, body image, etc., which can lead to heightened levels of performance anxiety. Another study also revealed that females reported higher levels of performance anxiety than males (Abrahamsen et al., 2008).

Conclusion

There were significant relationships found between the subscales of athletic identity (social identity, self-identity, negative affectivity, exclusivity), perceived coaching styles (training and. instruction, democratic behavior, autocratic behavior, social support, positive feedback) and performance anxiety (somatic anxiety, worry, concentration disruption). The self-identity subscale emerged as a significant negative predictor of performance anxiety, while all the subscales of perceived coaching styles were found to be positive predictors of performance anxiety. Moreover, training and instruction, democratic behavior, social support, and positive feedback significantly moderated the relationship between athletic identity (self-identity) and performance anxiety. Additionally, training and instruction, as well as autocratic behavior, significantly moderated the relationship between athletic identity (negative affectivity) and performance anxiety. The findings underpin Deci and Ryan's (2000) self-determination theory and can help to make sense of how athletes' athletic identity and their perception of different coaching styles may impact levels of performance anxiety. A strong athletic identity increases intrinsic motivation by satisfying the psychological needs for autonomy, competence, and relatedness. The provision of autonomy support by coaches helps to foster a motivational climate that decreases performance anxiety and leads to optimal performance. On the other hand, the provision of controlling coaching styles undermines these needs and creates anxiety and diminished performance. With the understanding of these dynamics, coaches can not only promote confidence and strengthen athletes' athletic identity but also adopt coaching styles that enhance their performance and overall wellbeing in the competitive sports environment. This study highlights the importance of coaches developing a coaching style that is democratic, supportive, and empowering rather than autocratic and controlling. By

understanding the impact of coaching behavior on the performance of university athletes, coaches can adapt an approach to create a positive and motivating environment for university athletes and help them succeed in their athletic performance. The study can help raise public awareness about the significance of the presence of a sports psychologist among university athletes by shedding light on the prevalence of performance anxiety and its impact on university athletes. It emphasizes the significance of providing coach training programs that focus on effective coaching behaviors to enhance the ability to manage performance anxiety among university athletes.

The scope of future research could be broadened by including a wider variety of sports beyond the ones specified, such as cycling, marathon running, and weightlifting. Additionally, examining recreational sports alongside competitive ones could offer insights into how different contexts influence coaching dynamics and athletes' anxiety levels. Future research could explore the impact of additional factors, such as motivation, academic stress, and nutrition, on university athletes' performance and levels of performance anxiety.

Limitations

The present study has several limitations that should be considered. The study included a specific set of sports. Therefore, the results may not be generalizable to university athletes playing other sports, such as recreational sports. The study aimed to understand university athletes' performance in terms of their athletic identity and perceived coaching styles. There are various other factors that can affect the performance of university athletes that were not studied in the present research, such as motivation, academic stress, and nutrition.

Ethics Statement

The study followed the ethical guidelines of the Departmental Ethical Research Committee and obtained approval. The research was conducted following the highest ethical standards to ensure the informed consent, safety, wellbeing, and rights of all the participants involved.

Author Contributions

FM, HA: conceived the idea, conceptualization, writing. DR.MF, FM: methodology, formal analysis, results, editing. FM, HA, STMK: discussion, limitations, writing.

Conflicts of Interest

The authors declare no conflicts of interest.

References

Ahmad, S., & Safdar, F. (2020). Goal orientation, motivation, and competitive anxiety in players of domestic cricket in Pakistan. *Pakistan Journal of Psychological Research*, *35*(1), 87–105. https://doi.org/10.33824/pjpr.2020.35.1.6

Almagro, B.J., Saenz-Lopez, P., Fierro-Suero, S., & Conde, C. (2020). Perceived performance, intrinsic motivation, and adherence in athletes. *International Journal of Environmental Research and Public Health, 17*(24), 9441. https://doi.org/10.3390/ijerph17249441

Atta, H., Nazeer, M.T., Mafooz, M., Ilyas, M., & Khan, S.U.R. (2021). Relationship between coaching styles and achievement motivation in basketball players. *Humanities and Social Sciences Reviews, 9*(3), 1446–1451. https://doi.org/10.18510/hssr.2021.93144

Ballesteros, J., Capielo, C., Blom, L.C., Buckman, L., & Kroot, A. (2022). Block and tackle or interfere: Student-athletes' identities and well-being. *Journal for the Study of Sports and Athletes in Education*, 1–25. https://doi.org/10.1080/19357397.2022.2060704

Brewer, B.W., Van Raalte, J.L., & Linder, D.E. (1993). Athletic identity: Hercules' muscles or Achilles heel? *International Journal of Sport Psychology, 24*(2), 237–254. https://doi.org/10.1037/t15488-000

Bum, C.H., & Shin, S.H. (2015). The relationships between coaches' leadership styles, competitive state anxiety, and golf performance in Korean junior golfers. *Sport Science Review, 24*(5–6), 371–386. https://doi.org/10.1515/ssr-2015-0024

Chelladurai, P., & Saleh, S.D. (1980). Dimensions of leader behavior in sports: Development of a leadership scale. *Journal of Sport Psychology, 2*(1), 34–45. https://doi.org/10.1123/jsp.2.1.34

Chen, S., Snyder, S., & Magner, M. (2010). The effects of sport participation on student-athletes' and non-athlete students' social life and identity. *Journal of Issues in Intercollegiate Athletics, 3*(1), 10.

Cnen, T., Chiu, Y., & Hsu, Y. (2021). Perception of social support provided by coaches, optimism/pessimism, and psychological well-being: Gender differences and mediating effect models. International *Journal of Sports Science & Coaching, 16*(2), 272–280. https://doi.org/10.1177/1747954120968649

Davis, L., Appleby, R., Davis, P., Wetherell, M., & Gustafsson, H. (2018). The role of coach-athlete relationship quality in team sport athletes' psychophysiological exhaustion: Implications for physical and cognitive performance. *Journal of Sports Sciences, 36*(17), 1985–1992. https://doi.org/10.1080/02640414.2018.1429176

Edison, B.R., Christino, M.A., & Rizzone, K.H. (2021). Athletic identity in youth athletes: A systematic review of literature. *International Journal of Environmental Research and Public Health, 18*(14), 7331. https://doi.org/10.3390/ijerph18147331

Hanton, S., O Brien, M., & Mellalieu, S.D. (2003). Individual differences, perceived control and competitive trait anxiety. *Journal of Sport Behaviour, 26*(1), 39–55.

Haq, M., & Kamran, F. (2022). Athletic identity and life satisfaction in Pakistani athletes. *Journal of Behavioral Sciences, 32*(2).

Haslam, C., Lam, B.C., Yang, J., Steffens, N.K., Haslam, S.A., Cruwys, T., & Fransen, K. (2021). When the final whistle blows: Social identity pathways support mental health and life satisfaction after retirement from competitive sport. *Psychology of Sport and Exercise, 57*. https://doi.org/10.1016/j.psychsport.2021.102049

Hayes, C.J., Petrie, T.A., & Moore, W.G. (2023). Athletic Identity and psychological distress: The moderating roles of social support and self-compassion. *Journal of Issues in Intercollegiate Athletics, 16*(1), 9.

Heird, E.B., & Steinfeldt, J.A. (2013). An interpersonal psychotherapy approach to counselling student athletes: Clinical implications of athletic identity. *Journal of College Counselling, 16*(2), 143–157. https://doi.org/10.1002/j.2161-1882.2013.00033.x

Huml, M.R., Hancock, M.G., & Hums, M.A. (2019). Athletics and academics: The relationship between athletic identity subconstructs and educational outcomes. *Journal of Issues in Intercollegiate Athletics, 12*, 46–62.

Jooste, J., Kruger, A., & Tinkler, N. (2023). The influence of emotional intelligence on coping ability in senior female field-hockey players in South Africa. *Journal of Human Kinetics, 87*, 211–223. https://doi.org/10.5114/jhk/161550

Kao, S., & Tsai, C. (2016). Transformational leadership and athlete satisfaction: The mediating role of coaching competency. *Journal of Applied Sport Psychology, 28*(4), 469–482. https://doi.org/10.1080/10413200.2016.1187685

Kara, E., Türküm, A.S., & Turner, M.J. (2023). The effects of rational emotive behavior therapy (REBT) group counselling program on competitive anxiety of student-athletes. Journal of Rational-emotive & Cognitive-behavior Therapy. https://doi.org/10.1007/s10942-023-00497-z

Keatlholetswe, L., & Malete, L. (2019). Coaching efficacy, player perceptions of coaches' leadership styles, and team performance in premier league soccer. *Research Quarterly for Exercise and Sport, 90*(1), 71–79. https://doi.org/10.1080/02701367.2018.1563277

Masaki, H., Maruo, Y., Meyer, A., & Hajcak, G. (2017). Neural correlates of choking under pressure: Athletes high in sports anxiety monitor errors more when performance is being evaluated. *Developmental Neuropsychology, 42*(2), 104–112. https://doi.org/10.1080/87565641.2016.1274314

Masten, R., Tušak, M., & Faganel, M. (2006). Impact of identity on anxiety in athletes. *Kinesiology, 38*(2), 126-134.

Mercader-Rubio, I., Del Carmen Quezada Berumen, L., Da Silva, S.M., & Brito-Costa, S. (2023). Levels of somatic anxiety, cognitive anxiety, and self-efficacy in university athletes from a Spanish public university and their relationship with basic psychological needs. *International Journal of Environmental Research and Public Health, 20*(3), 2415. https://doi.org/10.3390/ijerph20032415

O'Neil, L., & Hodge, K. (2019). Commitment in sport: The role of coaching style and autonomous versus controlled motivation. *Journal of Applied Sport Psychology, 32*(6), 1–11. https://doi.org/10.1080/10413200.2019.1581302

Ronkainen, N.J., Kavoura, A., & Ryba, T.V. (2015). A meta study of athletic identity research is sports psychology: Current status and future directions. *International Review of Sports and Exercise Psychology, 9*, 45–64. https://doi.org/10.1080/1750984X.2015.1096414

Scanlan, T.K., & Lewthwaite, R. (1986). Social psychological aspects of competition for male youth sport participants: IV. predictors of enjoyment. *Journal of Sport Psychology, 8*(1). https://doi.org/10.1123/jsp.8.1.25

Schutte, N.S., & McNeil, D.G. (2015). Athletic identity mediates between exercise motivation and beneficial outcomes. *Journal of Sport Behavior*, *38*(2).

Smith, R.E., Smoll, F.L., Cumming, S.P., & Grossbard, J.R. (2006). Measurement of multidimensional sport performance anxiety in children and adults: The Sport Anxiety Scale-2. *Journal of Sport and Exercise Psychology, 28*(4), 479–501. https://doi.org/10.1123/jsep.28.4.479

Smith, R.E., Smoll, F.L., & Schutz, R.W. (1990). Measurement and correlates of sport-specific cognitive and somatic trait anxiety: The sport anxiety scale. *Anxiety Research*, *2*(4), 263–280. https://doi.org/10.1080/08917779008248733

Solomon, V., & Malik, F. (2021). Psychological skills and performance efficacy in hockey players: The mediating role of sportsmanship. *FWU Journal of Social Sciences*, *15*(2), 173–189. http://doi.org/10.51709/19951272/Summer-2/10

Solstad, B.E., Ivarsson, A., Haug, E.M., & Ommundsen, Y. (2018). Youth sport coaches' well-being across the season: The psychological costs and benefits of giving empowering and disempowering sports coaching to athletes. *International Sport Coaching Journal, 5*(2), 124–135. https://doi.org/10.1123/iscj.2017-0026

Tsai, Y.M., & Chen, L.H. (2009). Relation of motivational climate and fear of failure in Taiwanese adolescent athletes. *Psychological Reports, 104*(2), 627–632. https://doi.org/10.2466/pr0.104.2.627-632

Vallerand, R.J., & Losier, G.F. (1999). An integrative analysis of intrinsic and extrinsic motivation in sport. *Journal of Applied Sport Psychology, 11*(1). 142–169. https://doi.org/10.1080/10413209908402956

Vealey, R.S., Armstrong, L., Comar, W., & Greenleaf, C.A. (1998). Influence of perceived coaching behaviors on burnout and competitive anxiety in female college athletes. *Journal of Applied Sport Psychology, 10*(2), 297–318. https://doi.org/10.1080/10413209808406395

Wilson, G.D., & Roland, D. (2002). Performance anxiety. The science and psychology of music performance: Creative strategies for teaching and learning. Oxford University.

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Perceived Mental Workload and Psychological Variables in Elite Individual and Team Bulgarian Athletes: An Exploratory Study

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Background. The concept of mental workload (MW) is a conceptual framework for evaluating the balance between the cognitive resources allocated to a task and those available to an individual. MW is influenced by the effort expended, the complexity of the task, and the individuals total processing capacity and resources.

Objective. This paper aims to explore MW in the field of sport and its relationship with other psychological variables, such as anxiety and burnout. This approach is not widely used in this context so this analysis is considered novel and unique.

Design. This paper is a cross-sectional study, with a sample selected by convenience sampling, consisting of Bulgarian athletes divided into three qualification categories: athletes competing at international competitions, athletes participating in national-level competitions, and non-professional athletes. The sample consisted of 107 athletes from various sports, with 62% male and 38% female participants.

The instruments used to assess the different psychological variables included the NASA-TLX for MW and an abbreviated questionnaire derived from the SAS-2 for Anxiety and Burnout based on ABQ.

Results. Athletes' mental workload is multifaceted, influenced by physical and psychological factors, which may also act as a protective factor against anxiety. Team sports show higher levels of mental workload due to contextual uncertainty (entropy), which could reduce performance anxiety. Two athlete profiles emerged: a *bright side* (high effort, low anxiety) and a *dark side* (low effort, high anxiety).

Conclusion. These findings contribute to existing knowledge in sports psychology, providing deeper insights into the role of mental workload in athletic preparation and its potential function as a protective factor against anxiety.

Keywords: mental workload, NASA-TLX, sports, anxiety, burnout

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Introduction

In the field of sports and physical activity sciences, it is common to measure and quantify physical workload and fatigue when, for example, planning and programming the different phases of the sports season (Freitas et al., 2016; Terrados et al., 2011).

The adaptation of physical load in sports is a common consideration in seeking to achieve optimal performance at the appropriate time of the season, for avoiding overtraining, sports injuries, andor burnout (Brenner & Watson, 2024; Glandorf et al., 2023). While this perspective focuses on physical aspects and it does not consider psychological aspects such as mental workload (MW). MW in sport is a neglected area of study either from a theoretical experimental standpoint. There are some existing studies related to the pre-fatigue induced by cognitive tasks done prior to to sporting tasks, observing increased mistakes in attempting free throws or passing a football (Alarcón et al., 2017; Alarcón et al., 2018). Additionally, there exists a few longitudinal assessments of MW linked with the physical load of rugby players (Barnard et al., 2020).

The origin of the conceptual framework for MW dates to the work of authors such as O'Donnell and Eggemeier (1986), who defined MW as the portion of a person's limited capacity required at a given moment to perform a specific task. These authors described MW as a hypothetical construct representing the cost incurred by a human operator to achieve a particular level of performance. *Cost,* asdefined by these authors, is a subjectively perceived experience summarized by a variety of environmental factors related to demands of a given task.

Mental effort, in turn, refers to the volitional allocation of cognitive resources to meet the demands imposed by a task. The load, on the other hand, refers to the resources invested relative to those available and, therefore, depends on the effort exerted, the complexity of the taskand the total processing resources (Paas et al., 2003).

In short, MW is a dynamic construct that emerges from the interaction between task complexity and human resources, simultaneously reflecting and shaping these factors. Task complexity is determined by factors such as the task's objectives, constraints on the number of items or elements, available time or time pressure, available space, the presence of distractors, and the availability of feedback (Cárdenas et al., 2015). Human resources refer to the individuals skills and abilities, learning history, motivation to complete the task, and subjective assessment of the task (Mischel & Shoda, 1995). It may be possible to manipulate MW in a manner similar to the management of physical load. Physical training load must provide sufficient stimulus to enable physiological adaptation but not so excessive as to impede that adaptation. Similarly, when managing mental workload, the stimulus inducing the load should fall within the same range. Having established this principle, perhaps the challenge may be reduced to (1) identifying which elements of the task determine its level of complexity or entropy and (2) individualizing the approach to generate an adequate stimulus (Cárdenas et al., 2015). Additionally, sports with higher levels of complexity or entropy may produce higher levels of WL.

There are activities that, despite lacking a prime motor component, can generate mental fatigue due to the significant mental resources required to carry out a given

task. Additionally, as a complement to the previous definition, the total mental resources mobilized to address a task are also referred to as mental workload (MW).

Perceptions of MW haves been widely studied in different human performance tasks and fields including the study of automobile drivers and aviation pilots (Garcia-Mas et al., 2016; Jansen et al., 2016; Morgan & Hancock, 2011; Young et al., 2019). In the case of MW in the context of the workplace, MW has been related to burnout in some studies, studies that highlight that MW not only generates a short-term impact, but requires long-term adaptation and consideration with respect to labor policy. When these adaptations are compromised or fail due to poor planning, this may result in undesirable results, such as overtraining or burnout (Goodger et al., 2007).

According to Eastern European psychological literature, MW is primarily considered in relation to ergonomic standards of mental workload. Yakovlev (2002, 194 pp.) defined mental workload as "a random process of interaction (interpenetration) between external conditions (ecological, behavioral, situational), *i.e.*, objective workload demands, and internal conditions (functions, states, properties), *i.e.*, subjective manifestations that mobilize or drive the individual to a particular purposeful activity (activity)".

In her online course, Ilieva (2023) defined MW as "the combination of all measurable influences on a person from the outside that affect them mentally". Four main elements of mental workload were derived:

- Task requirements (sustained attention, responsibility, duration of activity, etc.).
- Physical conditions (lighting, microclimate, noise, odors, etc.).
- Social and organizational factors (organizational climate, teamwork, etc.)
- Social factors (outside the organization).

  Despite Yakovlev and Litovchenko (2007) indicating that the term *mental workload* has yet to receive official status in psychology, there are several *working* definitions of mental workload that suffice as a conceptual framework, which include:
- The recommendations of the Labor Research Institute have assessed the the combined effect of psychophysiological and hygienic factors on human performance and health. The primary indicator of the degree of MW on the organism is the pressure exerted on the emotional sphere, analytical functions, and attention (Kosilov, 1979).
- "A process of work which places such demands on the person that they are able to regulate the psychophysiological equilibrium of their organism only at a higher level or with the help of connecting functional systems" (Kunat, 1973, pp. 319-324).
- The result of situational and macro-temporal factors, such as individual-psychological characteristics, experience, degree of preparedness, along with factors that cause time-resistant changes in the level of mental stress, affects a person's MW (Gorskaya, 1994).
- "Complexity, intensity, comprehensiveness, time constraints and semantics of the requirements imposed on the mental functions and processes of a person in the activity process" (Gazenko, 1987, 32 p.).

Four components of MW have been established the first of which includes the demands placed on the athlete's personality and pattern of behavior by external and internal conditions. The second component is related to the evaluation and correction of actions, the level of activity of psychological functions, including a change in emotional excitement. The third component concerns the optimal level of emotional excitement, which is achieved by the presence of the athlete's mental self-regulation skills. The fourth component involves mobilizing the athlete's functional resources to achieve a set goal. If the first component represents a set of conditions that are currently independent of and uncontrolled by the athlete, the other three components represent processes controlled by the athlete.

MW is therefore a complex construct with a range of meanings that stem from a variety of external factors and conditions as well as the effects derived from the complexity of a given task, physical conditions, and social and organizational factors (Rogaleva et al., 2024). All of these factors coalesce to influence the behavioral patterns of an athlete including their perceived physical/mental effort required in the face of a given situation as well as the observable effects of fatigue, both mental and physical.

It is important to note that the MW does not occur in a vaccum as illustrated above. Moreover, it is reasonable to hypothesize that MW may relate to psychological variables, such as anxiety and burnout.

Competitive anxiety has been widely studied, and yet, from the Martens models (1977) through to those of Smith & Smoll (1990), it has become increasingly complex, leading to the identification of dimensions such as *Cognitive Anxiety*, *Somatic Anxiety*, *Deconcentration, while its* relationships with other variables, such as well-being and performance, have become more diffuse (Núñez & Garcia-Mas, 2017). Anxiety should not be considered a detrimental factor affecting performance or well-being in isolation, as this dynamic may be mediated by coping strategies or other psychological variables (Leguizamo et al., 2021).

Burnout has been studied both in the workplace and in sport due to its direct consequences on psychophysical well-being highlighting a causal relationship with overtraining (Glandorf, 2024), and other related factors such as sport injuries (Brenner & Watson, 2024; Gil-Caselles et al., 2024), often resulting in the abandonment of the activity as a consequence (Sors et al., 2020). Other research highlights the relationship between MW and burnout in the workplace and observes this inadequate adaptation of MW may occur due to either an excess or lack of demand volume both in terms of -quantitative and in terms of its complexity, qualitative output (Karwowski, 2006).

This research aimed to study MW exhibited by a sample of Bulgarian athletes from a variety of sports, and evaluate the levels of MW according sport, and the relationships between MW and the psychological variables anxiety and burnout.

We hypothesized that those types of sports that are relatively more complex requiring a greater number of real-time decisions, will obtain higher scores in MW. Regarding the relationships with the other variables, we speculated that anxiety and burnout be positively related to MW, and therefore, the greater the MW, the higher the levels of burnout and anxiety.

Methods

Participants

This paper's design was a cross-sectional study, with a sample selected by convenience sampling. The athletes were recruited in Bulgaria through direct contact and on a voluntary basis. The participants in this study included student athletes from the National Sports Academy "Vassil Levski", Sofia, Bulgaria, who represented competitive club teams and national teams.

The sample consisted of 107 athletes from a variety of sports, of which 62% were male and 38% female. The average age of the participants was 22.4, with an SD of 9.16, and an average number of years participating in their respective sport of 11.2 years, with an SD of 6.31. The inclusion criterion was regular physical activity. In this sense, a distinction was made between participants who regularly practiced physical activity at an amateur level (23.9%), national competitors (47.7%) and international competitors (28.4%).

The study was conducted individually with each participant, who provided written informed consent personally or, in the case of minors, through a parent or legal guardian, after being briefed about the study objectives. Data collection took place after training sessions or academic classes, following a specific sequence: participants first completed the NASA-TLX questionnaire, followed by anxiety and burnout assessment tools. All questionnaires were administered under research supervision, and proper instructions were provided. Subsequently, the collected data were coded and entered into a data processing system for analysis.

Procedure

Questionnaires

An assessment protocol was developed based on the following three psychological variables with the incorporation of instruments established to measure each: *Mental Workload* (NASA-TLX), *Anxiety* (SAS-2), and *Burnout* (ABQ). Notably, since the primary objective of the study was to assess mental workload, the NASA-TLX measure was retained in its original length. Conversely, following the expert panel's recommendations, the anxiety and burnout questionnaires were shortened by selecting items according to their factor loadings.

The Hart and Staveland, (1988) *NASA-Task Load Index* (NASA-TLX) instrument provided an overall workload score based on a weighted average of six dimensions: *Mental Demands*, *Physical Demands*, *Temporal Demands*, *Perceived Performance*, *Effort*, *and Frustration*. Each dimension is rated on a visual analog scale ranging from 0 to 100 points. The NASA-TLX questionnaire was translated into Bulgarian by three independent English-Bulgarian translators. The reliability analysis of the NASA-TLX yielded a Cronbach's alpha coefficient of .704.

The application of the NASA-TLX requires two phases:

1. The first phase is called *pairwise weighting*. In this phase, the six dimensions of NASA-TLX are presented in pairs with the athlete selecting the more relevant dimension in each pair based on their prior experience and expectations. These selections are used to weigh the responses in the second phase.

2. The second phase involves completing the questionnaires with which the athlete rates each NASA-TLX dimension according to a visual analog scale (0–100 points).

The *Sport Anxiety Scale-2* (SAS-2, Smith et al., 2006) consists of 15 items, divided into three categories: *Somatic Anxiety*, *Worry*, and *Deconcentration*. Each of these items are rated on a 4-point Likert scale, ranging from 1 (Not at all) to 4 (Very much).

The *Athlete Burnout Questionnaire* (ABQ, Raedeke & Smith, 2001) consists of 15 items, divided into three dimensions: *Physical/Emotional Exhaustion*, *Reduced accomplishment*, and *sport devaluation*. Each item is rated using a 5-point Likert scale.

A shortened version of both scales was used due to factor load considerations. Based on the recommendations of an expert panel and item factor loadings, the two items with the highest factor loadings from each dimension of the construct were selected. This process resulted in reduced versions of both the SAS-2 and the ABQ, each comprising six items—two per dimension or factor.

Results

The data were tested for normality using the Shapiro–Wilk test (Shapiro & Wilk, 1965). The NASA-TLX, SAS-2, and ABQ factors did not meet the normality assumption according to the Shapiro–Wilk (SW) test. Therefore, a non-parametric analysis was applied.

The Mann-Whitney test, Welch's test, and Kruskal-Wallis test were used, along with Spearman correlations, to examine relationships and compare groups. Finally, a cluster analysis was conducted using K-means techniques. The statistical analysis was performed with Jamovi software (The Jamovi Project, 2023).

Descriptive Statistics

The results indicated that international athletes were, on average, older and had more experience than the other groups *(Table 1)*. Descriptive statistics were not analyzed according to sport given the sample size for certain sports were too small, making separate analysis impractical.

Table 1

Mean values of the variables Age and Years of Sport experience for Qualification groups

Qualification	Age (Years)	Sport Experience (years)
International	23.0 (9.35)	12.5 (7.31)
National Competitor	22.4 (7.90)	11.5 (5.44)
Sports Activity	21.9 (10.9)	9.40 (6.25)

As shown in *Table 2*, the sports that, *a priori*, involve the highest physical demands are Canoe-Kayak, Wrestling, Skating, and Handball.

The sports that require the highest mental demands are skiing and snowboarding. However, in general, the *Mental Demand factor* remained low across all sports in the *a priori* assessment.

The sport with the highest time pressure was dance, attributed to the need for precise synchronization with music to ensure optimal performance.

The sport that requires the most effort to achieve results was boxing.

Analyzing the Global Workload Index (Global WL Index), wrestling had the highest overall score, followed by handball. In contrast, sambo and track and field athletics were the sports with the lowest Global WL Index scores.

Table 2

Mean Values for NASA-TLX Factors on the pairwise weighting phase

Sport	Sample (n)	WL Global Index	Mental Weight	Physical Weight	Temporal Weight	Performance Weight	Effort Weight	Frustration Weight
Canoe-Kayak	1	88.3	3.00	5.00	1.00	2.00	4.00	.00
Ski & Snowboard	1	63.0	4.00	.00	1.00	2.00	3.00	5.00
Karate	11	71.7	2.00	3.10	1.10	2.80	3.60	2.40
Rhythmic Gymnastics	5	89.4	2.20	1.40	3.40	3.20	3.80	1.00
Volleyball	20	75.8	2.00	3.16	1.95	3.47	3.47	.94
Wrestling	1	96.3	2.00	5.00	1.00	4.00	3.00	.00
Basketball	18	76.8	1.44	3.56	2.56	3.44	3.50	.50
Handball	1	91.0	2.00	5.00	2.00	3.00	3.00	.00
Football	31	72.9	1.94	3.10	2.16	2.77	3.10	1.94
Dance	1	7.7	1.00	3.00	5.00	.00	3.00	3.00
Track & Field athletics	2	58.5	3.00	3.50	3.50	1.00	1.50	2.50
Taekwondo	1	88.0	1.00	4.00	3.00	3.00	3.00	1.00
Box	1	73.7	1.00	2.00	4.00	2.00	5.00	.00
Bowling	1	6.0	.00	3.00	1.00	5.00	4.00	2.00
Figure Skating	1	75.0	2.00	5.00	.00	3.00	3.00	2.00
Sambo	13	55.5	.77	3.15	2.15	3.62	3.31	2.00

When analyzing the different weighted factors (using both the first phase and the second phase) in the NASA-TLX, we observed that the highest value was assigned to the importance of Performance, while the lowest value was assigned to the importance of Frustration *(Table 3)*.

Table 3

Descriptives of the NASA-TLX (weighted) and SAS-2, ABQ scale factors

	Mean	SD	Min.	Max.
Mental Demands	119.67	111.736	0	500
Physical Demands	25.70	118.173	0	500
Temporal Demands	175.61	131.375	0	500
Performance	258.50	133.865	0	500
Effort	239.21	112.789	45	500
Frustration	48.50	79.495	0	475
Somatic Anxiety	2.29	.753	1.00	4.00
Worry	2.35	.875	1.00	4.00
Deconcentration	1.51	.651	1.00	4.00
Exhaustion	2.32	1.036	1.00	5.00
Devaluation of Sport	1.75	.808	1.00	4.50
Low Fulfillment	3.34	.657	2.00	5.00

The correlation matrix *(Table 4)* of the NASA-TLX and SAS-2 factors confirmed a negative correlation between Anxiety and Effort. Additionally, a positive correlation was observed between the Somatic and Worry factors in relation to the Frustration dimension of NASA-TLX.

Table 4

Correlations between NASA-TLX factors and SAS-2 factors means

	Men	Phys	Temp	Perf	Eff	Frus	Som	Wo	Dec
Men	—								
Phys	–.019	—							
Temp	–.178	.020	—						
Perf	–.019	–.120	–.349***	—					
Eff	–.014	.079	–.309**	–.005	—				
Frus	–.028	–.382***	–.062	–.273**	–.266**	—			
Som	–.048	–.072	.114	–.095	–.278**	.248**	—		
Wo	–.181	–.019	.061	–.119	–.293**	.224*	.445***	—	
Dec	–.024	–.123	.094	–.054	–.426***	.144	.271**	.331***	—

*Note. * $p < .05$, ** $p < .01$, *** $p < .001$*

Another correlation matrix was obtained when we analyzed the relationships between the ABQ factors *(Table 5)*. A negative correlation was observed between the Devaluation of Sports Practice factor and Mental Demand (NASA-TLX).

The Low Commitment factor (LFP) correlated positively with Effort. It is important to note that the two selected items comprising this factor assess (1) goal achievement through sport. Therefore, a higher score corresponds to a higher perceived Effort and (2) suboptimal performance, where the item score is inverted. Therefore, the higher the perceived Performance, the higher the perceived Effort.

Table 5

Correlations between NASA-TLX factors and ABQ factors means

	Men	**Phys**	**Temp**	**Perf**	**Eff**	**Frust**	**Exh**	**Dev**	**Lpf**
Mental Weighted	—								
Physical Weighted	–.019	—							
Temporal Weighted	–.178	.020	—						
Performance Weighted	–.019	–.120	–.349***	—					
Effort Weighted	–.014	.079	–.309**	–.005	—				
Frustration Weighted	–.028	–.382***	–.062	–.273**	–.266**	—			
Exhaustion Mean	.160	.189	.135	–.026	–.033	–.081	—		
Devaluation of Sports Mean	–.195*	–.021	–.069	–.020	.009	.103	.121	—	
LPF	–.001	.058	.147	–.117	.273**	–.203*	–.128	–.266**	—

*Note. * $p < .05$, ** $p < .01$, *** $p < .001$*

To analyze the overall correlations between the three assessment tools, we present another correlation matrix *(Table 6)*. It can be observed that a high Perceived Mental Load (global index) tended to decrease scores representing Worry and Distraction (SAS-2), while exhibiting a tendency to increase Exhaustion and Low Personal Fulfillment (ABQ).

Table 6

Correlation between NASA-TLX global index and SAS-2, ABQ factors

	WL Global	Som	Wo	Dec	Exh	Lpf	Dev
WL Global	—						
Som	–.131	—					
Wo	–.249**	.445 ***	—				
Dec	–.237*	.271**	.331***	—			
Exh	.250**	.138	.027	.081	—		
Lpf	.204*	–.097	–.158	–.152	–.128	—	
Dev	–.183	.006	.013	–.005	.121	–.266**	—

*Note. * $p < .05$, ** $p < .01$, *** $p < .001$*

Group Comparison

Athletes grouped into team sports and individual sports were compared using the NASA-TLX and SAS-2 questionnaires. Levene's test indicated a violation of the assumption of equality of variances ($p < .05$); therefore, Welch's t-test was applied to the NASA-TLX scores. In contrast, for the SAS-2, Levene's test did not indicate a violation of the assumption of equal variances ($p > .05$); consequently, the Mann-Whitney test was used.

Significant differences were observed between team and individual sports for the Global Mental Workload Index *(Table 7)*.

Table 7

Welch's test for independent samples (team/individual) for NASA TLX factors

		Statistical	df	p
Mental Weighted	T de Welch	–.667	81.1	.506
Physical Weighted	T de Welch	–1.584	57.9	.119
Temporal Weighted	T de Welch	–1.386	76.3	.170
Performance Weighted	T de Welch	–1.605	71.7	.113
Effort Weighted	T de Welch	1.399	59.8	.167
Frustration Weighted	T de Welch	.607	59.3	.546
WL Global Index	T de Welch	–2.155	54.6	.036

Note. $H_a \mu_{individual} \neq \mu_{team}$

By identifying differences between groups in the Global Workload (WL) Index, we aim to determine the direction of these differences using a single-task contrast. The results indicated that the group with the highest mean Global WL Index was the team sports group, with Welch's test revealing a statistically significant difference ($T = -2.16$, $df = 54.6$, $p = .018$). This suggests that, on average, the individual sports group has a lower Global WL Index than the team sports group.

Differences were also observed in somatic anxiety between team and individual athletes. When testing the one-tailed (unilateral) hypothesis, results indicate that the individual sports group exhibited higher levels of somatic anxiety than the team sports group. A Mann-Whitney test confirmed a statistically significant difference in Somatic Anxiety ($U = 933$, $p = .012$), supporting this finding. However, no significant differences were found for Worry ($U = 1063$, $p = .101$) or Deconcentration ($U = 1177$, $p = .346$).

Clustering

A clustering analysis was conducted using the K-means technique. The optimal number of clusters was determined to be two *(Figure 1)*. The objective of this analysis was to group the psychological variables evaluated as psychological profiles.

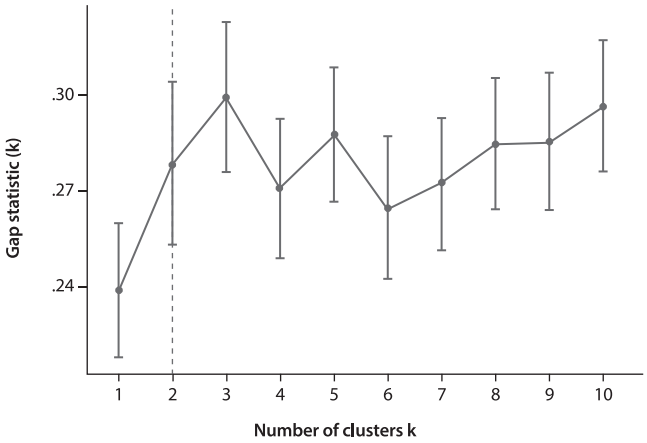

Figure 1. Optimal number of clusters suggested by K-Means Clustering technique

Examining both the centroid table *(Table 8)* and the dendrogram, two distinct psychological profiles emerged, particularly regarding Frustration and Performance.

Table 8

Centroids of cluster factors

	Frustration Weight	Effort Weight	Worry Mean	Somatic Mean	Physical Weight	Performance Weight
1	0.762	3.536	2.202	2.155	3.464	3.476
2	4.174	2.609	2.891	2.761	2.043	1.696

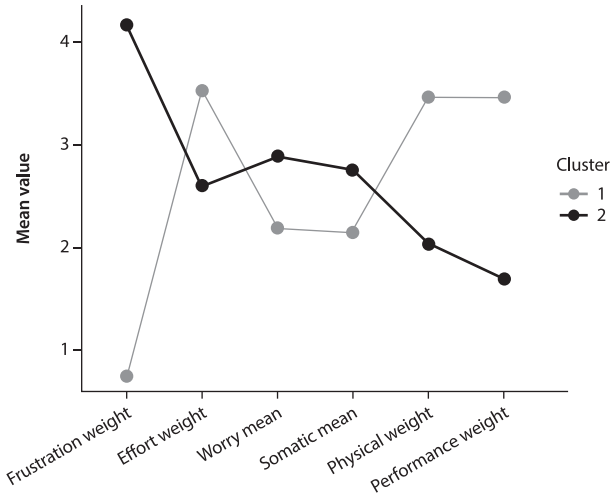

Figure 2. Plot of means across Clusters (K-Means Clustering)

The first profile was characterized by low frustration, high effort, lower anxiety levels, higher physical demand, and high performance.

The second profile showed high frustration, low effort, medium-high levels of anxiety, and low physical demand and performance.

These profiles are more clearly visualized in the Plot of Means illustration *(Figure 2).*

Discussion

The results of this study indicate that the perception of mental workload (WL) is multifactorial and should be analyzed on various levels, extending beyond purely descriptive aspects related to the practice of the studied sports.

The high level of competition intensity and training experienced by the sample participants lends significant relevance to the results and their interpretation, providing valuable insights into the psychological mechanisms underlying their predisposition to sports performance.

The initial data analysis suggests that certain sports, such as canoe-kayak, wrestling, skating, and handball, report higher physical demands than others. These same sports also demonstrate higher overall workload values as measured by the Global WL Index.

Examining the list of sports studied, it is notable that these differences emerge, especially when compared to sports that might initially seem more demanding. The sports with the lowest perceived physical demands are sambo and track and field athletics.

Wrestling stands-out as particularly significant in terms of workload (WL). As will be discussed later (Rogaleva et al., 2024), this may be attributed to group and social pressure to excel in wrestling due to the cultural significance of this sport and its emphasis on achieving high performance.

One factor that underscores the importance of considering other factors, such as decision-making, automation of sports movements, and associated injury risks (Gao et al., 2024), is highlighted by the observation that skiing and snowboarding have the highest mental demands, while dance is perceived as having the most significant time pressure, despite not being the only sport with a unique time-dependent execution requirements (Pittman et al., 2005).

When examining the relationship between these values and anxiety associated with competition and performance, the results are striking, even at first glance. It appears that perceived effort, the amount of energy expended to perform an athletic action, may serve as a protective factor against competitive anxiety, as these two variables consistently exhibit a negative correlation. This interpretation gains reliability when considered alongside more typical findings (Núñez & Garcia-Mas, 2017), such as the relationship between performance-related anxiety and frustration or between somatic anxiety and time pressure. Therefore, observing the overall results, it appears that as effort increases in one direction, frustration (across both WL factors) decreases.

As the relationship between burnout and workload (WL) is further analyzed, intriguing data emerges that complement the previous findings. Specifically, as overall perceived WL increases, reflecting greater physical and mental demands, levels of performance-related anxiety and issues of concentration tend to decrease among athletes. These findings suggest that WL may act as a protective factor. Somatic anxiety appears at very low levels, almost exclusively related to time demands in certain sports. On the other hand, a high Global WL Index correlates predictably with the Exhaustion factor, which has a strong physical component. In a similar positive correlation, increased WL appears to alleviate the pressure on athletes to demonstrate higher levels of personal commitment, as they already perceive themselves as performing well, both physically and mentally.

These findings raise important questions for future research, particularly regarding their implications for training programs and competition structures. Moreover, they highlight the counterintuitive nature of psychological dynamics in high-performance sports.

Building upon these findings and prior to an exploration of potential sporting group classifications, it should be noted that eudaimonic psychological well-being shows no significant positive or negative relationship with any of the research variables. This finding contrast starkly with similar studies (Carson, et al. 2020). This may be due to cultural bias that influences the understanding of eudaimonic well-being, suggesting that perhaps hedonic well-being is more deeply ingrained in the mindset and cognitive framework of the athletes studied. This is a crucial area warranting further investigation, potentially even from an anthropological perspective.

The findings of this research align with existing literature on individual and team sports. Higher levels of anxiety, particularly somatic anxiety, has been observed most significantly among athletes competing in individual sports. In some cases, this can be attributed to the fact that responsibility rests solely on the athlete, whereas in team sports, responsibility is distributed among team members, reducing the psychological burden (Bandura, 1991; Corrion et al., 2009). In contrast, higher levels of WL, as indicated by the Global WL Index, are found in team sports. This finding supports the premise underlying the workload framework proposed by Cardenas et al. (2015), as it demonstrates that WL is a product of systemic entropy. In the context of sports, a system can be defined by the interaction between two components: a) the specific sport and its characteristics, and b) the athletes themselves, with their learning history, expectations, and beliefs. The greater the uncertainty (ie. entropy) within a task, the more resources it demands; leading to higher emotional strain and, consequently, higher perceived WL by the athletes. These observations align with our research results, as the entropy of a sport or task, according to Cardenas et al., 2015 are determined by four cognitive parameters: numerical relationships of players, degrees of freedom, available time, and available space. Considering these parameters, it becomes evident that team sports, as more *entropic* systems, exhibit higher WL values in the Global WL Index.

The variance in anxiety levels across groups have traditionally been attributed to the concept of shared responsibility. However, based on these findings, we can

hypothesize that the higher levels of WL may also influence this difference assuming WL functions as a protective factor.

Finally, the clustering analysis identified two distinct athlete profiles based on the previously analyzed factors:

1. The *bright side* profile that includes athletes who perceive high levels of effort and physical demand, while experiencing low levels of anxiety and frustration.
2. The *dark side* profile that includes athletes who exhibit high levels of anxiety and very high frustration, but report low perceived effort and physical demands.

Conclusion

This study yields three key conclusions. First, workload (WL) in athletes is multifaceted, influenced by both physical and mental factors, and may serve as a protective factor against anxiety. Due to their higher *entropy* (environmental uncertainty), team sports exhibit higher WL levels than individual sports. This increased WL may help reduce performance-related anxiety and enhance concentration. Second, individual sports athletes experience higher levels of somatic anxiety, likely due to greater personal responsibility. In contrast, team sport athletes report lower anxiety levels but higher WL levels, reflecting the demands and complexity of team interactions. Finally, two contrasting athlete profiles emerge including bright side and dark side profiles These profiles highlight how athletes' perceptions of workload and demand-types shape their emotional experiences in sports.

Future research should explore workload management interventions aimed at optimizing the balance between perceived effort and competitive anxiety through tailored approaches. Additionally, a deeper understanding of the *bright* and *dark* athlete profiles as this may provide valuable insights for the development of psychological training programs, particularly with respect to efforts to reduce frustration levels among athletes within the dark profile segment.

Additionally, the examination of the role of *entropy* in team versus individual sports could offer new strategies for improving psychological preparation.

From a cultural perspective, continued investigation into factors affecting eudaimonic well-being is essential. Finally, studying the relationship between mental workload (MW) and burnout may provide valuable insights into reducing burnout through more effective training load management in high-performance athletes.

Limitations

While this exploratory study concerning WL in sports provides suggested future areas of WL research including its theoretical and practical implications, it leaves open the question of assessment tools. Anxiety, burnout, and well-being were evaluated using selected items from three validated instruments in order to explore their relationships. Additionally, while the NASA-TLX is one of the most widely used questionnaires for assessing WL across various domains, it is not specifically designed for athletes.

Author Contributions

A.N. and A.G.M. conceived the idea. T.I and, A.G.M. developed the theory. A.N and M.K performed the computations and verified the analytical methods. All authors discussed the results and contributed to the final manuscript.

Conflict of Interest

The authors declare no conflict of interest.

Ethics Statement

The study and consent procedures were approved by the Ethics Committee of National Sports Academy "Vassil Levski", Sofia, Bulgaria.

References

Bandura, A. (1991). Social cognitive theory of moral thought and action. In W.M.Kurtines & J.L.Gewirtz (Eds.), *Handbook of moral behavior and development: Theory, research, and applications* (pp. 71–129). Lawrence Erlbaum Associates.

Brenner, J.S., & Watson, A. (2024). Council on Sports Medicine and Fitness. Overuse injuries, overtraining, and burnout in young athletes. *Pediatrics, 153*(2), e2023065129. https://doi.org/10.1542/peds.2023-065129

Carson, F., Dynon, N., Santoro, J., & Kremer, P. (2020). Examining negative emotional symptoms and psychological wellbeing of Australian sport officials. *International Journal of Environmental Research and Public Health, 17*(21), 8265. https://doi.org/10.3390/ijerph17218265

Corrion, K., Long, T., Smith, A.L., & d'Arripe-Longueville, F. (2009). "It is Not My Fault; It is Not Serious": Athlete Accounts of Moral Disengagement in Competitive Sport. The Sport Psychologist, *23*(3), 388-404. https://doi.org/10.1123/tsp.23.3.388

Gao, F., Li, H., He, C., Qian, Y., Guo, S., Zhao, Z., …, & Zhou, J. (2024). Epidemiology of injuries among snowboarding athletes in the talent transfer program: A prospective cohort study of 39,880 athlete-exposures. *PloS one*, *19*(7), e0306787. https://doi.org/10.1371/journal.pone.0306787

Gazenko, O.G. (1987). *Slovar' fiziologicheskikh terminov* [Dictionary of Physiological Terms]. Nauka.

Gil-Caselles, L., Ruiz Barquín, R., Giménez Egido, J.M., & Olmedilla-Zafra, A. (2024). Bidirectional relationship between mental health and sport injuries: A review of reviews. *Apunts Sports Medicine, 59*(224). https://doi.org/10.1016/j.apunsm.2024.100452

Glandorf, H.L., Madigan, D.J., Kavanagh, O., & Mallinson-Howard, S.H. (2023). Mental and physical health outcomes of burnout in athletes: A systematic review and meta-analysis. *International Review of Sport and Exercise Psychology,* 1–45. https://doi.org/10.1080/1750984X.2023.2225187

Gorskaya, G.B. (1994). Makrovremennie reguliatorii psikhicheskih nagruzok visokokvalifitsirovannikh sportsmenov [Macroscopic Regulators of Psychological Loads in Highly Qualified Athletes], *Teoriia i praktika fizicheskoi kulturi* [Theory and practice of physical culture], *11*.

Hart, S.G. & Staveland, L.E. (1988). Development of NASA-TLX (task load index): results of empirical and theoretical research. In P.A. Hancock, Meshkat (Eds). *Human mental workload* (p. 139–83). Elsevier Science. https://doi.org/10.1016/S0166-4115(08)62386-9

Ilieva, D. (2023, December 18). *Video: Ergonomichni standarti za psihichno natovarvane i pshihichno naprejenie* [Ergonomic Standards for Mental Workload and Mental Stress]. ZBUT NORMI i PRAKTIKA [OHS STANDARDS and PRACTICE]. https://zbut.eu/psihichno-natovarvane-i-psihichno-naprezhenie/

Karwowski, W. (Ed.). (2006). *International Encyclopedia of Ergonomics and Human Factors* (2nd ed.). CRC Press.

Kosilov, S.A. (1979). *Psikhofiziologicheskie osnovy nauchnoi organizatsii truda* [Psychophysiological foundations of the scientific organization of labor]. Ekonomika.

Kunat, P. (1973). Problema nagruzki s tochki zreniia psikhologa sporta [The problem of workload from the perspective of a sports psychologist]. *Psikhologiia i sovremenniy sport* [Psychology and contemporary sport], 319–324.

Leguizamo, F., Olmedilla, A., Núñez, A., Ponseti, F.X., Ruiz, R. Espejo, V. & Garcia-Mas, A. (2021). Personality, coping strategies and mental health in high-performance athletes during confinement derived from the COVID-19 pandemic. *Frontiers in Public Health*, 8:561198. https://doi.org/10.3389/fpubh.2020.561198

Núñez, A., & Garcia-Mas, A. (2017). Relación entre el rendimiento y la ansiedad en el deporte: una revisión sistemática [Relationship between performance and anxiety in sport: a systematic review], *Revista Retos* [Challenges Journal]*, 32,* 173–178. https://doi.org/10.47197/retos.v0i32.53297

Pittman, A., Waller, M., & Dark, C. (2005) (Eds.). *Dance a while: A handbook of folk, square, contra, and social dance (9th ed.).* Pearson, Benjamin Cummings.

Raedeke, T.D., & Smith, A.L. (2001). *The Athlete Burnout Questionnaire Manual. Fitness Information Technology*. West Virginia University.

Rogaleva, L.N., Zhong, T. & Garcia-Mas, A. (2024). Is culture the key? Emotional intelligence, autonomous motivation and physical activity of student-athletes from China and Russia. *Frontiers in Psychology*, 15:1420430. https://doi.org/10.3389/fpsyg.2024.1420430

Ryff, C. (1989b). Happiness is everything, or is it? Explorations on the meaning of psychological well-being. *Journal of Personality and Social Psychology, 57*, 1069–1081. https://doi.org/10.1037/0022-3514.57.6.1069

Sánchez-Romero, E.I., Ponseti Verdaguer, F.J., Cantallops Ramón, J., & García-Mas, A. (2021). The Quantity and Quality of Anxiety Are Mediating Variables between Motivation, Burnout and Fear of Failing in Sport. *Int J Environ Res Public Health, 18*(23), 12343. https://doi.org/10.3390/ijerph182312343

Smith, R.E., Smoll, F.L., Cumming, S.P., & Grossbard, J.R. (2006). Measurement of multidimensional sport performance anxiety in children and adults: The sport anxiety scale-2. *Journal of Sport and Exercise Psychology, 28*, 479–501. https://doi.org/10.1123/jsep.28.4.479

Sors, F., Tomé Lourido, D., Damonte, S., Santoro, I., Galmonte, A., Agostini, T., & Murgia, M. (2020). Former road cyclists still involved in cycling report lower burnout levels than those who abandoned this sport. *Frontiers in Psychology, 11*, 400. https://doi.org/10.3389/fpsyg.2020.00400

The jamovi project (2023). Jamovi (Version 2.3) [Computer Software]. Retrieved from https://www.jamovi.org

Van Dierendonck, D. (2004). The construct validity of Ryff's Scale of Psychological well-being and its extension with spiritual well-being. *Personality and Individual Differences, 36*(3), 629–644. https://doi.org/10.1016/S0191-8869(03)00122-3

Yakovlev, B.P. (2002). *Psikhicheskaia nagruzka v sporte: teoreticheskie i prakticheskie aspekty* [Mental workload in sports: Theoretical and practical aspects]. Velikie Luki.

Yakovlev, B.P. (2007). *Psikhicheskaia nagruzka v sporte vysshikh dostizhenii* [Mental Load in Elite Sports]. SurGPI.

Yakovlev, B.P., & Litovchenko, O.G. (2007). Psikhicheskaia nagruzka v sovremennom obrazovatel'nom protsesse [Mental workload in the modern educational process], Psikhologicheskaia nauka i obrazovanie [Psychology and Education], 12(4), 16–22.

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SYSTEMATIC REVIEW AND META-ANALYSIS

Self-Efficacy in High-Performance Sports: A Systematic Review and Meta-Analysis

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Background. Studies of self-efficacy in sports have demonstrated its importance in performance. These have been of English-speaking and Latin American origin, mostly descriptive, qualitative, and relate it essentially to emotional variables; interventions reveal its sources and the way to improve it.

Objective. A meta-analysis and systematic review of self-efficacy studies in high- performance sports in 2015–2022.

Design. The PRISMA method and a flow diagram were used. The databases were SciELO, Dialnet, Redalyc, CORE, REBID, Science Research, Google Scholar, and PubMed. The dimensions of analysis were: descriptions of the articles; methodological approach, and characteristics of the self-efficacy measurements. The keywords "self-efficacy" and "sports," along with their translations into Spanish, were connected using the OR Boolean operator. The inclusion of "high performance" or "elite" was carefully considered to avoid unintended exclusions.

Results. Thirty-four articles were selected, with soccer and basketball being the most studied sports. Descriptive and correlational designs predominated: increasing relationships between two or more variables with self-efficacy, the studies that discussed interventions were the only ones that addressed longitudinal studies. In the measurements, those of general self-efficacy predominate according to the tasks faced by the athletes; individual self-efficacy is more highly valued; strength and generality are considered in the microanalyses.

Keywords: self-efficacy, sports, high-performance, meta-analysis, review

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Conclusion. Progress has been shown in studies of self-efficacy in high-performance sports. There remain opportunities for longitudinal studies, instruments with sport-specific indicators, analysis of levels and collective self-efficacy that will allow researchers to further explain the phenomenon

Introduction

In the realm of motivation, any scholarly investigation must possess a grand scope, compelling objectives, and inherent complexity stemming from its multifaceted components (Morris et al., 2022). These attributes, eloquently articulated by Fernández-Abascal (1997), likely account for the polysemous nature of the practices of psychologists and other professionals dedicated to the study and management of human behavior. Therefore, it is imperative to approach this subject matter with rigorous scientific methodologies and theoretical underpinnings.

In the domain of sports, precise terminology becomes even more indispensable, particularly when examining concepts such as self-efficacy. Developed by Bandura (1977), the theory of self-efficacy encapsulates the belief in one's capacity to successfully execute tasks at varying levels of complexity. This category comprises two intertwined components: outcome expectation, which pertains to the anticipation of specific results from certain actions, often with a professional and impersonal focus, and self-efficacy expectation or personal efficacy expectation, referring to the belief in one's capability to achieve success through individual actions.

Numerous studies have established the nexus between self-efficacy and motivation (Bandura, 2000; Cartagena, 2018; Girardi et al., 2018; Ornelas et al., 2012), showcasing their susceptibility to emotional influences and performance outcomes, and their role in fostering a sense of security when approaching established standards (Feltz, 2007; Mananis et al., 2020; Montoya et al., 2020). Moreover, research in sports psychology underscores the significant impact of self-efficacy on performance and motor tasks, aiding in the prediction of athletic outcomes (Feltz, 1992; Habeeb et al., 2019; McLean et al., 2020). These investigations span diverse sporting disciplines, employing experimental and observational methodologies, and utilize instruments such as the Physical Self-Efficacy Questionnaire and task-specific scales to assess self-efficacy in sports contexts.

Scholars have delved into the various sources of self-efficacy, encompassing achievement experiences, verbal persuasion, vicarious experiences, and physiological cues (Bandura, 1998; Feltz & Riessinger, 1990; Weinberg et al., 1982), often through experimental inquiries to elucidate their impact on performance outcomes. While descriptive inquiries into self-efficacy in sports have proliferated (Abalde & Pino, 2016; De Andrade et al., 2019), studies grounded in experimental designs and theoretical frameworks related to performance are relatively scarce.

Meta-analyses and reviews focusing on self-efficacy in high-performance sports have predominantly adopted a qualitative lens, highlighting its predictive utility and influence on athlete preparation. Notable scholarly works from English-speaking and Latin American sources have elucidated the dynamics of performance in conjunction

with psychological and formal variables, shedding light on fundamental sources and strategies to enhance self-efficacy, particularly in post-injury rehabilitation settings (Balaguer et al., 1995; Brinkman et al., 2019; Guillén, 2007; Moritz et al., 2000; Olortegui, 2020; Yevilao, 2019).

High-performance sports are characterized by rigorous physical and mental demands during training, necessitating the convergence of sophisticated physical, athletic, and psychological techniques. This integration stems from interdisciplinary research on human capabilities aimed at achieving goals and fostering efficacy in task execution, underscoring the pivotal role of psychological intervention (Guillen, 2007, pp. 21–32).

Acknowledging the imperative to advance research on self-efficacy in sports, Yevilao (2019) examined its relationship with motivation, effort, performance, thought control, and attribution of successes and failures.

There is a pressing need to develop specialized assessment tools and novel methodologies to explore self-efficacy in activity-specific contexts and devise intervention programs to further elucidate this construct.

The general objective of this study is to analyze the current state of self-efficacy in high-performance sports and propose future directions for research development in this field. Specifically, it aims to characterize the most relevant publications in terms of geographical and temporal scope, identify the most commonly used study designs in this area, explore the main relationships between self-efficacy and variables such as sports performance and motivation, as well as review the most frequently used instruments to assess self-efficacy and the interventions implemented to enhance it in high-performance sports contexts.

Methods

This manuscript presents a systematic review conducted in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, which are recognized standards for reporting systematic literature reviews and meta-analyses. The PRISMA framework, comprising a 27-item checklist and a four-phase flow diagram, aids in the comprehensive reporting of such studies (Page et al., 2021). While primarily intended for randomized trials, PRISMA is adaptable for systematic reviews across various research types, particularly intervention evaluations, thereby facilitating critical assessments of published systematic reviews.

In this review, empirical evidence is presented, offering a scientific approach to identifying and analyzing previous studies (Botella & Sánchez-Meca, 2015) on the subject of self-efficacy in high-performance sports, reported in publications from 2015 to 2022. The decision to include publications from 2015 to 2022 in this systematic review ensures that the most recent and relevant evidence on self-efficacy in high-performance sports is captured. This period was selected for several reasons. First, it reflects advances in knowledge and methodology, as the last decade has witnessed significant developments in sports science, including new measurement techniques and analytical tools that align with current standards and theories. Focusing

on this timeframe ensures that the included studies are methodologically robust and consistent with contemporary research practices. Second, prioritizing recent evidence enhances the relevance and applicability of the findings, particularly in a field that evolves rapidly. Earlier studies may rely on outdated methodologies or contain findings that are no longer applicable in the current context. Third, this period coincides with a growing interest in self-efficacy research, capturing key publications and trends that have shaped the field in recent years. Finally, limiting the scope to recent years is a common practice in systematic reviews to ensure a manageable volume of studies while maintaining the validity and applicability of the results. Together, these considerations justify the chosen timeframe and reinforce the review's contribution to advancing current understanding in the field.

Search Strategy

The search strategy encompassed three key indicators: databases, keywords, and exclusion criteria. Databases such as SciELO, Dialnet, Redalyc, CORE, REBID, Science Research, Google Scholar, and PubMed were selected based on their international visibility and recognition. The keywords "self-efficacy" and "sport," along with their translations into Spanish, were connected using the OR Boolean operator (Avelar-Rodríguez & Toro-Monjarez, 2018). The inclusion of "high-performance" or "elite" was carefully considered to avoid unintended exclusions, with specific emphasis placed on high performance in subsequent analyses.

Study Selection

The filters applied in the databases included publications from 2015 to 2022, full-text articles, and publications in English, Spanish, or Portuguese. The inclusion of English was prioritized as it is the most widely used language in scientific publications, facilitating global dissemination and visibility (Drubin & Kellogg, 2017). Spanish was selected due to its rising prominence in scientific research. Portuguese was included as it represents a major language within Ibero-American scientific production, offering significant opportunities for knowledge dissemination both within the European Union and among the Community of Portuguese Language Countries (Badillo, 2021). Exclusion criteria were applied at multiple levels to ensure the relevance and quality of the selected articles, with duplicate articles being removed initially, followed by exclusion of articles not related to self-efficacy in high-performance sports and those not published in journals indexed in SJR and/or JCR. Review articles were further excluded, and the remaining information was compiled for subsequent analysis.

Evaluation of Risk of Bias and Quality of Selected Articles

Two approaches were employed to assess the quality of the selected articles. The first approach utilized evaluation criteria established by previous authors, including Barba et al. (2020), López & Gené-Morales (2021), and Garcés de Los Fayos et al. (2023). The second approach was based on theoretical dimensions guiding the analysis process. Three authors with extensive research experience evaluated the quality of the

articles based on predefined criteria, including description of methodology, inclusion in JCR/SJR, sample size, and duration. Total scores were calculated for each article and classified as low quality (LQS), moderate quality (MQS), or high quality (HQS), based on predefined thresholds. The criteria were as follows:

Description of the methodology ("0": not included, "1": brief description, "2": detailed description); inclusion in JCR/SJR, publication of the study in a journal indexed in JCR and/or SJR ("0": not indexed, "1": indexed in SJR, "2": indexed in JCR); sample size ("0": less than 10 participants, "1": 10 to 50 participants, "2": more than 50 participants); duration ("0": less than eight sessions, "1": 9 to 14 sessions, "2": more than 15 sessions); JCR, Journal Citation Reports; SJR, Scimago Journal Rank; HQS (7–10): high-quality study; MQS (4–6): moderate-quality study; LQS (0–3): low-quality study.

After evaluating the articles, total scores were calculated for each one, and they were classified into three categories based on quantitative criteria. Articles scoring below 3 points were classified as LQS, those scoring between 4 and 6 points as MQS, and those scoring above 7 points as HQS. These thresholds were established following the methodologies and guidelines proposed by Barba et al. (2020), López and Gené-Morales (2021), and Garcés de Los Fayos et al. (2023).

Analysis Dimensions of Selected Articles for Synthesis

1) Descriptive analysis of formal characteristics of the selected articles included calculation of frequency of journal titles, language, country of research, sports disciplines studied, and distribution of publications across the analyzed years (2015–2022).
2) Methodological procedures of the articles were analyzed, including the percentage distribution of research designs adopted, differentiation between descriptive, correlational, explanatory, and validation studies (Hernández-Sampieri & Mendoza, 2018). Correlational and explanatory studies identified variables or categories associated with self-efficacy, while experimental designs analyzed self-efficacy as both an independent and dependent variable. Various sources of self-efficacy were explored, along with validations of measurement instruments.
3) Self-efficacy measurements were examined for general and specific evaluations, considering Bandura's dimensions for microanalysis. Additionally, studies evaluating self-efficacy individually and collectively were included, with collective self-efficacy defined as a shared sense of collective competence.

Quantitative analysis of the collected information was performed using IBM SPSS Statistics for Windows version 25.0 (IBM Corp. Released, 2017).

This systematic review provides a comprehensive synthesis of empirical evidence on self-efficacy in high-performance sports, offering valuable insights into methodological approaches, quality assessment, and analysis dimensions of the selected articles.

Results

The search and selection process yielded a total of 34 articles meeting the inclusion criteria, following a systematic screening and evaluation procedure (*Figure 1*).

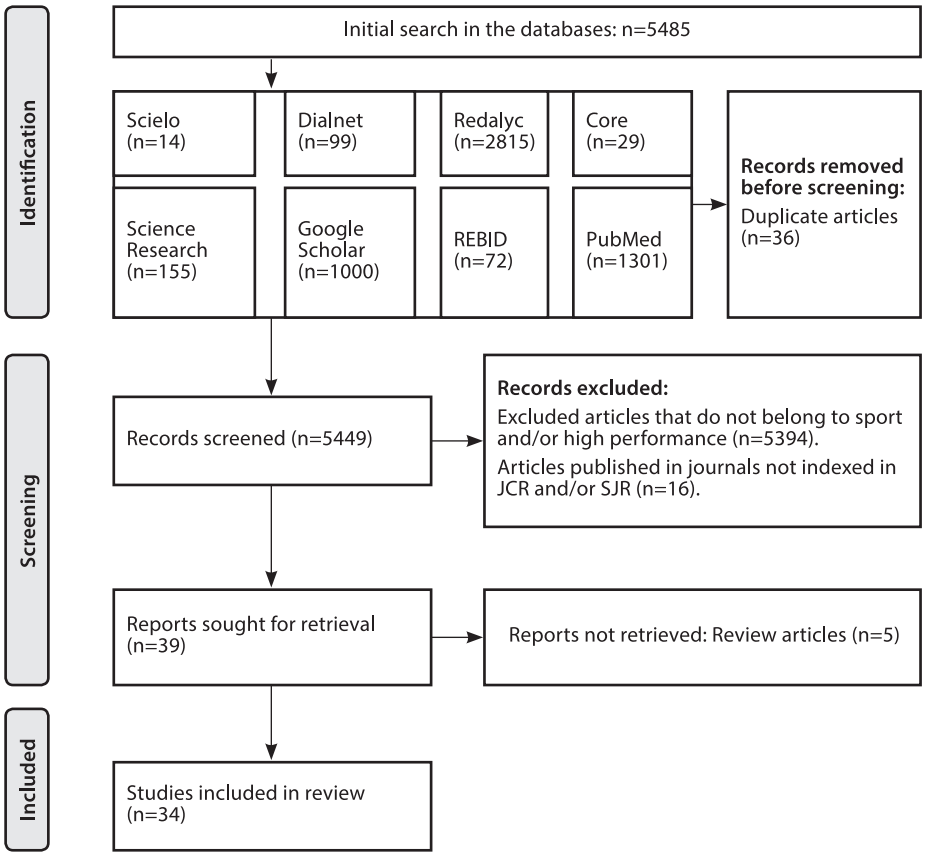

Figure 1. Flowchart for Article Selection

These articles offer valuable insights into the multifaceted dimensions of self-efficacy in high-performance sports, spanning diverse sports disciplines and methodological approaches (*Table 1*).

Risk of bias and quality assessment of the selected articles were evaluated. Of the 34 articles included in the review, 3 were classified as high-quality studies (HQS), 31 as medium-quality studies (MQS), and none as low-quality studies (LQS). Among these studies, 22.5% of HQS were indexed in JCR and SJR; 73.5% of the articles were cross-sectional, indicating that the duration criterion significantly influenced the total scores. The evaluation of the quality of the articles can be found in *Table 2*.

Table 1

Coding of the Studies Based on the Author, Year of Publication, Journals, Study Objective, Participants, Sport, and Country

Authors	Year	Journals	Study objective	N	Sport	Country
Leo, González-Ponce & Sánchez	2015	Journal of Sport Psychology	Simultaneously analyze the empirical relationship between two variables posited as antecedents, role conflict, and team conflict (task and relationship), and the collective efficacy of professional female soccer players.	225	Soccer	Spain
Rivas, Ponzanelli, López de la Llave, Pérez & Garcia-mas	2015	Revista Mexicana de Psicología	Examine the levels of collective efficacy related to the required behaviors for effective performance as competitive soccer players and compare it with individuality-collectivity regarding the willingness to work in a team.	112	Soccer	Mexico
Rodríguez, López, Gómez, Rodríguez & Granada	2015	Revista Iberoamericana de Psicología del Ejercicio y el Deporte	Verify, through a case study, the effect of a training program on activation control using breathing techniques and biofeedback on self-efficacy and putting effectiveness.	4	Golf	Colombia
Argudo, Ricardo de la Vega & Ruiz	2015	Apunts. Educación Física y Deportes.	Analyze the degree of consistency between a high-level water polo goalkeeper's perception of behavioral success and their observable performance in competition.	1	Water polo	Spain
Gacek	2015	Roczniki Panstwowego Zakladu Higieny	Investigate dietary behaviors and their association with general self-efficacy.	100	Football	Poland
Estevan, Álvarez & Castillo	2016	Cuadernos de Psicología del deporte	Develop the Perceived Self-Efficacy Questionnaire in Taekwondo Actions (CAPAT) and analyze its psychometric properties; 2) Examine differences in the perception of technical-tactical self-efficacy among taekwondo practitioners based on gender and combat success; and 3) Analyze the technical-tactical performance based on gender and combat success of the athlete. Construction and validation of a self-confidence scale for both individual and team sports in competitive situations.	85	Taekwondo	Spain

Authors	Year	Journals	Study objective	N	Sport	Country
Martínez-Romero, Molina & Oriol-Granado	2016	Cuadernos de Psicología del deporte.	Construction and validation of a self-confidence scale for both individual and team sports in competitive situations.	307	Soccer, boating basketball, cycling, roller hockey, tennis, volleyball, handball	Chile
Abalde & Pino	2016	Retos	Examine whether individuals with higher perceived self-efficacy for sports and higher self-esteem achieve better sports outcomes.	56	judo	Spain
Tejero-González, De la Vega-Marcos, Vaquero-Maestre & Ruiz	2016	Journal of Sport Psychology	1) Describe the levels of life satisfaction and mobility self-efficacy among individuals with physical disabilities who practice wheelchair basketball, 2) Contrast these levels based on the participants' level of competition or sports excellence, and (3) Measure the association between the life satisfaction of these individuals and their age, functional classification, and wheelchair mobility self-efficacy perception.	103	Wheelchair basketball	Spain
Gacek	2016	Roczniki Panstwowego Zakladu Higieny	Analyze the association between the level of general self-efficacy and the use of dietary supplements in competitive Polish athletes playing American football.	100	Football	Poland
García- Naveira	2017	Deportes CCD (Cultura, ciencias y deportes)	Understand optimism, competitiveness, and self-efficacy, their relationship, and differences based on gender.	72	Athletics	Spain

Authors	Year	Journals	Study objective	N	Sport	Country
Peinado, Cocca, Solano & Blanco	2017	Journal of Sport Psychology	Evaluate the factorial structure of the Self-Efficacy Scale in Food and Physical Health Care (ECASF) and verify its psychometric equivalence in athletes and non-athletes.	637 athletes and 668 non-athletes	College selective teams. Does not specify.	Mexico
Segura, Adanis, Barrantes-Brais, Ureña & Sánchez	2018	MH Salud	Analyze the relationships between self-efficacy, pre-competitive anxiety, and subjective perception of sports performance.	32	Soccer	Costa Rica
García-Naveira	2018	Cuadernos de Psicología del Deporte	Examine the relationship between specific self-efficacy (perceived competence in defense and attack) and individual sports performance (objective and subjective measures of performance in attack and defense).	172	Soccer	Spain
Molina, Granado & Mendoza	2018	Journal of Sport Psychology	Investigate the influence of athlete's autonomy support relationships on their positive effectiveness, emotional regulation experienced in competition, and the acquisition of personal resources such as self-confidence and self-efficacy.	300	Boating, swimming, tennis, taekwondo, athletics, rhythmic gymnastics, volleyball, basketball rugby	Chile
Rubio, Hernández, Sánchez-Iglesias, Cano & Bureo	2018	Journal of Sport Psychology	1) Compare athletes' self-efficacy beliefs upon arrival at the facilities and immediately after receiving the coach's pep talk.. 2) Analyze the influence of pre-game talks in eight matches following the same procedure with a sample of ten male players from the same team.	61	soccer	Spain
Malinaukas, Sniras & Malinaukienes	2018	Journal of Sport Psychology	Evaluate the effectiveness of an educational program aimed at improving social self-efficacy among students who practice basketball.	54	Basketball	Lithuania

Authors	Year	Journals	Study objective	N	Sport	Country
Olmedilla, Rubio, Fuster-Parra, Pujals & García-Mas	2018	Frontiers in Psychology	Construct a Bayesian network to assess probabilistic links between relevant psychological variables and the occurrence of injuries.	297	Athletics, swimming kayak, rowing, figure skating, judo, fencing, boxing, karate, basketball, handball, soccer.	Spain
De Andrade, Gattás & Moura	2019	Revista Brasileira de Medicina do Esporte	Examine the validity of the Individual Zone of Optimal Functioning (IZOF) model from a multidimensional anxiety perspective and investigate the possibility of expanding the IZOF theory to the construct of self-efficacy.	7	volleyball	Brazil
Salles, Soares, Collet, Milan, Palheta, Mendes, Kós, Nascimento & Carvalho	2019	Cuadernos de Psicología del Deporte	Analyze the variation of collective efficacy among young basketball players, considering the influence of chronological age and maturational stage.	57	Basketball	Brazil
Chen, Zhang, Yin, Li, Cao, Gutiérrez-García & Guo	2019	Frontiers in Psychology	Explore the relationship between self-efficacy and aggressive behavior, as well as the mediating effect of self-control.	414	Boxing	China
Walter, Nikoleizig & Alfermann	2019	Sports	Verify the impact of self-talk on psychological and performance outcomes (competitive anxiety, volitional skills, self-efficacy, and performance ratings).	117	Boating, artistic gymnastics, rhythmic gymnastics, judo, swimming, wrestling, ice hockey, handball, volleyball	Germany

Authors	Year	Journals	Study objective	N	Sport	Country
Reigal, Vázquez-Diz, Morillo-Baro, Hernández-Mendo & Morales-Sánchez	2019	International Journal of Environmental research and public health	1) Analyze the relationships between sport psychological profile, competitive anxiety, mood, and self-efficacy in Beach Handball players. 2) Determine the predictive capacity of the psychological profile on competitive anxiety, mood, and self-efficacy.	181	beach handball	Spain
Martínez-Alvarado, García, Palacios & Rodríguez	2020	Revista Iberoamericana de Diagnóstico y Evaluación e Avaliação Psicológica	Analyze the psychometric properties of the Collective Efficacy Questionnaire for Sports (CEQS).	935	Soccer, football soccer flags, basketball	Mexico
Chen, Qiu, Chen, C., Qang, Zhang, & Chai	2020	Frontiers in Psychology	Explore the relationship between boxers' self-efficacy and depression, as well as the mediating effect of self-control.	231	Boxing	China
Carreres-Ponsoda, Escartí, Jimenez-Olmedo & Cortell-Tormo	2021	Frontiers in Psychology	Implement the Teaching Personal and Social Responsibility (TPSR) model in a competitive context and analyze differences between the intervention group and the control group.	34	Soccer	Portugal
Monteiro, D. Monteiro, M. Torregrossa & Travassos	2021	Frontiers in Psychology	Examine the role of self-efficacy, professional goals, and athletic identity in the career planning of elite soccer players, proposing a model.	281	Soccer	Portugal
Goraczko, Zurek, Lachowicz, Kujawa & Zurek	2021	International Journal of Environmental research and public health	Investigate self-efficacy, quality of life, and their correlations among outstanding athletes who have experienced spinal cord injuries and determine if these individuals have specific psychological characteristics contributing to better quality of life.	32	Wheelchair dance, car racing, rugby, wheelchair basketball, canoe, skiing, hand cycling	USA, United Kingdom, Canada, Brazil, Poland, Austria, Australia, Japan, South Africa.

Authors	Year	Journals	Study objective	N	Sport	Country
Ramolale, Malete & Ju	2021	Frontiers in Psychology	Examine whether mental toughness mediates the relationship between self-efficacy and prosocial/antisocial behaviors in young athletes from Botswana.	158	Soccer, netball, athletics, volleyball, softball, boxing	Botswana
Peng & Zhang	2021	Frontiers in Psychology	Examine the moderating effects of goal orientations and self-efficacy on competitive cognitive anxiety and motor performance in conditions with varying levels of ego threats.	81	basketball	China
Stanković, Todorović, Milošević, Mitrović & Stojiljković	2022	Frontiers in Psychology	Compare trained athletes and athletes from various team sports in terms of aggression manifestation, personality traits, emotional intelligence, and aggression self-efficacy.	140	Judo, handball, soccer, water polo	Serbia
Tang, Liu, Jing, Wang & Yang	2022	International Journal of Environmental Research and Public Health	Verify the effects of mindfulness interventions on competitive anxiety and burnout in injured athletes returning to sports.	433	Does not specify.	China
Kwon, Shin & Shin, M	2022	International Journal of Environmental Research and Public Health	1) Verify the validity and reliability of the Korean versions of the Observational Learning Function Questionnaire and the Self-Efficacy Questionnaire. 2) Examine whether observational learning predicts self-efficacy under different pressure and personal performance conditions. 3) Test the doubly mediating effect of observational learning and the effect of winning or losing attributions on self-efficacy.	211	Basketball, ice hockey, baseball, archery, tennis, judo, soccer, rugby	Korea
Rogowska, Tataruch, Niedz´wiecki & Wojciechowska-Maszkowska,	2022	International Journal of Environmental Research and Public Health	Explore the relationship between motivational system focus, self-efficacy, and athletic success among athletes, while controlling for gender, sports discipline, and athletic level.	156 (54-102)	Speed skating, athletes studying physical education (does not specify).	Poland

Table 2

Evaluation of the Quality of the Articles

Studies	Methodology	Inclusion in JCR/SJR	Sample	Time	Total score	Quality level
Leo, González-Ponce & Sánchez (2015)	2	2	2	0	6	MQS
Rivas, Ponzanelli, López de la Llave, Pérez &Garcia-mas (2015)	1.7	2	2	0	5.7	LQS
Rodríguez, López, Gómez, Rodríguez & Granada (2015)	1	1	0	2	4	MQS
Argudo, Ricardo de la Vega & Ruiz (2015)	2	1	1	2	6	LQS
Gacek (2015)	1	1	2	0	4	HQS
Estevan, Álvarez & Castillo (2016)	1.3	1	2	0	4.3	HQS
Martínez-Romero, Molina & Oriol-Granado (2016)	1.7	1	2	1	5.7	MQS
Abalde & Pino (2016)	1.3	1	2	0	4.3	HQS
Tejero-González, De la Vega-Marcos, Vaquero-Maestre & Ruiz (2016)	2	2	2	0	6	MQS
Gacek (2016)	1	1	2	0	4	LQS
García-Naveira (2017)	1.3	1	2	0	4.3	MQS
Peinado, Cocca, Solano & Blanco (2017)	1.7	2	2	0	5.7	MQS
Segura, Adanis, Barrantes-Brais, Ureña & Sánchez (2018)	1.7	2	1	0	4.7	LQS
García-Naveira (2018)	1.3	1	2	2	6.3	LQS
Molina, Granado & Mendoza Malo (2018)	2	2	2	0	6	LQS
Rubio, Hernández, Sánchez-Iglesias, Cano & Bureo (2018)	2	2	2	0	6	LQS

Studies	Methodology	Inclusion in JCR/SJR	Sample	Time	Total score	Quality level
Malinaukas, Sniras, & Malinaukienes (2018)	1.7	2	2	2	7.7	MQS
Olmedilla, Rubio, Fuster-Parra, Pujals & García-Mas (2018)	2	2	2	2	8	HQS
De Andrade, Gattás & Moura (2019)	1.7	1	0	1.7	4.4	LQS
Salles, Soares, Collet, Milan, Palheta, Mendes, Kós, Nascimento & Carvalho (2019)	2	1	2	0	5	LQS
Chen, Zhang, Yin, Li, Cao, Gutiérrez-García & Guo (2019)	2	2	2	0	6	HQS
Walter, Nikoleizig & Alfermann (2019)	2	1	2	0	5	HQS
Reigal, Vázquez-Diz, Morillo-Baro, Hernández-Mendo & Morales-Sánchez (2019)	2	2	2	0	6	HQS
Martínez-Alvarado, García, Palacios & Rodríguez (2020)	2	2	2	0	6	LQS
Chen, Qiu, Chen, C., Qang, Zhang, & Chai (2020)	1.7	2	2	0	5.7	HQS
Carreres-Ponsoda, Escartí, Jimenez-Olmedo & Cortell-Tormo (2021)	2	2	2	1	7	HQS
Monteiro, D. Monteiro, M. Torregrossa & Travassos (2021)	2	2	2	0	6	MQS
Goraczko, Zurek, Lachowicz, Kujawa & Zurek (2021)	1.3	2	1	0	4.3	LQS
Ramolale, Malete & Ju (2021)	2	2	2	0	6	LQS
Peng & Zhang (2021)	2	2	2	0	6	LQS
Stanković, Todorović, Milošević, Mitrović & Stojiljković (2022)	2	2	2	0	6	MQS
Tang, Liu, Jing, Wang & Yang (2022)	1	1	2	1.3	5.3	LQS
Kwon, Shin & Shin, M. (2022)	2	1	2	0	5	LQS
Rogowska, Tataruch, Niedz´wiecki & Wojciechowska-Maszkowska (2022)	2	1	2	0	5	LQS

Results of the Synthesis of Articles According to the Analysis Dimensions

1) Descriptive analysis of the formal characteristics of the selected articles:

During the search period (2015–2022), various studies on self-efficacy in high-performance sports were observed, indicating sustained interest in this variable among researchers.

The 34 articles were published in 14 scientific journals, being 67.5% ($n = 23$) from four main journals: *Frontiers in Psychology* (23.5% of the articles, $n = 8$), with an impact factor of 4.2 in JCR and originating from Belgium, specializing in psychology, movement sciences, and sports psychology, prioritizing multidisciplinary studies; *International Journal of Environmental Research and Public Health* (17.6% of the articles, $n = 6$), with an impact factor of 4.614 in JCR and originating from Switzerland, specializing in public, environmental, and occupational health, prioritizing interdisciplinary studies; *Revista de Psicologia del Deporte* (14.7% of the articles, $n = 6$), with an impact factor of 0.7 in JCR and originating from Spain, specializing in sports and exercise psychology, prioritizing multidisciplinary studies; and *Cuadernos de Psicología del Deporte* (11.7% of the articles, $n = 4$), with an impact factor of 0.304 in SJR and originating from Spain, specializing in psychology related to sports sciences. Overall, 71.4% of the analyzed journals ($n = 9$) belonged to the thematic areas of psychology and sports and physical exercise sciences. Regarding publication languages, 62% ($n = 21$) of the articles were in English, and 38% ($n = 12$) in Spanish, excluding publications in Portuguese.

Research on self-efficacy was conducted across different countries, with Spain having the highest number of studies, accounting for 29.4% of the total with 10 investigations. China followed with 11.7% ($n = 4$), and Mexico with 8.8% ($n = 3$). An expansion of self-efficacy studies was observed in various regions, including Europe (52.9%, $n = 18$), Latin America (26.5%, $n = 10$), Asia (14.7%, $n = 5$), and Africa (2.9%, $n = 1$). An exemplary study in this expansion is one conducted with elite athletes from five continents who have experienced spinal cord injuries, correlating self-efficacy with quality of life (Goraczko, 2021).

Investigations were carried out across a total of 30 sports disciplines. Among team sports, soccer (40%, $n = 13$) and basketball (36.7%, $n = 12$) were the most investigated. In individual sports, track and field stood out with 13.3% ($n = 4$), followed by tennis, judo, boxing, and canoeing, each with 8.8% ($n = 3$ articles each). Additionally, studies focused on adapted sports for athletes with disabilities, representing 23.3% of the total (Goraczko, 2021; Tejero-González, 2016). Three studies did not specify the sports discipline of the participants (Peinado et al., 2017; Rodríguez et al., 2015; Tang et al., 2022).

The average annual number of publications between 2015 and 2022 was 4.25 articles, with a standard deviation of 1.57. The year with the highest production was 2018, with six articles, while the year with the lowest production was 2017, with two articles.

2) Methodological approach of the articles and association of variables:

The articles analyzed in this study adopt characteristics of descriptive designs in 33.3% ($n = 20$) and correlational designs in 31.7% ($n = 19$), with 16 of them (41%) presenting a combination of both approaches. Several associated variables ($n = 36$) were identified, demonstrating the breadth of the investigated hypotheses (*Table 3*). Of the total variables, 82.8% are related to psychological variables.

Table 3

Variables and Direction of Their Association with Individual and Collective Self-Efficacy

Individual self–efficacy			**Collective self– efficacy**		
C (+)	**C (–)**	**NC**	**C (+)**	**C (–)**	**NC**
Self–confidence in sports competition	Somatic anxiety	Pre–game speeches	–	Team conflict	Individualism
Optimism	Cognitive anxiety	–	–	Role conflict	Chronological age
Competitiveness	Aggressive behavior	–	–	Horizontal collectivism	Maturational stage
Satisfaction with life	Antisocial behavior	–	–	Vertical collectivism / Conformism	–
Social emotional support	Depression	–	–	–	–
Behavior in competition	Occurrence of injury	–	–	–	–
Self–control	–	–	–	–	–
Career goals and planning	–	–	–	–	–
Athletic identity	–	–	–	–	–
Prosocial behavior	–	–	–	–	–
Constancy Mental toughness confidence	–	–	–	–	–
Self–confidence	–	–	–	–	–
Vigor	–	–	–	–	–
Quality of life	–	–	–	–	–
Behavior activation system	–	–	–	–	–
Sporting success	–	–	–	–	–
Observational learning	–	–	–	–	–
Dietary behavior	–	–	–	–	–
Defense performance (soccer)	–	–	–	–	–
Attack performance (soccer)	–	–	–	–	–
Consumption of dietary supplements	–	–	–	–	–

Note. ***C (+)*** *= Positive Correlation. C (-) = Negative Correlation. NC = No Correlation*

Regarding the association between variables and individual and collective self-efficacy, as presented in Table 3, 61.1% of the articles ($n = 22$) indicated a positive correlation, 27.8% ($n = 10$) showed a negative correlation, and in 11.1% of the studies($n = 3$), no statistically significant correlation was found between variables such as chronological age, maturation stage, individualism, and self-efficacy, as well as pre-game coach talks (Rivas et al., 2015; Rubio et al., 2018; Salles et al., 2019).

Additionally, 53% of the studies ($n = 18$) established relationships among three or more variables, including self-efficacy (Carreres-Ponsoda et al., 2021; Chen et al., 2019; García-Naveira, 2018; Goraczko et al., 2021; Kwon et al., 2022; Leo, 2015; Molina et al., 2018; Monteiro et al., 2021; Olmedilla et al., 2018; Peng & Zhang, 2021; Ramolale et al., 2021; Reigal et al., 2019; Rivas et al., 2015; Rogowska et al., 2022; Salles et al., 2019; Segura et al., 2018; Tang et al., 2022; Walter et al., 2019).

In studies employing explanatory or experimental designs ($n = 10$), self-efficacy was studied as a dependent variable in eight of them. It was found that self-efficacy was positively influenced by factors such as coach autonomy, socio-emotional support, internal dialogue, mindfulness, activation control training through breathing techniques and biofeedback, personal learning, and social responsibility, as well as by Bandura's model, verbal persuasion, personal experience, psychophysiological states, and vicarious experience (Carreres-Ponsoda et al., 2021; Malinaukas et al., 2018; Molina et al., 2018; Rodríguez et al., 2015; Tang et al., 2022; Walter et al., 2019). One study found a negative influence of team conflicts on self-efficacy (Leo et al., 2015), and another study found no effect of pre-game coach talks on self-efficacy (Rubio et al., 2018).

In a single study with an experimental design, it was demonstrated that under conditions of different ego threat levels, self-efficacy may not serve as a moderator (Peng & Zhang, 2021).

Among the objectives of the analyzed articles, 11 validations were found, with 4 (36.7%) focusing on interventions and 7 (63.3%) on diagnostic instruments. Validations of intervention programs or models to improve self-efficacy were conducted through designs with control and experimental groups, where instruments were applied before and after the intervention (Carreres-Ponsoda et al., 2021; Malinaukas et al., 2018; Rodríguez et al., 2015; Walter et al., 2019).

Regarding diagnostic instruments, 3 studies (8.8%) presented only psychometric properties, while 4 (11.7%) were part of studies with other objectives to evaluate individual and/or collective self-efficacy based on the domains of sports activity, competitive pressure conditions, and tactical performance. All these studies reported the values of Cronbach's alpha coefficient (Andrade et al., 2019; Estevan et al., 2016; García-Naveira, 2018; Kwon et al., 2022; Martinez-Alvarado et al., 2020; Martínez-Romero, 2016; Rivas et al., 2015). Three of them consisted of translations and verifications of questionnaires and models applied in new or specific contexts (Andrade et al., 2019; Kwon et al., 2022; Martinez-Alvarado et al., 2020).

3) Results of the self-efficacy measurements, including general and/or specific evaluations:

Out of the 30 studies that addressed self-efficacy assessment, 46.6% applied specific instruments to evaluate specific domains or activities, while 53.3% focused on

general self-efficacy. Among these studies, 43.7% used Schwarzer & Jerusalem's General Self-Efficacy Scale (1995), and 18.7% used Baessler & Schwarzer's General Self-Efficacy Scale (1996). Self-efficacy was assessed in a general, broad, and stable sense of personal competence in different situations related to optimism, competitiveness, aggressiveness, quality of life after injuries, internal dialogue, quality of life, depression, observational learning, psychological profiles, competitive anxiety, mood states, injury recovery, and the use of dietary supplements (Gacek, 2016; García-Naveira, 2018; Goraczko et al., 2021; Monteiro et al., 2021; Peng & Zhang, 2021; Rogowska et al., 2022; Stanković et al., 2022; Walter et al., 2019). One study conducted both general and specific self-efficacy measurements (Segura et al., 2018).

Regarding microanalyses, 100% of the instruments considered the strength of self-efficacy, 93.3% ($n = 32$) considered its generality, and only 23.33% ($n = 7$) took into account the levels of self-efficacy (Abalde & Pino, 2016; Argudo et al., 2015; Estevan et al., 2016; Leo et al., 2015; Malinaukas et al., 2018; Rivas et al., 2015; Salles et al., 2019). Furthermore, 90% of the studies ($n = 30$) measured self-efficacy individually and 10% ($n = 4$) collectively, regardless of the sport evaluated (Leo et al., 2015; Rivas et al., 2015; Salles et al., 2019).

Discussion

The theme of self-efficacy in high-performance sports has gained more visibility in sports psychology. There has been an expansion in the number of countries studied, with Spain leading in research output, followed by other European countries, Latin America, and countries from Asia and Africa. Participants from Australia have been involved, with early studies being predominantly English-speaking. A systematic review of self-efficacy measurement instruments found that the majority of articles were from Mexico and published in the Spanish language (Olortegui, 2020). These results align with those found by Martínez-Ramírez et al. (2024), who identified a similar pattern in their systematic review on sports performance and self-efficacy, highlighting the predominance of studies conducted in Latin America and in the Spanish language.

This expansion is in line with the wide range of individual and team sports studied, including adapted sports for athletes with motor disabilities. The use of self-efficacy measures allows athletes to assess their beliefs in coping with adapted sports situations, regardless of the characteristics of the actions involved (Van Raalte et al., 2019). Previous research faced challenges in measuring physical variables for athletes with disabilities due to the lack of standardized tests (Pérez, 2009), but this issue has been overcome. In recent years, there has been international progress in social inclusion, with sports playing a significant role (Tarqui-Silva et al., 2023).

Regarding the sports most chosen for studying self-efficacy in high-performance sports, there have been recent changes. While Balaguer et al. (1995) mentioned that most studies were conducted in individual sports, currently, the team sports soccer and basketball are the most selected. This aligns with Urcino et al. (2019), who found in a review of sports performance evaluation that these two sports were the most commonly evaluated. Soccer, in particular, is highly popular worldwide and attracts considerable interest from researchers. A study focused on football asserted that it

is undoubtedly the most mediatized sport and suggested exploring various research topics related to media and science (Meneses & Avalos, 2013).

The most commonly used methodological designs were descriptive-correlational types. There has been diversification in the type of study to assess self-efficacy, as noted by Correa et al. (2022); however, few studies explored and explained the dynamics of self-efficacy in sports activities longitudinally. It would be prudent to support athletes and coaches in their efforts for improvement and to structure work that allows for specific periodization. The importance of quasi-experimental studies in sports psychology lies in the ability to analyze athletes in their natural environments. This approach aligns with one of the main objectives of applied sports psychology: to study athletes during training sessions and competitions within pre-established groups, such as sports teams. By doing so, it becomes possible to observe how independent variables influence dependent ones, allowing for the development of intervention strategies aimed at solving specific issues. Quasi-experimental studies provide a practical framework for identifying the interplay of psychological factors in real-world settings, ultimately bridging the gap between theoretical research and applied practice (Bermúdez-Zea et al., 2024).

Studies showing positive relationships between anxiety, confidence, and self-efficacy persisted, corroborating findings by Balaguer et al. (1995) and Machado et al. (2019). The relationship between performance and self-efficacy was most frequently explored in review articles (Balaguer et al., 1995; Guillén, 2007; Moritz et al., 2000). Moritz et al. (2000) found in a meta-analysis of 45 articles that self-efficacy was more strongly associated with subjective performance measures than with objective ratings, but this did not affect the relationship between the two; Balaguer et al. (1995) reported that many studies found a relationship but could not establish a causal direction.

The most significant finding of the study was the increase in research that established relationships between two or more variables with self-efficacy, affirming the need for integrated understanding and analysis due to the complexity of subjectivity in sports activities (Arruza et al., 1998; Louchbaum et al., 2023).

Exploratory and experimental methodological designs revealed causal relationships, with self-efficacy acting as both a dependent and independent variable. As a dependent variable, it was positively influenced by various practical variables and tools that impacted athletes' self-efficacy variability, as well as by Bandura's sources model, as seen in previous reviews (Balaguer et al., 1995; Escarti & García, 1994; Feltz et al., 1992; Yevilao, 2019). Studies on self-efficacy as an independent variable have been limited, with only one case demonstrating that self-efficacy did not serve as a moderator in different ego threat levels.

There has been a decline in experimental studies where self-efficacy explains the movement of another variable, contrary to the findings of Balaguer et al. (1995) in a review of the state of self-efficacy in physical education and sports, where its influence on motor performance was evident in several studies.

Validated interventions provided tools such as internal dialogue, social training, activation control, and teaching personal and social responsibility. These interventions were the only ones within the meta-analysis that were sustained over time through sessions, adapting to longitudinal characteristics of individual or group strat-

egies to solve problems (Olivares et al., 2014). However, addressing how to confront and solve self-efficacy issues continues to be a pending task, as more research focuses on diagnosing the phenomenon of self-efficacy rather than providing solutions for it.

Regarding instrument validation, considerations were made based on Bandura's (2000) and Feltz's (1992) arguments about the need to create instruments capable of evaluating specific tasks or domains of the activity. These instruments require a solid conceptual specification of the determinants that govern performance in those domains. For example, individual aspects include technical domains (type of actions for scoring) and tactical domains (attack and counterattack actions) in taekwondo, while collective aspects include situations in attack, defense, offensive transitions, and defensive transitions in football. This is consistent with the findings of Balaguer et al. (1995) and Olortegui (2020), who identified studies using self-efficacy questionnaires created for the specific sport in question.

Despite the above, some studies continue to use general scales. Similar findings were reported by Machado et al. (2019) in a review of self-efficacy in volleyball, who asserted that this remains a limitation and that no study is analyzed based on the psychological demands of the specific activity. This suggests a difficulty in interpreting the construct by authors, since self-efficacy assessment has always specified a task, even at specific levels. Bandura (2000) referred to this in the context of microanalyses in self-efficacy evaluations, and despite considering the dimension of generality, it is formed through the integration of parts or various domains of the task. Studies involving microanalyses in self-efficacy evaluations considered strength and generality in the assessments. Unipolar scales were constructed ranging from zero to maximum belief, using Likert scaling with various response options, as suggested by Bandura (2000), which always implies strength, as found in studies by Balaguer et al. (1995). Levels were less frequently considered, indicating that authors have struggled to implement them within a specific dimension of the facets they represent. These results resemble those obtained by Balaguer et al. (1995). Among 23 English-speaking studies, only five took into account task levels.

The results of this last paragraph suggest a need for a deeper approach. When research in high-performance sports is used to achieve athletes' performance goals and actions can be implemented to correct issues, the need to involve task levels in self-efficacy assessments becomes more evident. This would help correct and continuously evaluate athletes' specific beliefs in performance domains as their preparation progresses.

On the other hand, there were also few studies on collective self-efficacy (Leo et al., 2015; Rivas et al., 2015; Salles et al., 2019). Although many studies included team sports, the analysis only considered collective self-efficacy in football and basketball. The measures considered technical, tactical, and skill domains during the game, such as effort, persistence, preparation for overall performance, unity in conflict resolution, communication, and positive attitude. Other studies included group cohesion, leadership, and interpersonal relationships (Black et al., 2019; Judge et al., 2021).

Regarding the analysis of collective self-efficacy with other group-level indicators, there have been advancements. However, compared to individual self-efficacy, there continues to be a limitation in terms of the number of investigations, as pre-

viously reported by Machado et al. (2019), or in the objectives of previous reviews (Moritz et al., 2000; Olortegui, 2020; Yevilao, 2019).

Conclusion

Self-efficacy in high-performance sports continues to be of interest to researchers. There has been an expansion in research to include Europe, Asia, and Africa, and numerous sports, with football and basketball being the most studied, along with a notable inclusion of adapted sports. The results show that a large number of studies are descriptive-correlational, with a positive increase in research that establishes relationships between two or more variables with self-efficacy, highlighting the complexity of the analyses. Experimental studies, in terms of causal relationships, showed limited results in which self-efficacy explains the movement of another variable. However, as a dependent variable, some studies demonstrated that self-efficacy was positively influenced by variables that impacted athletes' self-efficacy variability, and by Bandura's sources model. This is consistent with the validated interventions, which incorporated variables and tools that explain the increase in self-efficacy. Validated interventions were the only ones within the meta-analysis that included longitudinal studies, which constituted a limitation in self-efficacy research. Many studies still rely on cross-sectional designs. For microanalysis in self-efficacy evaluation instruments, considerations were made regarding strength and generality, but the inclusion of levels in the domains was found to be limited. Considering the dimension of time could offer the opportunity for precise knowledge of the activity and its development in the preparation stages. Self-efficacy in these performances could be analyzed as the preparation progresses. This scientific gap opens the way for new research. Regarding the evaluation of self-efficacy individually and collectively, the former was more widely studied, even for participants in team sports. Another aspect to consider is the formulation of new contributions to collective self-efficacy, considering intrinsic indicators and variables related to dynamics in team sports.

Limitations

It is possible that there are other studies of self-efficacy in high-performance sports that are found in other databases and that provide new considerations. These analyses are limited to these indicators that do not preclude the possibility of other findings. One of the primary limitations of this study was the accessibility of databases. While the selected databases were chosen for their international visibility and recognition, access to certain resources proved to be a constraint. It is known that some databases include content from others; for example, PubMed offers full-text documents from many biomedical journals, including those indexed in Medline, as well as articles from other fields such as physics, chemistry, and astrophysics, many of which are available for free.

Another important limitation lies in the geographic and linguistic disparities within the databases. Renowned databases such as Scopus and Web of Science (WoS) exhibit regional limitations that affect accessibility and representation. Additionally, the ecosystem of scientific articles reflects a division between commercial publishers, who historically published in print and now sell digital access to journals, and non-

commercial publishers, which are typically institutions, scientific societies, or non-profit organizations. These factors may have influenced the comprehensiveness of the review by limiting access to certain regional or open-access studies.

The findings of this study provide valuable insights for practitioners and researchers in high-performance sports. Coaches and sports psychologists can leverage validated interventions that incorporate Bandura's self-efficacy sources to enhance athletes' confidence and performance. These interventions, particularly when applied longitudinally, have been shown to positively influence self-efficacy and its variability over time. Furthermore, considering self-efficacy as a dynamic variable throughout different preparation stages offers a practical framework for tailoring interventions to athletes' needs during training and competition phases. The limited exploration of collective self-efficacy in team sports highlights the need to address team dynamics and intrinsic indicators, which could foster stronger team cohesion and collective performance. Addressing the current over-reliance on cross-sectional designs, future research should aim to incorporate experimental and longitudinal studies to establish causal relationships and provide a deeper understanding of how self-efficacy evolves over time. This could ultimately aid in designing more effective training programs that improve both individual and team outcomes in high-performance sports contexts.

Ethics Statement

The study was reviewed and approved by the Ethics Committee of the Sports Medicine Institute, Havana, Cuba (approval no: 2023/4).

Author Contributions

L.L. conceived of idea. L.L, C.A.M., M.C.S., M.G., O.C. and A.Y searched the databases according to the strategy and developed the theory and performed the computations. L.L. and C.A.M. verified the analytical methods. L.L., L.G.G., M.C.S. and A.F.M. discussed the results and contributed to the final manuscript.

Conflict of Interest

The authors declared no conflict of interest.

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References

Abalde, N., & Pino, R. (2016). Evaluación de la autoeficacia y de la autoestima en el rendimiento deportivo en Judo [Assessment of self-efficacy and self-esteem in sport performance in Judo]. *Retos. Nuevas Tendencias en Educación física y recreación* [Challenges. New Trends in Physical Education and Recreation], *20*. 109–113. http://www.redalyc.otg/articulo.oa?id = 345743464022

Argudo, F.M., De la Vega, R., & Ruiz, R. (2015). Percepción de éxito y rendimiento deportivo de un portero de waterpolo [Perception of success and sporting performance of a water polo goalkeeper]. *Apunts. Educación Física y Deportes* [Apunts. Physical Education and Sports], *122*(4), 21–27. http://dx.doi.org/10.5672/apunts/2014-0983.es/(2015/4).122.02

Arruza, J., Balagué, G., & Arrieta, M. (1998). Rendimiento deportivo e influencia del estado de ánimo, de la dificultad estimada y de la autoeficacia en la alta competición [Sport performance and the influence of mood, perceived difficulty and self-efficacy in high-level competition.]. *Revista de Psicología del deporte* [Journal of Sport Psychology], *7*(2), 193–204. https://www.rpd-online.com/article/view/91/91

Avelar-Rodríguez, D., & Toro-Monjaraz, E.M. (2018). Pubmed: Clinical Queries, terminología MeSH y operadores booleanos [Pubmed: Clinical Queries, MeSH terminology and Boolean operators]. *Revista Medicina Clínica* [Journal of Clinical Medicine], *2*(3) 96–100. https://doi.org/10.5281/zenodo.1442811

Badillo, A. (2021). *El Portugués y el español en las ciencias: apuntes para un conocimiento diverso y accesible.* [Portuguese and Spanish in the sciences: notes for diverse and accessible knowledge]. OEI

Baessler, J., & Schwarzer, R. (1996). Evaluación de la autoeficacia: adaptación española de la escala de autoeficacia general [Assessment of self-efficacy: Spanish adaptation of the general self-efficacy scale]. *Ansiedad y estrés* [Anxiety and stress], 2(1), 1–8. https://doi.org/10.21865/RIDEP48.3.01

Balaguer, I, Escrati, A., & Villamarín, F. (1995). Autoeficacia en el deporte y en la actividad física: estado actual de la investigación [Self-efficacy in sport and physical activity: current state of research]. *Revista de Psicología General y aplicada* [Journal of General and Applied Psychology], *48*(1), 139–159. http://hdl.handle.net/10550/58497

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review,* 84, 191–215. https://doi.org/10.1037/0033-295X.84.2.191

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist*, *37*(2), 122–147. https://doi.org/10.1037/0003-66x.37.2.122

Bandura, A. (1998). Personal and collective efficacy in human adaptation and change. In J.G. Adair, D. Bélenger, & K.L. Dion (Eds.). *Advances in psychological science: Social, personal, and cultural aspects* (pp. 51–71). Psychology Press/Erlbaum (UK) Taylor & Francis.

Bandura, A. (2000). Self-efficacy: The foundation of agency. In W.E. Perrig (Ed.), *Control of human behavior, mental processes and consciousness* (pp.17–33). Erlbanum.

Barba, R.A., Bores, D., Hortigüela, D., & González-, G. (2020). The application of the teaching games for understanding in physical education. Systematic view of the last six years. *International Journal of Environmental Research and Public Health*, *17*(3330), 1–16. https://doi.org/10.3390/ijerph17093330

Bermúdez-Zea, P. V., González-de los Reyes, Y., & Mendoza- Romero, D. (2024). Programa psicofísico basado en los principios del taekwondo sobre agresividad [A psychophysical program based on the principles of taekwondo on aggression]. *Encuentros* [Meetings], *22*(1), 114–126. https://doi.org/1015665/encuen.v22i01-enero-junio-3015

Black, J., Kim, K., Rhee, S., Wang, K., & Sakchutchawan, S. (2019). Self-efficacy and emotional intelligence: Influencing team cohesion to enhance team performance. *Team Performance Management*, *25*(1/2), 100–119. https.//doi.org/10.1108/TPM-01-2018-0005

Botella, J., & Sánchez- Meca, J. (2015). *Metaanálisis en Ciencias Sociales y de la salud* [Meta-analysis in health and social sciences]. Síntesis.

Brinkman, C., Baez, S. E., Genoese, F., & Hoch, J.M. (2019). Use of goal setting to enhance self-efficacy after sports-related injury: A critically appraised topic. *Journal of Sport Rehabilitation, 29*(49), 498–502. https://doi.org/10.1123/jsr.2029-0032

Cartagena, M. (2018). Relación entre autoeficacia y rendimiento escolar y los hábitos de estudios en alumnos de secundaria [Relationship between self-efficacy and school performance and study habits in secondary school students.]. *REICE. Revista Iberoamericana sobre calidad, eficacia y Cambio en educación* [REICE. Ibero-American Journal on Quality, Effectiveness and Change in Education], *6*(3), 59–99. https://doi.org/10.15366/reice2008.6.3.003

Carreres-Ponsoda, F., Escartí, A., Jimenez-Olmedo, J.M., & Cortell-Tormo, J.M. (2021). Effects of a "teaching personal and social responsibility model" intervention in competitive youth sport. *Frontiers in Psychology,12*(624018). https://doi.org/103389/fpsyg.2021.624018

Chen, X., Guodong, Z., Xueqin Y., Yun, L., Guikang, C., Gutiérrez-García, C., & Guo, L. (2019). The relationship between self-efficacy and aggressive behavior in boxers: The mediating role of self-control. *Frontiers in Psychology 10*, 00212 https://doi.org 10.3389/fpsyg/2019.00.212

Chen, X., Qiu, Q., Chen, C., Qang, W., Zhang, Z., & Chai, L.Z. (2020). Self-efficacy and depression in boxers: A mediation model. *Frontiers in Psychology,* 11, 00791. https://doi.org/10.3389/fpsyg/2020.00.791

Correa, W.E., Pereira, A.J., Brum, G., Vagetti, G.C., & De Oliveira, V. (2022). A relação entre a autoeficácia e o autoconceito em jovens atletas de futebol: uma revisão de escopo [The relationship between self-efficacy and self-concept in young football players: A scoping review]. *Research, Society and Development, 11*(2), e21211225753, http://dx.doi.org/10.33448/rsd-v11i2.25753

De Andrade, F.C., Gattás, M., & Moura, L. (2019). Application of IZOF model for anxiety and self-efficacy in volleyball athletes: A case study. *Revista Brasileira de Medicina do Esporte, 25*(4), 338–343. https://doi.org/10.1590/1517-869220192504211038

Drubin, D.G., & Kellogg, D.R. (2017). English as the universal language of science: Opportunities and challenges. *Molecular Biology of the Cell*, *23*(8). https://doi.org/10.1091/mbc.e12-02-0108

Escarti, A., & García, A. (1994). Factores de los iguales relacionados con la práctica y motivación deportiva en la adolescencia [Peer factors related to sport practice and motivation in adolescence]. *Revista de Psicología del deporte* [Journal of Sport Psychology], *12*(54), 35–57. https://www.rpdonline.com/article/view/37

Estevan, I., Alvarez, O., & Castillo, I. (2016). Autoeficacia percibida y rendimiento táctico en taekwondistas universitarios [Perceived self-efficacy and tactical performance in collegiate taekwondists]. *Cuadernos de psicología* [Psychology notebooks], *16*(2), 51–54.

Feltz D.L., & Riessinger, C.A. (1990). Effects on in vivo emotive imagery and performance feedback on self-efficacy and muscular endurance. *Journal of Sport and Exercise Psychology, 12*, 132–143.

Feltz, D.L. (1992). Understanding motivation in sport: A self-efficacy perspective. In G.C. Roberts (Ed.), *Motivation in sport and exercise* (pp. 107–128). Human Kinetics.

Feltz, D.L. (2007). Self-confidence and sport performance. In D. Smith & M. Bar-Eli (Eds.), *Essential readings in sport and exercise psychology* (pp. 278–294). Human Kinetics.

Feria-Madueño, A., Montoya, C.A, López, L., & Carballido, L.G. (2023). Perfil de estado de ánimo y autoeficacia percibida en tareas de salto con contramovimiento en atletas cubanos de élite [Profile mood state and self-efficacy in countermovement jumps in elite Cuban athletes]. *Revista Latinoamericana de Psicología* [Latin American Journal of Psychology], 55, 160–168. https://doi.org/10.14349/rlp.2023.v55.18

Fernández-Abascal, E.G. (1997). Estilos y estrategias de afrontamiento [Coping styles and strategies]. In E.G. Fernández-Abascal, F. Palmero, M. Chóliz, & F. Martínez (Eds.), *Cuadernos de prácticas de motivación y emoción* [Motivation and emotion workbooks] (pp. 189–206). Pirámide.

Gacek, M. (2015). Association between self-efficacy and dietary behaviors of American football players in the Polish clubs in the light of dietary recommendations for athletes. *Roczniki Panstwowego Zakladu Higieny* [Annals of the National Institute of Hygiene], *66*(4), 361–366.

Gacek, M. (2016). Association between general self-efficacy level and use of dietary supplements in the group of American football players. *Roczniki Panstwowego Zakladu Higieny* [Annals of the National Institute of Hygiene], *67*(1), 31–36.

Garcés de Los Fayos, E., Garcés de Los Fayos, E.J., & Ortin, F.J. (2023). Ira y personalidad como dos factores relacionados en el deporte: una revisión sistemática [Anger and personality as two related factors in sport: a systematic review]. *Cuadernos de Psicología del Deporte* [Sport Psychology Notebooks], *23*(1), 21–37. https://doi.org/10.6018/cpd.533361

García-Naveira, A. (2018). Optimismo, autoeficacia general y competitividad en jóvenes atletas de alto rendimiento [Optimism, general self-efficacy and competitiveness in young high-performance athletes]. *Cultura, ciencias y deporte* [Culture, science and sport], *13*(37), 71–81.

Girardi, P., Pardo, R., Rivas, V., Trueba, A., Mur, D. A., Andrés, J., & Vargas, P. (2018). Autoeficacia: una revisión aplicada a diversas áreas de Psicología [Self-efficacy: a review applied to various areas of psychology]. *Ajayu Órgano de Difusión Científica del Departamento de Psicología UCBSP* [Ajayu Scientific Dissemination Organ of the Department of Psychology UCBSP], 2, 299–325.

Goraczko, A., Zurek, M., Lachowicz, K., & Zurek, G. (2021). Is self-efficacy related to the quality of life in elite athletes after spinal cord injury? *International Journal of Environmental research and public health, 18*(10866), https://doi.org/10.3390/ijerph182010866

Guillén, N. (2007). Implicaciones de la autoeficacia en el rendimiento deportivo [Implications of self-efficacy for sport performance]. *Pensamiento psicológico* [Psychological thinking], *3*(9), 21–32. http://revistas.javerianacali.edu.co/index.php/pensamientopsicologico/article/view/67/199

Habeeb, C.M., Eklund, R.C., & Cofee, P. (2019). Reciprocal relationships between efficacy and performance in athlete dyads: Self-, other-, and collective constructs. *Journal of Sport & Exercise Psychology, 41*(3), 147–158. https://doi.org/10.1123/jsep.2018-0248

Hernández-Sampieri, R., & Mendoza, C.P. (2018). *Metodología de la investigación: las rutas cuantitativa, cualitativa y mixta* [Research methodology: the quantitative, qualitative and mixed research routes]. McGraw-Hill.

IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.

Judge, L.W, Woodward, S.C., Gilham, A.D., Blom, L.C., Hoover. D.L., Schoeff. M.A., …, & Bellar, D.M. (2021). Efficacy sources that predict leadership behaviors in coaches of athletes with disabilities. *Journal of Human Kinetics*, *78*, 271–281. https://doi.org/102478/hukin-2021-0056

Kwon, T., Shin, S., & Shin, M. (2022). The effect of observational learning on self-efficacy by sport competition condition, performance level of team members, and whether you win or lose. I*nternational Journal of Environmental Research and Public Health, 19*(16), 10148. https.//doi.org/10.3390/ijerph191610148

Leo, F.M., González-Ponce, I., & Sánchez Miguel, P.A. (2015). El conflicto de rol y el conflicto de equipo como debilitadores de la eficacia colectiva [Role conflict and team conflict as underminers of collective efficacy]. *Revista de Psicología del Deporte* [Journal of Sport Psychology], *24(*1), 171–176. https://www.redalcy.org/pdf/2351/235139639020

Louchbaum, M., Sisneros, C., Cooper, S., & Terry, P.C. (2023). Pre-event self-efficacy and sports performance: A systematic review with meta-analysis. *Sports (Basel, Switzerland), 11*(11), 222. https://doi.org/10.3390/sports11110222

López, I., & Gené-Morales, J. (2021). Revisión sistemática de la investigación sobre el uso del mindfulness en la educación física [Systematic review of research on the use of mindfulness in physical education]. *Cuadernos de Psicología del Deporte* [Sport Psychology Notebooks], *21*(3), 83–98. https://doi.org/10.6018/cpd.482631

Machado, T.A., Balaguer, I., Paes, M.J., Fernandes, G.J., & Stefanello, M.F. (2019). Self-efficacy in volleyball: What has been evaluated? A systematic review. *Cuadernos de Psicología del Deporte, 19*(1), 76–94. https://doi.org/10.6018/cpd.329401

Malinaukas, R., Sniras, S., & Malinaukienes, V. (2018). Social self-efficacy training programme for basketball playing students. A case study. *Revista de Psicología del deporte, 27*(1), 165–185.

Martínez-Alvarado, J., García, F., Palacios, L., & Rodríguez, A. (2020). Traducción y validación del Collective efficacy questionnaire for sports en deportistas mexicanos [Translation and validation of the Collective efficacy questionnaire for sports in Mexican athletes]. *Revista Iberoamericana de Diagnóstico y Evaluación y Validación Psicológica* [Iberoamerican Journal of Psychological Diagnosis and Evaluation and Validation], *1*(54), 47–55. https://doi.org/10.21865/ridep54.1.04

Martínez-Ramírez, D.E., Camacho, J., Ibarra, M.L., García, J., & Flores, V. (2024). Rendimiento deportivo en función de la autoeficacia: revisión sistemática [Sport performance as a function of self-efficacy: a systematic review]. *Cultura, Ciencia y Deporte* [Culture, Science and Sport], *19*(61), 2054. https://ccd.ucam.edu/index.php/revista/article/view/2054/1318

Martínez-Romero, M., Molina, V.M., & Oriol-Granado, X. (2016). Desarrollo y validación del cuestionario de autoconfianza en competición CACD para deportes individuales y colectivos [Development and validation of the CACD competition self-confidence questionnaire for individual and team sports.]. *Cuadernos de Psicología del Deporte* [Sport Psychology Notebooks], *16*(2), 13–20.

McLean, S.P., Habeeb, C. M, Cofee, P., & Eklund, R. (2020). Efficacy beliefs are related to task cohesion: Communication is a mediator. *The Sport Psychologist, 34*(3), 187–197. https://doi.org/10.1123/TSP.2019-0056

Meneses, G.A., & Avalos, J.M. (2013). La investigación del futbol y sus nexus con los estudios de comunicación: Aproximaciones y ejemplos [Soccer research and its nexus with communication studies: Approaches and examples]. *Comunicación y sociedad* [Communication and society], *20*, 33–64. http://doi.org/10.32870/cys.v0i20.216

Molina, V.M., Oriol, X., Mendoza, M.C., & Malo, S. (2018). Influencia del apoyo socioemocional sobre la afectividad experimentada, autoconfianza y autoeficacia en jóvenes deportistas [Influence of socioemotional support on experienced affectivity, self-confidence and self-efficacy in young athletes.]. *Revista de psicología del deporte* [Journal of Sport Psychology], *27*(1), 51–58. https://www.dianelnet.unirioja.es/servl..ticulo?codigo62800484

Monteiro, R., Monteiro,D., Torregrossa, M., & Travassos, B. (2021). Career planning in elite soccer: the mediating role of self-efficacy, career goals, and athletic identity. *Frontiers in Psychology, 12* (6948689). https://doi.org/10.3389/fpsyg/2021.694868

Montoya, C.A., González, L.G., Sánchez, J.E., & Chavez, C.O. (2020). Dinámica de autoeficacia, ansiedad, perfil anímico y rendimiento deportivo en lanzadores cubanos de atletismo [Dynamics of self-efficacy, anxiety, mood profile and sporting performance in Cuban athletics throwers.]. In T. Trujillo (Ed.), *Teoría* y *práctica de la psicología del deporte en Iberoamérica* [Theory and practice of sport psychology in Ibero-America] (pp. 86–95). Independently published.

Moritz, S.E., Feltz, D., Fahrbach, K.R., & Mack, D.E. (2000). The relation of self-efficacy measures to sport performance: A meta-analytic review. *Research Quarterly for Exercise and sport*, *71*(3), 280–294. https://doi.org/10.1080/02701367.2000.10608908

Morris, L.S., Grenl, M.M., Rutter, S.B., Mehta, M., & Westwater, M.L. (2022). On what motivates us. A detailed review of intrinsic v. extrinsic motivation. *Psychological Medicine, 52*(10), 1801–1816. https://doi.org/10.1017/S0033291722001611

Olivares, J., Macía, D., Rosa, A. I., & Olivares-Olivares, P. J. (2014). *Intervención psicológica. Estrategia, técnicas y tratamiento* [Psychological intervention. Strategy, techniques and treatment]. Pirámide.

Olmedilla, A. Rubio, V.J., Fuster-Parra, P., Pujals, C., & García-Mas, A. (2018). Bayesian approach to sport injuries likelihood: Do players self-efficacy and environmental factors play the main role? *Frontiers in Psychology, 9*, 1174. https://doi.org/10.8639/fpsyg/2018.01.1174

Olortegui, L.M. (2020). *Revisión sistemática sobre instrumentos para medir la autoeficacia a partir de la literatura científica entre los años 2014–2019* [Systematic review of instruments to measure self-efficacy from the scientific literature, 2014–2019] [Diploma Thesis, César Vallejo University, Lima-Perú]. https://purl.org/pe- repo/ocde/ford·5.01.02

Ornelas, M., Blanco, H., Gastelum, G., & Chavez, A. (2012). Autoeficacia percibida en la conducta académica de estudiantes universitarias [Perceived self-efficacy in academic behaviour of female university students]. *Formación universitaria* [University education], *5*(2), 17–26. http://dx.doi.org/10.4067/S0718-50062012000200003

Page, M.J, Mckenzie, J.E., Bossuyt, P.M., Boutrom, I., Hoffmann, T.C., & Mulrow, C. D. (2021). Declaración PRISMA 2020: Una guía actualizada para informar sobre revisiones sistemáticas [PRISMA 2020 rationale: An updated guide to reporting systematic reviews]. *Revista Española de Cardiología* [Spanish Journal of Cardiology], *79*(9), 790–799. http://doi.org/10.1016/jrecesp.2021.06.016

Peinado, J.E, Cocca, A., Solano, N., & Blanco, H. (2017). Invarianza factorial de una escala de autoeficacia en deportistas y no deportistas [Factorial invariance of a self-efficacy scale in athletes and non-athletes]. *Revista de psicología del deporte* [Journal of Sport Psychology], *26*(2), 189–197. https://doi.org/10.4067/S0718-50062015000600008

Peng, F., & Zhang, L.W. (2021). The relationship of competitive cognitive anxiety and motor performance: testing the moderating effects of goal orientations and self-efficacy among Chinese collegiate basketball players. *Frontiers in Psychology*, *12*, 685649. https://doi.org/10.3389/fpsyg/2021.685649

Pérez, J. (2009). La investigación en actividades físicas y deportes adaptados: Un camino aún por recorrer [Research in physical activities and adapted sports: A road still to be travelled.]. *Revista internacional de Ciencias del deporte* [International Journal of Sport Science], *5*(16), 1–3.

Ramolale, M., Leapetswe, M., & Unhee, J. (2021). Mediational role of mental toughness on the relationship between self-efficacy and prosocial/ antisocial behavior in elite youth sport. *Frontiers in Psychology*, *12*(745323). https://doi.org/10.3389/fpsyg/2021.745323

Reigal, R.E, Vázquez-Diz, J.A, Morillo-Baro, J.P, Hernández-Mendo, A., & Morales-Sánchez, V. (2019). Psychological profile, competitive anxiety, moods and self-efficacy in beach handball players. *National Library of Medicine*, *17*(241), 1–13. https://doi.org/10.3390/ijerph17010241

Rivas, C.A., Ponzanelli, R., López de la Llave, A., Pérez, M.C., & García-Mas, A. (2015). Individualismo y colectivismo en relación con la eficacia colectiva percibida en jugadores de fútbol [Individualism and collectivism in relation to perceived collective efficacy in soccer players]. *Revista Mexicana de Psicología* [Mexican Journal of Psychology], *32*(1), 68–80. http://www.redalyc.org/articulo.oa?id=243045363008

Rubio, V.J., Hernández, J.M., Sánchez-Iglesias, I., Cano, A., & Bureo, R. (2018). The effects of coach pregame speeches on young players' self-efficacy. *Revista de psicología del deporte, 27*(1), 59–66. https://www.rpd-online.com/article/view/v27-n1-rubio-hernandez-sanchez-etal

Rodríguez, M.C., López, E., Rodríguez, P., & Granada, L.M. (2015). Programa de entrenamiento en control de la activación, rendimiento y autoeficacia en golfistas infantiles: un estudio de caso [Activation control, performance and self-efficacy training programme for junior golfers: a case study]. *Revista Iberoamericana de Psicología del Ejercicio y el Deporte* [Iberoamerican Journal of Exercise and Sport Psychology], *10*(1), 77–84. http://www.redalyc.org/articulo.oa?id=311132628010

Rogowska, A.M., Tataruch, R., Niedz´wiecki, K., & Wojciechowska-Maszkowska, B. (2022). The mediating role of self-efficacy in the relationship between approach motivational system and sports success among elite speed skating athletes and physical education students. I*nternational Journal of Environmental Research and Public Health, 19*(5), 2899. https://doi.org/10.3390/ijerph19052899

Salles, W.N., Soares, L.A., Collet, C., Milan, F.J., Palheta, C.E., Mendes, F.G., …, & Carvalho, H.M. (2019). Influence of age and maturation on perceived collective efficacy in youth basketball players, *Cuadernos de Psicología del Deporte* [Sports Psychology Notebooks], *19*(1), 275–282. https://doi.org/10.6818/cpd.347851

Segura, D., Adanis, D., Barrantes-Brais, K., Ureña, P., & Sánchez, B. (2018). Autoeficacia, ansiedad precompetitiva y percepción del rendimiento en jugadores de fútbol categorías sub 17 y juvenil [Self-efficacy, pre-competitive anxiety and perception of performance in U17 and youth players]. *MHSalud* [MHHealth], *15*(2). https://doi.org/10.15359/mhs.15–2.3

Schwarzer, R., & Jerusalem, M. (1995). Generalized self-efficacy scale. In J. Weinman, S. Wright, and M. Johnston (Eds.), *Measures in health psychology: A user's portfolio. Causal and control beliefs* (pp. 35–37). NFER-NELSON.

Stankovi, N., Todorovi, D., Miloševi, N., Mitrovi, M., & Stojiljkovi, N. (2022). Aggressiveness in judokas and team athletes: Predictive value of personality traits, emotional intelligence and self-efficacy. *Frontiers in Psychology*, *12*, 824113. https://doi.org/10.3389/fpsyg/2021.824113

Tang, Y., Liu, Y., Jing, L., Wang, H., & Yang, J. (2022). Mindfulness and regulatory emotional self-efficacy of injured athletes returning to sports: The mediating role of competitive state anxiety and athlete burnout. *International Journal of Environmental Research and Public Health, 19*(18), 11702. https://doi.org/10.3390/ijeph191811702

Tarqui-Silva, L.E., Sánchez Salinas, M.V., & Garcés-Mosquera, J.E. (2023). El deporte adaptado, inclusivo y paralímpico: una ruptura de estereotipos discriminatorios contra la diversidad funcional [Adapted, inclusive and Paralympic sport: breaking down discriminatory stereotypes against functional diversity]. *Revista Innova educación* [Innova education journal], *5*(1), 120–130. https://doi.org/10.35622/j.rie.2023.05.008.es

Tejero-González, C.M., De la Vega, M.R., Vaquero-Maestre, M., & Ruiz-Barquín, R. (2016). Satisfacción con la vida y autoeficacia en jugadores de baloncesto en silla de ruedas [Life satisfaction and self-efficacy in wheelchair basketball players]. *Revista de Psicología del Deporte* [Journal of Sport Psychology], *25*(1), 51–56. http://www.redalyc.org/articulo.oa?id=235143645007

Van Raalte, L. J., & Posteher, K. A. (2019). Examining social support, self-efficacy, stress, and performance, in U.S. Division I collegiate student-athletes' academic and athletic lives. *Journal for the*

Study of Sports and Athletes in Education, 13(2), 75–96. https://doi.org/10.1080/19357397.2019.1635419

Walter, L., Nikoleizig, N., & Alfermann, D. (2019). Effects of self-talk training on competitive anxiety, self-efficacy, volitional skills, and performance: An intervention study with junior sub-elite athletes. *Sports (Basel, Switzerland), 2*(6), 148. https://doi.org/10.3390/sports7060148

Weinberg, R., & Jackson, A. (1982). Building self-efficacy in tennis players: A coach's perspective. *Journal of Applied Sport Psychology*, *2*, 164–174. https://doi.org/10.1080/10413209008406427

Yevilao, A.E. (2019). Autoeficacia un acercamiento al estado de la investigación en Latinoamérica [Self-efficacy an approach to the state of research in Latin America]. *Revista Reflexión e Investigación Educacional* [Journal of Educational Reflection and Research], *2*(2), 91–102. https://doi.org/1022320/reined.v2i2.4124

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Hostility and Cognitive Complexity: A Meta-analysis

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Background. We can see outbreaks of social violence (notably wars, riots, and revolutions), both historically and in the current social situation. Some authors point to the impact of hostility on human cognitive processes and on decision making, and through these factors — on aggressive behaviour. Moreover, some retrospective studies note the role of cognitive complexity in the peaceful resolution of conflicts (including international conflicts). These findings prompted us to ask whether the two phenomena are related. To answer this question a meta-analysis of correlation between hostility and cognitive complexity was conducted.

Objective. Our objective was to summarise research findings on the relationship between hostility and cognitive complexity.

Design. The total number of papers screened was 839 (in English and Russian). A total of 5 effect sizes from 4 selected papers were included in the meta-analysis derived from a pooled sample of 3114 participants. Three-level random-effects meta-analysis, p-curve, p-uniform and p-uniform* methods were used in the data analysis.

Results. The results of different effect size calculation methods (three-level random-effects model, two-level random-effects model, and p-uniform*) confirmed that there is a moderately weak negative correlation between hostility and cognitive complexity. The most accurate result is $r_{pooled} = -.22$ [−.45; .003].

Conclusion. There is a negative correlational relationship between hostility and cognitive complexity. Apparently, hostility and cognitive complexity have some reciprocal influence on each other. The authors hypothesise that hostility is rather complementary to cognitive simplicity as the opposite pole of cognitive complexity - if the function of hostility in ensuring the protection of one's sense of Self is taken into account. Both hostility and cognitive simplicity work to create a simple (in one case dangerous, in another case unambiguous) world in which it is easier to make decisions (including the decision to engage in aggressive behaviour).

Keywords: hostility, cognitive complexity, integrative complexity, cognitive simplicity, meta-analysis

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Introduction

Hostility is proposed to be one of the key factors that ensures the implementation of aggressive behaviour on an individual level (Smeijers, 2023). Consequently, hostility seems to have an impact on the increase of social violence observed both in the historical perspective and in the current social situation. This influence can be analysed through the framework of considering hostility as a cognitive phenomenon that affects information processing and subsequent decision making.

According to the literature analysis, in most cases the term "hostility" refers to the nature of a certain phenomenon rather than an independent psychological reality (*i.e.*, a system of attitudes, cognitive distortions etc.). In other words, hostility acts as a functional "modifier" of cognition. According to Crick and Dodge (1994), the main function of this "modification" (as well as of the phenomenon of human aggression in general) is to protect one's sense of Self. A possible explanation of how hostility contributes to the defense of one's Self is by providing subjects with clear information in an uncertain and ambiguous social environment (Smeijers et al., 2019).

Aggression, hostility and anger are often presented as interrelated phenomena. This logic of consideration was suggested in the 1960s by the prominent American psychologist Arnold Buss (Buss, 1961). He believed that aggression as a phenomenon consists of three components: anger as an emotional component of aggression, physical and/or verbal aggression as a behavioural component, and hostility as a cognitive component. It is possible to say that there is some "consensus" regarding the "cognitive nature" of hostility. A large number of studies with different operationalisations of hostility have been conducted *i.e.* hostility as a personality trait (*e.g.*, Anderson et al., 1996), a system of attitudes (*e.g.*, Smith, 1992, Barefoot, 1992), an "image of the world" (*e.g.*, Enikolopov & Chudova, 2017), and a cognitive distortion (*e.g.*, Dodge et al., 1990). It is important to say that the operationalisation of hostility as a cognitive distortion is now the most popular and this approach has made some very significant contributions to the issue of understanding the essence of hostility.

The origins of the hostile cognitive distortions approach or the hostile biases approach was established within Kenneth Dodge`s framework. Dodge and Crick proposed a nonlinear cyclical model of social information processing (SIP) (Crick & Dodge, 1994). According to this model, children learn how to use aggressive behavior due to the hostile distortion at one of the social information processing stages. The model posits that human beings go through a series of stages when faced with a social cue. First, they encode the situation (Stage 1), taking in relevant information. Next, they create a *mental representation* of the situation (Stage 2), interpreting the cues and relating them to past experiences. The child then accesses or constructs potential *responses* from their repertoire (Stage 3). A *response decision* follows (Stage 4), where the child evaluates the potential consequences of each response and chooses one. Finally, the chosen response is *enacted* (Stage 5). Dodge`s original model presents these steps as a sequence.

The revised model retains these core processing steps but emphasises the cyclical and recursive nature of social information processing during the social interaction. It acknowledges that a child's initial response elicits a reaction from others, which then becomes new social information to be processed by the child, restarting the cycle.

Also the child's internal database has a very important role in this model — specifically their store of memories, social knowledge, and social schemas — all of which influences each step of the processing sequence. The model also takes into account the importance of clarifying goals within the social situation (*i.e.*, "how my peers will assess my action?), as these goals shape how the child interprets the cues and selects a response. For example, aggressive children might misinterpret ambiguous cues as hostile, struggle to generate non-aggressive responses, or overestimate the positive consequences of aggression.

It is noted that the hostile schema which occurs in childhood plays an important role in the development of a hostile encoding pattern and consequently, hostile biases (Crick & Dodge, 1994, Smeijers Bulten & Brazil , 2019). The schema itself is a complex mental phenomenon that emerges from memories, emotions, cognitions, self-attitudes and attitudes toward others (Smeijers et al., 2019). The hostile schema is a specific pattern of information perception. According to the schema-inconsistent hypothesis, the hostile schemas direct one`s attention not on the expected hostile social cues, but rather on the schema-inconsistent information (*i.e.* non-hostile information) because this information resonates with expectations.

A fundamental problem in hostility research is that the phenomenon itself has not been sufficiently reflected on from a theoretical and methodological point of view. A broad diversity of "hostile" entities distinctly demonstrates this problem. Moreover, there is a lack of evidence on how the different ways to operationalise hostility relate. There is some empirical evidence from eye-tracker studies that show aggressive people linger meaningfully longer on non-hostile information than non-aggressive people. In turn, non-aggressive people meaningfully hold their gaze longer on hostile information than aggressive people. In other words, people with a stable hostile schema require more cognitive effort to incorporate non-hostile information into the perception of social information (Horsley, de Castro & der Schoot, 2010).

This perspective allows us to fit hostility into the space of human cognitive life and raise simple analytical questions. In particular, within this paper, we will explore the relationship between hostility and cognitive complexity.

Hostility and cognitive complexity

Peter Suedfeld and Philip Tetlock were probably the first researchers who addressed the issue of the relationship between hostility and cognitive complexity. Their research is located at the intersection of conflictology, political science and psychology. One of the central problems of this research line is the problem of the role of "integrative complexity" in international conflict processes (Suedfeld, Tetlock & Ramirez, 1977). The concept of integrative complexity is a development of the concept of cognitive complexity-simplicity (Biery, 1955, Scott, 1962). The main difference between the concept of integrative complexity and the original concept[1] of cognitive complexity is that in addition to the differentiation of information, perspectives, or dimensions that are processed in relation to a concrete problem (differentiation), integrative

[1] There are many approaches that are quite synonymous with each other within the study of complexity as a psychological phenomenon: cognitive complexity, integrative complexity, conceptual complexity, etc. (Modrick, 1992).

complexity also includes the perception and understanding of connections between divergent dimensions (integration) (Békés & Suedfeld, 2020). Interesting results have been obtained about the relationship between integrative complexity and the situation of armed conflict. In the study of the political rhetoric of the Soviet Union and the US (1945–1983), it was found that the integrative complexity of foreign policy statements from officials decreased significantly in the situation of the outbreak of war (Tetlock, 1985, 1988). In particular, integrative complexity might be a significant predictor of military or peaceful outcomes of international crises (Conway III, Suedfeld & Tetlock, 2001).

Research on the need for cognitive closure is also an area on the intersection of hostility and cognitive complexity. The need for cognitive closure appears when there is an increased need for simple answers that can reduce uncertainty (Kruglanski & Fishman, 2009). There is evidence that in post-war periods, the need for cognitive closure often escalates authoritarian and extremist attitudes (Nestik, 2023). In other words, cognitively simple answers to cognitively simple questions lead to increased political and national hostility.

Before describing the methods, we will define hostility and cognitive complexity. Hostility is understood as a stable complex system of worldviews, which manifests itself in the overwhelming evaluation of the external world and surrounding people as posing a danger to the subject. Due to the stability of this system, it can be operationalised in the study as trait hostility (Enikolopov & Chudova, 2017).

In turn, we define cognitive complexity through the conception of integrative complexity as a stable pattern of information processing that includes two aspects: differentiation and integration. Differentiation refers to the breadth of perceptions of different dimensions and perspectives when considering a problem. Integration refers to the ability to create a holistic image from these dimensions and perspectives (Békés & Suedfeld, 2020).

The idea for this paper was born from the suggestion that hostility should be negatively correlated with cognitive complexity because hostility (and related cognitive biases) should construct a simple black-and-white reality. The main research question was formulated as follows: "Is there a relationship between hostility and cognitive complexity?"

We also thought about possible mediators of the relationship between hostility and cognitive complexity, although it was not possible to implement a mediator analysis in this study. The role of gender in the manifestation of hostility is a debatable issue. Early studies noted that there are no differences in hostility between men and women (Enikolopov & Tsibulsky, 2007, Moreno et al., 1994). However, modern systematic reviews do not give such an unambiguous answer. In a number of studies, differences are still found, and both in the direction of greater hostility of men and women.

In some studies, it is noted that hostility begins to "control" social-perceptual processes more strongly during the course of life experience and adulthood. In the same study, adults found a link between hostility and failures in information processing and perception of the world as uncertain and complex, while no such link was observed in young people (Enikolopov & Chudova, 2017).

In the context of social information processing concepts (N. Crick, K. Dodge, D. Smeijers, etc.), these findings are quite logical, since the source of hostility is a "database" that includes accumulated experience, gender socialisation, etc.

To our surprise, we found no studies of the correlation between hostility and cognitive complexity in our initial search. Because of that the decision was made to use meta-analysis to locate studies and determine the generalised strength of the relationship between these two variables.

Methods

Study Selection

The aim of the study was to include empirical research of the relationship between cognitive complexity and hostility conducted from 1950[2] to 2024.

Overall, three databases were used to search for papers: Google Scholar, ScienceDirect, and PubMed. The search was iterative, using the keywords denoting hostility ("trait hostility", "hostil*", "hostility", "hostile", and "враждебность") and cognitive complexity ("cognitive complexity", "cognitive complexity-simplicity", "cognitive simplicity", "cognitive simplicity-complexity", "integrative complexity", "conceptual complexity", "когнитивная сложность", "когнитивная простота-сложность",

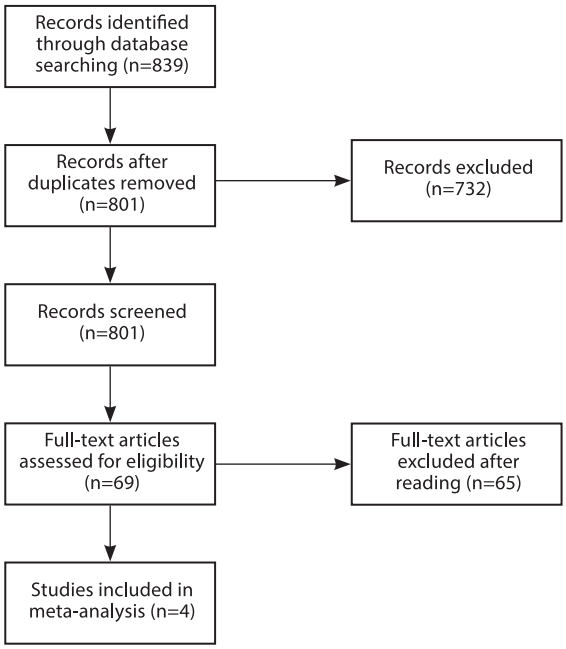

Figure 1. Flowchart of the meta-analysis study selection process

[2] This limit was set according to the bibliographical data: Ermakov, P. N., Abakumova, I. V., Fedotova, O., & Shchetinina, D. P. (2016). Hostility as a Psychological Phenomenon and Object of Scientific Research. *International Journal of Environmental and Science Education*, *11*(18), 10829–10837.

"когнитивная сложность-простота", "когнитивная простота", "концептуальная сложность", and "интегративная сложность"). Keywords and databases were selected by authors. The total number of papers screened was 839. The criteria for initial screening of papers were as follows: relevance to the research questions, non-clinical status of participants, method of measuring effect size (correlation), publication in English or Russian languages, and absence of a paywall.

Figure 1 shows the study selection process (Mohrer et al., 2009).

The following items were prescribed for the included studies: authors, year of publication, way of operationalisation of hostility, hostility measure, way of operationalisation of cognitive complexity, cognitive complexity measure, raw effect size (correlation coefficient), corrected effect size, mean age, of the sample, gender of participants.

Four papers including a total of five effect sizes were selected for a detailed examination of subsequent inclusion in the meta-analysis.

Table 1

Characteristics of studies included in meta-analysis

Authors	Hostility (Measure)	Cognitive Complexity (Measure)	Raw effect size	N	Mean age	Sex
Bruch, McCann & Harvey, 1999	Type A Behaviour (JAS)	Cognitive Differentiation (Listing and Comparing of Attributes)	–.28	67	19	Males only
Bruch, McCann & Harvey, 1999	Type A Behaviour (JAS)	Cognitive Integration (Paragraph Completion Method)	–.49	67	19	Males only
Malesza & Kaczmarek, 2018	Vulnerable Narc. (HSNS)	Cognitive Complexity (reversed scale) (BIS-11)	–.24	337	23.1	Both
Sillars & Parry, 1982	Other-directed attributions of blame (16 roommate grievances questionnaire)	Communicative Complexity (Paragraph Completion Method)	–.17 (ns)	78	19	Both
Kapitány-Fövény et al., 2020	Hostility (BSI)	Cognitive Impulsivity (BIS-11_Hungarian)	–.06 (ns)	2632	40.3	Both

Note. ns = non-significant

Statistical Analyses

Calculating Effect Sizes

All raw effect sizes were Z-transformed (Rosenthal, 1991).

Meta-analytic integration

A three-level random-effects model (Harrer et al., 2021) was used to elucidate an association between hostility and cognitive complexity. This model was chosen because two of the five available effect sizes were extracted from the one paper. The classic meta-analytic random-effects model builds on the logic of the existence of two error levels of the true effect size. The first level of error, or "participant level", reflects a sampling error or a deviation from the true effect size due to the data being collected in a single study. The second level of error, or "study level", reflects heterogeneity between the studies included in the meta-analysis.

For a classic meta-analysis, an important assumption is that studies are fundamentally independent from each other. If several effect sizes were extracted from a single study, this could distort the real level of heterogeneity of studies. However, this problem is solved in three-level models. The third level of error, or "cluster level" (which can be either individual studies or subsets of studies), reflects heterogeneity between clusters.

Thus, in our study we used three-level random-effects model due to: 1) the expected heterogeneity associated with different operationalisation of the cognitive complexity and hostility; 2) two effect sizes were extracted from the same study. The method we used to estimate the between-study heterogeneity is multilevel version of I^2 (Cheung, 2014).

Analysis of moderators

Sex, age and way of operationalisation of hostility and cognitive complexity were chosen initially as moderators, but due to the limited number of included papers, it was decided to drop the moderator analysis due to inability to conduct a moderation analysis because of the small number of effect sizes.

Publication bias analysis

The p-curve (Simonsohn, Nelson & Simmons, 2014) and p-uniform (van Aert & van Assen, 2018; van Aert, Wicherts & van Assen, 2016) methods were used to test for publication bias. The p-uniform* is a more accurate modification of p-uniform because it incorporates insignificant effect sizes in the calculations. In addition, p-uniform* does not overestimate the effect size.

Software for data analysis

The R programming language and RStudio environment with metafor, meta, dmetar, and puniform packages were used for statistical data processing.

Results

A total of 5 effect sizes were included in the meta-analysis derived from a pooled sample of 3114 participants, and 84.5% was a sample of one of the four papers.

Three-level meta-analysis

Due to the severe external heterogeneity of the data (almost the whole study is unique in the methods used and operationalisation of the constructs), the usage of multivariate meta-analytic models seemed to be adequate.

Table 2

Distributions of studies by clusters, effect sizes and their variance

Number of cluster	Study	Effect size (Zrs)	Variance of Zrs
1	Bruch, McCann & Harvey, 1999	–.29	.015
1	Bruch, McCann & Harvey, 1999	–.54	.014
2	Malesza & Kaczmarek, 2018	–.24	.002
3	Sillars & Parry, 1982	–.17	.013
4	Kapitány-Fövény et al., 2020	–.06	.0004

As can be seen in the table, the first and second effect sizes were distributed in one cluster.

Table 3

Results of evaluation of the components of the variance of the true effect

τ^2	Est.	Number of groups on level
$\tau^2_{\text{level 3}}$	.0133	4
$\tau^2_{\text{level 2}}$	.0088	5

Figure 2 shows the distribution of explained variance of heterogeneity across levels (Cheung, 2014).

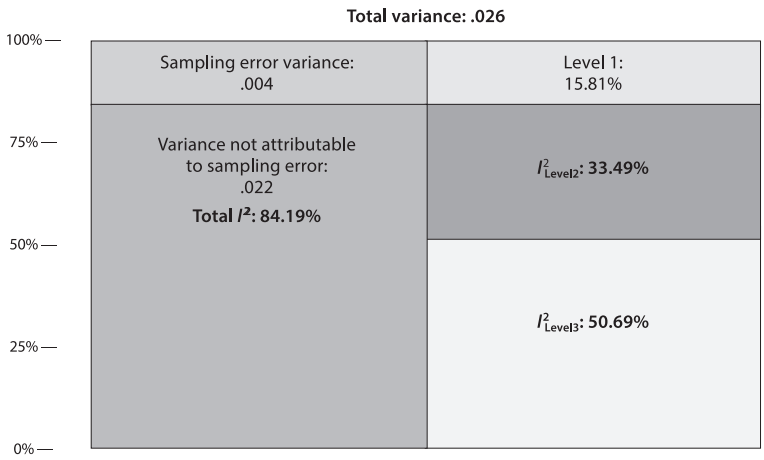

Figure 2. Distribution of the total heterogeneity variance

As can be seen from the figure, half of the heterogeneity is explained by differences between studies and a third of the variance is explained by features within studies.

Table 4 presents the results of the three-level random-effects meta-analysis and the results of the two-level classical random-effects meta-analytic model. *Table 5* presents the results of statistical comparison of these models with each other.

Table 4

Three-level random-effects meta-analysis and two-level random-effects meta-analysis results (k=5)

Type of model	Pooled Zr (pooled r)	ES (k)	Samples	95% CI
Three-level random-effects model	–.22 (–.22)	5	4	[–.45; .003]
Two-level random-effects model	–.24 (–.23)	5	5	[–.45; –.02]

Table 5

Comparison of three- and two-level meta-analysis models

Type of model	df	AIC	BIC	AICc	logLik	χ^2_1	p-value
Three-level random-effects model	3	3.24	1.4	27.24	1.4	.23	.633
Two-level random-effects model	2	1.5	0.24	13.5	1.3		

As can be seen from the comparative analysis data, no statistically significant differences were found between the models.

Publication bias data analysis

Methods based on p-values were used to test for publication bias.

Table 6

P-curve analysis results

Type of test	$p_{binomial}$	Full Curve		Half Curve		Evidential Value		True effect size (Cohen`s d)
		Z_{full}	P_{full}	Z_{half}	P_{half}	present	inadequate	
Right-Skewness test	.062	–4.454	< .001	–3.471	< .001	Yes	No	.402
Flatness test	1	2.733	.997	3.682	> .999	Yes	No	

The p-curve analysis results indicate that the data are generally undistorted. This conclusion is supported by the p-uniform and p-uniform* methods (*Table 7*).

Table 7

P-uniform and p-uniform methods results*

Type of test	Test of no effect	Publication bias test
p-uniform	z = –2.65, p = .004	z = –.836, p = .8
p-uniform*	z = .8, p = .09	–

As can be seen from the table, the two related methods gave slightly different results. In the first case, it can be said that the null hypothesis of no effect (*i.e.*, distortion of any nature) is rejected, but in the second case the situation is the opposite. In this case it makes sense to rely on p-uniform* data as a more accurate method of distortion estimation. Overall, publication bias also was not detected.

Thus, we can conclude that our data are ***statistically*** free from distortions.

Overall effect size

Due to the strong heterogeneity of the studies, it was decided to combine the outcomes of the different effect size estimation methods.

Table 8

Overall effect size according to four different calculation methods

Method of effect size calculation	Effect Size (r) and CI
Three-level random-effects model	–.22 [–.45; .003]
Two-level random-effects model	–.23 [–.45; –.02]
P-uniform* (estimator: ML)	–.143 [–.37; .39]
P-uniform* (estimator: P)	–.196 [–.46; .151]

Overall, it can be said that there is a moderately weak negative correlation between hostility and cognitive complexity.

Discussion

The results of the literature search for inclusion in this meta-analysis characterise not only a particular area of research on the relationship between hostility and cognitive complexity, but also the problem of research on hostility overall. Hostility as an object of psychological research is less popular than anger or aggression, so the difficulties we faced during literature search are legitimate. It can be honestly said that this meta-analysis is heavily cluttered with different ways of operationalising hostility. For example, hostility was operationalised as an independent psychological phenomenon

only in one study[3]. In most studies, however, hostility appears as an important, but far from independent, part of larger constructs such as A-type behaviour, vulnerable narcissism, or the attitude of blaming others for everyday problems. The situation with cognitive complexity is slightly better, but there is also a strong confusion of concepts from integrative to communicative complexity, and ways of operationalisation as some ability that can be assessed externally to self-reported cognitive complexity. Of course, this situation makes it difficult to draw conclusions, although modern statistical methods do produce relatively accurate results despite the strong heterogeneity between studies.

It was not possible to conduct mediator analysis due to the fact that each study was categorised into groups according to their moderator. The multivariate meta-analysis method allows the avoidance of biases caused by dependent outcomes, which in the case of 2 out of 5 effect sizes poses high risks. Although comparative analysis did not show a significant difference between the three-level and two-level models, the 3-level model cannot be rejected due to our empirical knowledge of the relatedness of 40% of the effect sizes.

The p-values analysis showed that our data, at least statistically, did not fall victim to publication bias. These results are convergently confirmed by the two methods. It also confirms our thesis about the unpopularity of the topic of hostility.

Due to the high heterogeneity, we decided to use multiple methods of effect size calculation at once. The results showed that the relationship between hostility and cognitive complexity ranged from –.143 to –.23, indicating a moderately weak negative relationship between the variables.

If we turn to the analysis of confidence intervals (*Table 8*), it can be seen that the effect size obtained from the p-uniform* method using different estimators gives a broad range. Therefore, the results of three-level random-effects meta-analysis seem to be more accurate. Thus, it can be said that the correlation between hostility and cognitive complexity is closer to moderately negative.

It is possible that hostility and cognitive complexity have some reciprocal influence on each other: the lower the cognitive complexity, the greater the hostility, and vice versa. Without speculating in this paper about causal relationships between the variables, let us clarify the thesis which has been stated at the beginning: Hostility is rather complementary to cognitive simplicity as the opposite pole of cognitive complexity, if the function of hostility in ensuring the protection of one's sense of Self is taken into account.

Given that hostility in a certain way constructs a dangerous world image (Enikolopov & Chudova, 2017; Wang & Xia, 2019), this world is simultaneously more comprehensible in the sense that there are one's own and strangers, and it is necessary to always be prepared and to defend oneself. In its turn, cognitive simplicity provides a limited number of categories for assessing the external environment and simplified patterns of information integration due to which a black-and-white world is established. And this black-and-white image of the world is very consonant and complementary to the hostile dangerous image of the world.

[3] To be accurate, hostility in this research (Kapitány-Fövény et al., 2020) was operationalised not as a personality trait, but rather as a particular psychological symptom.

Currently, many questions remain about the nature and presence of this relationship in children, for example the presence or absence of sex differences, the nurture or nature question, and the distinction of cause and effect in this correlation. However, the result obtained appears to be the first attempt to generalise the small amount of scientific knowledge on this topic.

Conclusion

Given the "cognitive" way to the research on hostility is now prevalent in science, the results of our meta-analysis are important in context of future theoretical and empirical developments in the psychology of hostility. Our goals were to summarise the existing literature on the topic of the relationship between hostility and cognitive complexity, and to clarify whether there is a relationship between these two variables. Our results led us to a conclusion that there is a moderately negative correlational relationship between hostility and cognitive complexity ($r = -.22$). The small number of published studies gives freedom for creative search. Therefore it is necessary to continue research in this area to understand the place and role of hostility in the space of human cognition.

Limitations

The main limitation of the study can be considered to be the lack of access to the full texts of the dissertations because there may be data of interest in the context of this problem.

Another limitation is the choice of only two publication languages, as it is possible that there may be published evidence in languages other than Russian or English.

Ethics Statement

The study and consent procedures were approved by the Ethics Committee of the Faculty of Psychology at Lomonosov Moscow State University.

Author Contributions

Both authors conceived the idea of this research. Both authors took part in literature searching. G.D.E. carried out statistical analysis of data. S.N.L. supervised the findings of this work. Both authors discussed the results and contributed to the final manuscript.

Conflict of Interest

The authors declare no conflict of interest.

References

Anderson, C.A., Anderson, K.B., & Deuser, W.E. (1996). Examining an affective aggression framework weapon and temperature effects on aggressive thoughts, affect, and attitudes. *Personality and social psychology Bulletin*, *22*(4), 366–376. https://doi.org/10.1177/0146167296224004

Barefoot, J.C. (1992). Developments in the measurement of hostility. In H.S.Friedman (Ed.), *Hostility, coping, & health* (pp. 13–31). American Psychological Association. https://doi.org/10.1037/10105-001

Békés, V., & Suedfeld, P. (2020). Integrative complexity. In V. Zeigler-Hill, T.K. Shackelford (Eds.) *Encyclopedia of personality and individual differences* (pp. 2280–2283). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-24612-3_1942

Bieri, J. (1955). Cognitive complexity-simplicity and predictive behavior. *The Journal of Abnormal and Social Psychology, 51*(2), 263–268. https://doi.org/10.1037/h0043308

Bruch, M.A., McCann, M., & Harvey, C. (1991). Type A behavior and processing of social conflict information. *Journal of Research in Personality, 25*(4), 434–444. https://doi.org/10.1016/0092-6566(91)90032-L

Buss, A.H. (1961). *The psychology of aggression.* John Wiley & Sons, Inc. https://doi.org/10.1037/11160-000

Cheung, M.W.-L. (2014). Modeling dependent effect sizes with three-level meta-analyses: A structural equation modeling approach. *Psychological Methods, 19*(2), 211–229. https://doi.org/10.1037/a0032968

Conway III, L.G., Suedfeld, P., & Tetlock, P.E. (2001). Integrative complexity and political decisions that lead to war or peace. *Peace, conflict, and violence: Peace psychology for the 21st century*, 66–75. https://hs.umt.edu/politicalcognition/documents/publications/215-ComplexityandWarorPeace.pdf

Crick, N.R., & Dodge, K.A. (1994). A review and reformulation of social information-processing mechanisms in children's social adjustment. *Psychological Bulletin, 115*(1), 74–101. https://doi.org/10.1037/0033-2909.115.1.74

Dodge, K.A., Price, J.M., Bachorowski, J.-A., & Newman, J.P. (1990). Hostile attributional biases in severely aggressive adolescents. *Journal of Abnormal Psychology, 99*(4), 385–392. https://doi.org/10.1037/0021-843X.99.4.385

Enikolopov, S., & Chudova, N. (2017). Problema proiavlenii vrazhdebnoi ustanovki [The problem of hostile attitude]. *Psikhologicheskie issledovaniia* [Psychological Studies], *10*(54). https://doi.org/10.54359/ps.v10i54.360

Enikolopov, S.N., & Tsibulsky, N.P. (2007). Psikhometricheskii analiz russkoiazychnoi versii Oprosnika diagnostiki agressii A. Bassa i M. Perri [Psychometric Analysis of the Russian-Speaking Version of the Aggression Diagnostic Questionnaire by A. Bass and M. Perry]. *Psychologicheskii Zhurnal* [Psychological Journal], 28, 115–124.

Kapitány-Fövény, M., Urbán, R., Varga, G., Potenza, M. N., Griffiths, M. D., Szekely, A., …, & Demetrovics, Z. (2020). The 21-item Barratt Impulsiveness Scale Revised (BIS-R-21): An alternative three-factor model. *Journal of behavioral addictions*, *9*(2), 225–246. https://doi.org/10.1556/2006.2020.00030

Harrer, M., Cuijpers, P., Furukawa, T., & Ebert, D. (2021). *Doing meta-analysis with R: A hands-on guide*. Chapman and Hall/CRC. https://doi.org/10.1201/9781003107347

Higgins, J.P.T., Thomas, J., Chandler, J., Cumpston, M., Li, T., Page, M.J., & Welch, V.A. (Eds.). (2019). *Cochrane handbook for systematic reviews of interventions* (2nd ed.). John Wiley & Sons. https://doi.org/10.1002/9781119536604

Horsley, T.A., de Castro, B.O., & Van der Schoot, M. (2010). In the eye of the beholder: eye-tracking assessment of social information processing in aggressive behavior. *Journal of abnormal child psychology*, *38*(5), 587–599. https://doi.org/10.1007/s10802-009-9361-x

Kruglanski, A.W., & Fishman, S. (2009). The need for cognitive closure. In M.R. Leary & R.H. Hoyle (Eds.), *Handbook of individual differences in social behavior* (pp. 343–353). Guilford Press.

Malesza, M., & Kaczmarek, M.C. (2018). Grandiose narcissism versus vulnerable narcissism and impulsivity. *Personality and Individual Differences, 126,* 61–65. https://doi.org/10.1016/j.paid.2018.01.021

Modrick, J.A. (1992). Review of concepts and approaches to complexity. *Proceedings of the Human Factors Society Annual Meeting*, *36*(15), 1166–1170. https://doi.org/10.1518/107118192786749720

Moher, D., Liberati, A., Tetzlaff, J., Altman, D.G., & PRISMA Group. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *PLoS Medicine*, *6*(7), e1000097. https://doi.org/10.1371/journal.pmed.1000097

Moreno, J.K., Selby, M.J., Fuhriman, A., & Laver, G.D. (1994). Hostility in depression. *Psychological Reports, 75*(3), 1391–1401. https://doi.org/10.2466/pr0.1994.75.3.1391

Nestik, T.A. (2023). Vliianie voennykh konfliktov na psikhologicheskoe sostoianie obshchestva: Perspektivnye napravleniia issledovanii [The influence of military conflicts on the psychological state of society: Promising areas of research]. *Sotsial'naya psikhologiya i obshchestvo* [Social Psychology and Society], *14*(4), 5–22. https://doi.org/10.17759/sps.2023140401

Scott, W.A. (1962). Cognitive complexity and cognitive flexibility. *Sociometry, 25*(4), 405–414. https://doi.org/10.2307/2785779

Sillars, A., & Parry, D. (1982). Stress, cognition, and communication in interpersonal conflicts. *Communication Research, 9*(2), 201–226. https://doi.org/10.1177/009365082009002002

Simonsohn, U., Nelson, L.D., & Simmons, J.P. (2014). P-curve: a key to the file-drawer. *Journal of experimental psychology. General*, *143*(2), 534–547. https://doi.org/10.1037/a0033242

Smeijers, D., Bulten, E.B.H., & Brazil, I.A. (2019). The Computations of hostile biases (CHB) model: Grounding hostility biases in a unified cognitive framework. *Clinical psychology review*, *73*, 101775. https://doi.org/10.1016/j.cpr.2019.101775

Smith, T.W. (1992). Hostility and health: Current status of a psychosomatic hypothesis. *Health Psychology, 11*(3), 139–150. https://doi.org/10.1037/0278-6133.11.3.139

Suedfeld P., Tetlock P.E., Ramirez C. (1977). War, peace, and integrative complexity: UN speeches on the Middle East problem, 1947–1976. *Journal of Conflict Resolution*, 21(3), 427–442. https://doi.org/10.1177/002200277702100303

Tetlock, P.E. (1988). Monitoring the integrative complexity of American and Soviet policy rhetoric: What can be learned? *Journal of Social Issues, 44*(2), 101–131. https://doi.org/10.1111/j.1540-4560.1988.tb02065.x

van Aert, R.C., & van Assen, M.A. (2018). *Correcting for publication bias in a meta-analysis with the p-uniform* method.* MetaArXiv. https://doi.org/10.31222/osf.io/zqjr9

van Aert, R.C., Wicherts, J.M., & van Assen, M.A. (2016). Conducting Meta-Analyses Based on p Values: Reservations and Recommendations for Applying p-Uniform and p-Curve. *Perspectives on psychological science: a journal of the Association for Psychological Science*, *11*(5), 713–729. https://doi.org/10.1177/1745691616650874

Wang, Y.J., & Xia, L.X. (2019). The longitudinal relationships of interpersonal openness trait, hostility, and hostile attribution bias. *Aggressive behavior*, *45*(6), 682–690. https://doi.org/10.1002/ab.21862

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