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Research Article

Psychological Immune Competence as a Mediator Between Perceived Stress and Mood: A Pandemic Perspective

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ABSTRACT

This research examined the effects of perceived stress on general mood mediated by psychological immune competence during the COVID-19 pandemic. In a sample of 581 participants from Serbia (75.7% female), an instrument set was applied comprising the Psychological Immune Competence Inventory (PICI), the Brief Mood Introspection Scale (BMIS), and the Perceived Stress Scale (PSS-10). The results of the mediation analysis revealed that the relationship between perceived stress and general mood was significantly shaped by emotion control and social mobilizing capacity as aspects of psychological immune competence. These aspects had a protective role in general mood, with the perceived stress level compromising the role of emotion control but supporting the role of social mobilizing capacity. The obtained findings can aid the development of psychological interventions aimed at enhancing psychological immune competence and, consequently, improving mental health and building the capacity for more functional coping in crisis situations.

Keywords: perceived stress, psychological immune competence, mood, COVID-19 pandemic

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Introduction

The initial waves of the COVID-19 pandemic constituted a global public health disaster and a constant threat to people's health and lives. As a response to the pandemic, the Government of the Republic of Serbia declared a state of emergency on March 15, 2020, and introduced a movement ban three days later. Although adherence to certain protective measures was still officially required, the state of emergency ended on May 6. At the height of the pandemic, people's everyday lives changed drastically: movement bans of varying severity were introduced (e.g., in Serbia, senior citizens were only allowed to leave their homes between the early morning hours of four and seven), schools and universities moved to online learning, safety concerns caused a major shift to remote work, etc. (Agbaria & Mokh, 2022; Park et al., 2021).

Mental Health Consequences of Pandemic Stress

The rapid spread of the virus and the growing number of victims understandably caused global medical concern. Thus far, the numerous studies that have researched the mental health state of the world population have primarily focused on the first several months of the pandemic (Aknin et al., 2022). Although certain countries including the Czech Republic, the USA, and Great Britain initially observed slightly disquieting tendencies in the form of a higher general level of distress and even an increased prevalence of certain mental disorders (Daly et al., 2020; McGinty et al., 2020; Winkler et al., 2021), other countries such as Brazil, Norway, and the Netherlands did not register a significant deterioration of mental health compared to the pre-pandemic period (Brunoni et al., 2021; Knudsen et al., 2021; van der Velden, 2020). The results of a nationally representative study conducted in Serbia did not show an increase in the prevalence of psychopathological disorders, and the observed indicators of depression and anxiety did not reach clinical significance (Marić et al., 2022). Recent longitudinal research has shown that even in countries in which various indicators of compromised mental health were documented at the very beginning of the pandemic, most of the indicators reverted to pre-pandemic levels by mid-2020 (Aknin et al., 2022; Daly & Robinson, 2021; Fancourt et al., 2020).

Apart from focusing on topics highlighting difficulties in psychological functioning during the pandemic, a contribution to understanding the global population's mental health in the context of the COVID-19 crisis has also been made from the perspective of positive psychology. Subjective well-being, most broadly defined as a cognitive and affective evaluation of the quality of life (Diener, 2000), has figured as the main variable of interest in numerous studies on the effect of the pandemic, both in the sense of an evaluation of life satisfaction (the cognitive component) and in the sense of experiencing pleasant and unpleasant emotions and moods (the affective component). The first wave of research on adverse emotional responses to the wide range of pandemic-related stressors predicted an intensification of short-term and long-term emotional reactions, including heightened fear, anxiety, irritability, anger, exhaustion, negative mood, and loneliness (Agbaria & Mokh, 2022; Marić et al., 2021). However, comprehensive systematic analyses of subjective well-being in the pandemic context have highlighted striking incompatibilities between study conclusions. Namely, while the World Happiness Report emphasized the pandemic's toll on negative emotions in the form of significantly higher frequency of negative emotions among the world's population (Helliwell et al., 2021), meta-analyses of longitudinal research have revealed a negligible effect of the pandemic and associated quarantine measures on negative affect and positive psychological functioning (Prati & Mancini, 2021). The results of certain studies conducted in Serbia also suggested that the initial intensification off negative affect in the first wave of the pandemic was followed by a return to previous, baseline values (Barzut et al., 2023; Sadiković et al., 2020).

Stress-Coping Resources – Psychological Immune System

Stress-coping resources refer to intrapsychic, social, and material capital for achieving healthy adaptation even when the perceived stress levels are significantly heightened, that is, when people appraise their life circumstances as unpredictable, uncontrollable, and overloaded (Agbaria & Mokh, 2022; Cohen & Williamson, 1988). The contemporary health psychology expert, Attila Oláh (2005), defined the psychological immune system as a set of personality traits, abilities, and skills that are grouped into cognitive, emotional, behavioral, and environmental dimensions that have the protective function of integrated stress-coping resources (Al-Hamdan et

al., 2021; Móró et al., 2011; Nagy & Nagy, 2016; Oláh, 2005; Takács et al., 2021).

Oláh's complex, multilayered model of the psychological immune system integrates as many as 16 stress-coping resources, several of which were selected for examination in the present research due to their potential to constitute relevant psychic antibodies in coping with pandemic conditions. *Positive Thinking* describes optimistic, success-oriented individuals who expect desirable stress process outcomes even under unfavorable circumstances (Oláh, 2005). Multiple studies have documented optimists' tendency to view different stressors as challenges and not threats, along with their tendency to exhibit fewer signs of distress and generally higher degrees of satisfaction and happiness (Carver et al., 2010; Snyder & Mann Pulvers, 2001).

Sense of Control denotes individuals' tendency to primarily rely on their own skills and abilities in the coping process due to the belief that different life circumstances predominantly depend on them, which further implies that such individuals have a pronounced internal locus of control (Genc, 2021). Empirical research has consistently reported on internals' tendency to interpret stressors more benignly and prevent illness more successfully (Thompson, 2005).

Change and Challenge Orientation pertains to curiosity and enjoyment in unexpected events. This concept describes individuals who commonly interpret unpleasant situations as challenges, readily choose active coping strategies, and perceive every stress process outcome as a precious benefit to be added to their arsenal of useful life experiences (Oláh, 2005).

Persons with highly developed *Self-Efficacy* deeply believe in their possession of the abilities necessary to achieve the set goals. They successfully choose and implement adequate coping strategies (Genc, 2021). Relevant research has shown that the frequency of experiencing positive and negative moods depends on the degree of Self-Efficacy (Joie-La Marle et al., 2021).

Social Mobilizing Capacity describes individuals who are open to interpersonal contact, possess highly developed communication skills, and show satisfaction with their social network (Jaiswal et al., 2020). These qualities contribute to the tendency to rely on the strengths of others in

stressful situations, that is, successfully use social support as an external stress-coping resource and a form of interpersonal capital (Kaur & Som, 2020). Findings suggest that adequately provided and received social support has significant psychological and health benefits, including more common and intense pleasant emotions, more effective coping with a wide range of stressors, and a lower overall distress level (Batenburg & Das, 2014; Bodie et al., 2011).

Emotion Control refers to the ability to regulate unpleasant emotions. Persons in whom this psychological immune system component is underdeveloped often experience more unpleasant emotions. For instance, they can be more prone to feeling worried, anxious, irritable, and upset. It appears that their tendency to frequently experience such affective states becomes particularly conspicuous in tense and potentially threatening situations, and a pandemic certainly encompasses an entire array of threatening stressors (Oláh, 2005).

The results of several empirical studies obtained thus far seem promising, indicating that high psychological immune competence significantly positively correlates with subjective well-being dimensions such as life satisfaction, purpose in life, and personal growth (Gombor, 2009; Hullám et al., 2006; Jaiswal et al., 2020; Kaur & Som, 2020; Oláh et al., 2010; Shapan & Ahmed, 2020; Voitkáné, 2004). To the best of our knowledge, the components of the psychological immune system have not been empirically researched in relation to positive and negative moods as potential indicators of subjective well-being. Thus, the present research addressed the question of whether previously described psychic antibodies mediate the relationship between perceived stress and general mood as indicators of the affective component of subjective well-being in the context of pandemic stress.

Method

Sample and Procedure

The sample comprised 581 respondents (75.7% female) from Serbia aged between 19 and 75 years, with an average age of 38.74 years (*SD* = 10.48). Most respondents lived with someone in the household at the time of the pandemic (83.7%) and more than half of them (53.6%) knew someone

with a coronavirus infection. All respondents participated voluntarily and anonymously and provided informed consent in compliance with the ethical guidelines for psychological research. Using Google Forms, the data were gathered online during April and May 2020 as part of a larger study. Each participant spent roughly 30 minutes filling out the questionnaires. The research has been approved by the Institutional Ethics Committee (http://psihologija.ff.uns.ac.rs/etika/?odobreno=202004161954_RNmE).

Instruments

Perceived Stress Scale (PSS-10)

The PSS-10 (Cohen & Williamson, 1988) is a 10-item self-report scale measuring the perception of unpredictable and uncontrollable stressful life events. Responses are provided on a Likert-type scale ranging from 0 (*never*) to 4 (*very often*). The sum of the 10 items can be used to determine the overall perceived stress score (for details, v. Cohen & Williamson, 1988). We modified the response instructions to limit the perceived stress evaluation to the period of the COVID-19 pandemic (e.g., *How often have you been nervous and stressed since the start of the pandemic?*). The measure's overall reliability was .83.

Brief Mood Introspection Scale (BMIS)

The BMIS scale (Mayer & Gaschke, 1988) is an open-source mood scale comprising 16 mood-adjectives. The scale can yield measures of overall pleasant-unpleasant mood and arousal-calm mood. It can also be scored according to positive-tired and negative-calm mood. Responses are provided on a Likert-type scale ranging from 1 (*definitely do not feel*) to 4 (*definitely feel*). In this research, we used the inverse scale scoring to obtain the overall pleasant-unpleasant mood, with a higher total score indicating a higher level of pleasantness. We also modified the instructions to address the COVID-19 pandemic *(Circle the response on the scale that indicates how well each adjective – tired, sad, lively, happy, etc. describes your mood during the pandemic.)*. Namely, in the present research, the frequency of different moods was assessed over a longer time period (from the state of emergency declaration until the time of the research), which provided insights into the

affective component of respondents' subjective well-being (Diener et al., 1999). The overall reliability of the BMIS was .86.

Psychological Immune Competence Inventory (PICI)

The PICI (Oláh, 2005) measures the level of psychological immune competence using 80 items. We selected 30 items measuring six subscales of this inventory. Positive Thinking (e.g., *I enjoy thinking about the future*; α = .79) refers to the tendency to expect a positive or favorable outcome even in the most difficult stressful conditions. Change and Challenge Orientation (e.g., *I'm mostly looking for new challenges*; α = .83) is described as sensitivity to novelty and immediate enjoyment of the moment. Emotion Control (e.g., reverse *I get easily annoyed when I make a mistake*; α = .77) pertains to the ability to regulate unpleasant emotions. Social Mobilizing Capacity (e.g., *Among the people I know, there are many who I can certainly rely on*; α = .79) involves managing other people and getting appropriate support from others. Self-Efficacy (e.g., *I successfully achieve the goals I set for myself*; α = .70) refers to one's belief in being able to successfully perform all actions necessary to achieve a goal. Finally, Sense of Control (e.g., *In my experience, success is the result of good planning*; α = .61) refers to people's belief that they can influence the events in their lives. Responses are provided on a Likert-type scale ranging from 1 (*completely disagree*) to 4 (*completely agree*).

Results

Descriptive Statistics and Correlations Between Measures

The most pronounced dimension of psychological immune competence was Positive Thinking, followed by Social Mobilizing Capacity (Table 1). On the other hand, Emotion Control and Self-Efficacy were the least pronounced dimensions. All the PICI dimensions, as well as the general PICI measure, were significantly more expressed compared to the assumed theoretical values, as indicated by the one-sample t-test. The same applies to perceived stress and general mood. All measures were normally distributed, according to the guidelines proposed by Tabachnick & Fidell (2021).

Table 1

Descriptive Statistics of Perceived Stress, General Mood, and Psychological Immune Competence Dimensions

	M	*SD*	*Skewness*	*Kurtosis*	Min	Max	*t*
Perceived Stress	2.13	0.44	-0.15	1.46	0.00	3.70	7.26**
General Mood	2.60	0.29	-0.09	1.26	1.56	3.94	7.99**
Positive Thinking	3.17	0.58	-0.81	0.63	1.20	4.00	27.83**
Change and Challenge Orientation	2.84	0.53	-0.44	0.57	1.00	4.00	15.32**
Emotion Control	2.59	0.50	-0.14	-0.31	1.20	4.00	4.44**
Social Mobilizing Capacity	3.04	0.62	-0.51	0.01	1.20	4.00	21.16**
Self-Efficacy	2.77	0.38	-0.37	0.53	1.20	4.00	17.26**
Sense of Control	2.97	0.46	-0.52	1.09	1.00	4.00	24.34**
PICI Total Score	2.90	0.34	-0.42	0.60	1.70	3.77	28.77**

Note. t – t-test value; ** $p < .01$.

Correlations between general mood and all dimensions of psychological immune competence were significant and positive (Table 2). Conversely, perceived stress showed significant and positive relations with Social Mobilizing Capacity and Sense of Control, but it correlated negatively with Emotion Control. The intercorrelation between perceived stress and general mood was also significant and negative. The general PICI measure did not significantly correlate with either general mood (r = 0.01, p = .76) or perceived stress (r = -0.01, p = .88).

Table 2

Correlations Between Perceived Stress, General Mood, and Psychological Immune Competence

	1	2	3	4	5	6	7
(1) Perceived Stress	-						
(2) General Mood	-.27**	-					
(3) Positive Thinking	.01	.52**	-				
(4) Change and Challenge Orientation	.03	.33**	.55**	-			
(5) Emotion Control	-.30**	.46**	.29**	.12**	-		
(6) Social Mobilizing Capacity	.12**	.28**	.44**	.35**	.07	-	
(7) Self-Efficacy	-.04	.35**	.45**	.40**	.20**	.30**	-
(8) Sense of Control	.12**	.21**	.34**	.40**	-.01	.33**	.39**

Note. ** $p < .01$.

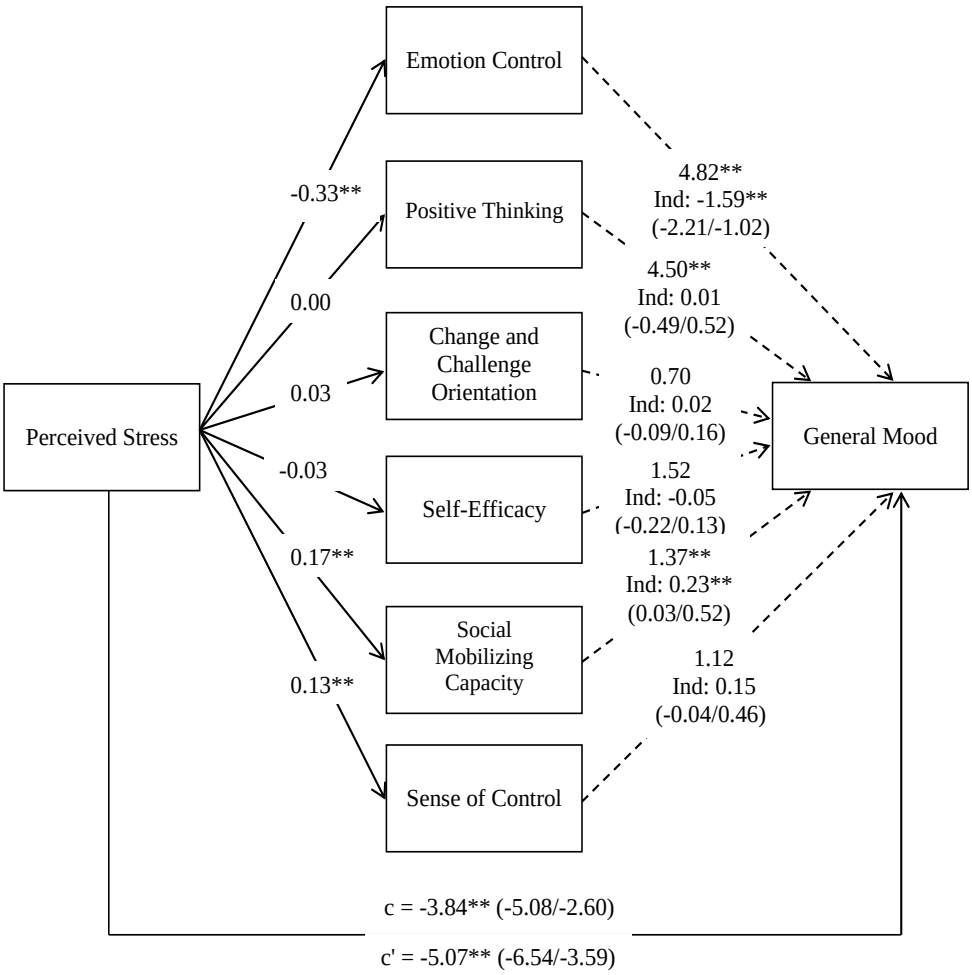
Psychological Immune Competence as a Mediator in the Relation Between Perceived Stress and General Mood

The data were analyzed using the PROCESS macro for SPSS (Hayes, 2017), which serves to determine multiple simultaneous mediations between variables. This method allows for (1) an analysis of the total indirect effect – the joint effect of all mediation variables included in the research, and (2) an analysis of specific indirect effects, the effect of each mediator separately. More precisely, this method enables the examination of the total effect of the predictor variable on the criterion variable (c'), the direct effect of the predictor variable on the criterion variable when controlling for mediators (c), and the indirect effect, that is, the individual effect of each mediator (ab). In addition to the simultaneous inclusion of a larger number of mediators in the analysis, this procedure also covers the bootstrapping method for calculating the confidence interval of the indirect effect. The lower confidence interval coefficient (LLCI) represents the lowest value of the indirect effect (ab), and the upper confidence interval coefficient (ULCI) represents the highest value. To detect a significant mediation effect, the

condition of significant relations between the predictor and the mediator (a) as well as the mediator and the criterion (b) must be satisfied. Likewise, the LLCI-ULCI range should not contain zero value. The results of the multiple mediation analysis are presented in Figure 1.

Figure 1

Multiple Mediation Analysis Results with General Mood as the Dependent Variable



Note. c – direct effect; c' – total effect; Ind – indirect effect; LLCI and ULCI are presented in parenthesis. ** $p < .01$.

Emotion Control and Social Mobilizing Capacity emerged as significant PICI mediators. Perceived stress reduced Emotion Control but increased Social Mobilizing Capacity. On the other hand, the general mood was positively affected by Emotion Control and Social Mobilizing Capacity and negatively affected by perceived stress. Therefore, both PICI scales had a protective role in the relationship between perceived stress and general mood, with perceived stress compromising the role of Emotion Control and facilitating the role of Social Mobilizing Capacity. Perceived stress did not significantly correlate with the general PICI measure, β = .01, *SE* = .03, *t* = -0.15, *p* = .79, 95% CI [−0.07, 0.06]; and the general PICI measure did not have a significant mediator role in the relation between perceived stress and general mood, β = .00, 95% CI [−0.07, 0.06].

Discussion

Relations Between Perceived Pandemic Stress and General Mood

The evaluation of the stressogenicity of life circumstances during the first wave of the COVID-19 pandemic correlated negatively with general mood during the state of emergency in Serbia. This relationship between the variables was observed both at the bivariate correlation level and the level of direct predictor effect on the criterion, controlling for mediators. The established relationships between perceived stress and the affective component of subjective well-being can be explained via the concept of subjective evaluation of stressful events, which constitutes the cornerstone of the transactional stress model (Lazarus & Folkman, 2004). Namely, the theoretical foundation for the construction of the PSS-10 (Cohen & Williamson, 1988) lies in the transactional belief that stress constitutes individuals' assessment that an aspect of their surroundings is threatening or otherwise challenging and that their coping resources are insufficient under such circumstances (Lazarus & Folkman, 2004). The PSS-10 encompasses both the evaluation of the severity of the stressful situation (primary cognitive appraisal) and the assessment of the available stress-coping resources (secondary cognitive appraisal) (Cohen et al., 1983). Hence, the obtained results on the negative association between perceived stress and general mood align with studies in which evaluating pandemic circumstances as highly threatening correlated with lower positive and higher negative affect,

while evaluating personal control of events as high correlated with higher positive and lower negative affect in the context of the pandemic (Zacher & Rudolf, 2021). Similarly, in studies exploring cognitive appraisals and psychological distress in the context of the H1N1 pandemic in 2009, higher appraisals of the threat and uncontrollability of the pandemic circumstances led to an increase in anxiety levels (Taha et al., 2014).

However, the mean values showed that general mood was significantly more pleasant compared to the assumed arithmetic mean, indicating that in the weeks leading up to the end of the state of emergency in Serbia, respondents predominantly experienced pleasant moods. This finding is supported by studies reporting that after the initial, pandemic-induced deterioration in the affective component of subjective well-being, in most cases, a return to emotional functioning within baseline subjective well-being occurred by mid-2020 (Ebert et al., 2020; Hagen et al., 2022; Sadiković et al., 2020; Zacher & Rudolph, 2024). Such findings align with the empirically validated assumptions of set-point theory (Cummins & Wooden, 2014) and can be explained by a genetically predetermined set-point of subjective well-being, which is constantly temporarily disturbed and reestablished according to the principle of homeostasis (Bonanno, 2004; Diener et al., 2006). Namely, the aforementioned studies registered a specific recovery pattern during the first wave of the pandemic, within which the initial intensification of negative affect was followed by a gradual decrease in the level of negative emotions and a return to their previous, baseline values, which is a regularity observed even in situations involving significant losses and traumas (Bonnano, 2004). It is entirely possible that the present research, since conducted in the final weeks of the state of emergency, captured a resetting of people's set-point in general mood and a return to the baseline, reflected in the predominant saturation of general mood with a sense of pleasantness.

Mediating Effects of Psychological Immune System Components

Having in mind the colossal scale of the pandemic crisis, evaluations recognizing the pandemic circumstances as highly demanding conditions of low controllability affected general mood via Social Mobilizing Capacity, which constitutes a psychological immune system component

encompassing the ability to establish/deepen relationships with others, successfully use social support as an external stress-coping resource, and leverage interpersonal capital (Kaur & Som, 2020). The discussion of these findings can be taken in at least three directions. Namely, the finding that the perception of pandemic stress intensified Social Mobilizing Capacity and consequently contributed to a more pleasant mood can be most closely linked to the concept of social capital, which is defined as the tendency to establish relationships of trust, solidarity, and reciprocity with members of the social community (Putnam, 2000). A significant number of studies have identified social capital as a crucial resource for overcoming crisis situations as it contributes to a wider and more rapid spread of information within a given community, helping members stay informed about new knowledge, procedures, and threats related to crisis events (Aldrich, 2010). It can further reinforce informal support among community members (Hurlbert et al., 2000) and contribute to a higher level of social responsibility (e.g., in the form of adhering to pandemic prevention measures; Barrios et al., 2021; Ding et al., 2020). Another line of research on interpersonal relations during the pandemic has generated consistent findings on increased social cohesion among community members (Courtet et al., 2020; Tull et al., 2020), with people bridging the social distance by using diverse digital modes of communication (Richter, 2020), which could undoubtedly contribute to stabilizing general mood. Finally, research on the mechanism of homeostasis in the domain of subjective well-being has emphasized the crucial significance of social support as an external attenuator of the effects of negative life events on experiencing positive emotions (Diener & Oishi, 2005), with social resources having a protective role in relation to affective well-being only when the individual is exposed to prominent stressors (Kuhn & Brulé, 2019).The power of the psychological immune system component – Emotion Control – has been shown to decrease with an increasing level of perceived stress, which consequently contributes to more pronounced unpleasant moods. The negative effect of stress on Emotion Control could be explained by the fact that the beginning of the pandemic generated a higher level of distress (Daly & Robinson, 2021), which negatively affected emotion regulation abilities. However, in the final weeks of the state of emergency in Serbia, Emotion Control emerged as a prominent protective factor in relation to general mood, which corresponds to the consistently

replicated finding that adaptation to major stressors is characterized by a specific resilience trajectory that involves a gradual shift from initial distress towards baseline psychological functioning (Hobfoll et al., 2009). These observations are supported by findings indicating that in countries where different indicators of heightened distress were documented at the very beginning of the pandemic, most of the indicators reverted to pre-pandemic levels by mid-2020 (Aknin et al., 2022; Daly & Robinson, 2021; Fancourt et al., 2020). On the other hand, effective Emotion Control positively affected general mood, suggesting that a greater capacity to recover from intense negative emotions, such as feeling worried, anxious, irritable, and upset, contributes to a more conspicuously pleasant general mood. This result aligns with findings indicating that emotion regulation in the form of modifying the intensity and valence of emotional reactions to stress significantly correlates with subjective well-being (Schelhorn et al., 2022).

Conclusion

The main contribution of the present research lies in a more thorough understanding of the mechanism underlying the effect of pandemic stress on affective well-being, along with insights into the mediating role of stress-coping resources from the perspective of a lesser-known theoretical model. Out of the six examined components of the psychological immune system, only two emerged as relevant psychic antibodies in coping with pandemic conditions. Namely, unlike Positive Thinking, Change and Challenge Orientation, Self-Efficacy, and Sense of Control, which are primarily cognitive dimensions, Social Mobilizing Capacity and Emotion Control constitute predominantly emotional aspects of the shield protecting a person's psychic apparatus. Due to the striking differences in the protective potential of various dimensions of psychological immune competence in relation to the abovementioned criterion, the obtained results bring into question the sustainability of Oláh's conception of the dimensions of psychological immune competence as integrated stress-coping resources. Hence, future research should further examine the attenuating effects of diverse components of psychological immune competence to illuminate the validity of their systemic conception.

Regardless of the necessity for further validating the concept of psychological immune competence, the obtained results have significant practical implications for enhancing psychological immunity by raising laypeople's awareness of the importance of social support and social cohesion in crisis situations and implementing psychological interventions aimed at improving the capacity to regulate unpleasant emotions when confronted with prominent stressors undermining affective well-being. Still, the present research is not devoid of methodological limitations, which are reflected in at least two aspects. Firstly, the research employed only one measure of general mood. Hence, caution is required when interpreting the obtained general mood level upon return to emotional functioning within baseline subjective well-being. Namely, in the absence of data on the pre-pandemic general mood level and multiple measurements of this construct in the first wave of the pandemic, it is impossible to confidently assert the existence of a specific recovery pattern based on the principle of homeostasis. The second methodological limitation lies in the inability to clearly differentiate between pandemic-induced stress and the stress caused by strict quarantine measures, which leaves open the question of the primary basis of respondents' perceptions of stress in the context of the pandemic.

Conflict of interest

We have no conflicts of interest to disclose.

Data availability statement

Data used in this paper are available upon a reasonable request.

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Research Article

The Mediating Role of Resilience in The Relationship between Game Addiction and Sleep Disorders in College Students

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ABSTRACT

Gaming addiction has attracted the attention of researchers and clinicians as a current and growing problem. Increased gaming addiction can lead to problems such as sleep disorders. The present study aimed to examine the mediating effect of resilience on the relationship between game addiction and sleep disorders in college students. The study was conducted on 320 college students aged between 20 and 27 years. The Internet Gaming Disorder Scale, Brief Resilience Scale, and DSM-5 Sleep Disorders Scale were used as data collection tools. In the analysis of the data, the SPSS package program and the PROCESS macro were used. The results revealed that gaming addiction significantly predicted resilience in a negative direction and sleep disorders in a positive direction. Resilience, in turn, significantly predicted sleep disorders in a negative direction, and it mediated the relationship between gaming addiction and sleep disorders. The findings demonstrated that resilience emerged as a significant process variable linking gaming addiction and sleep-related outcomes, suggesting that lower resilience may partially account for the pathway through which gaming behaviors affect sleep quality.

Keywords: game addiction, sleep disorders, resilience, mediating variable

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Introduction

With the new opportunities it has created, Internet technology is one of the most innovative developments that attracts people from all demographic groups (age, education, economic status, etc.). Its rapid evolution has had profound effects on various aspects of human life, particularly in the realm of entertainment. One significant change brought about by technological advancements is in how people meet their entertainment needs, which has shifted dramatically with the advent of Internet technology. Entertainment, a basic human need (Glasser, 2003), has transitioned from traditional formats to digital games, making these games increasingly appealing. The attractiveness of games has led individuals to spend more time in virtual environments, and as time spent gaming increases, so does the likelihood of developing game addiction (Rideout et al., 2010).

Game addiction, classified as a behavioral addiction, shares characteristics with substance addiction but does not involve the use or abuse of substances (APA, 2013a). These shared characteristics include impaired control, compulsive engagement, and the experience of withdrawal symptoms. Behavioral addictions have garnered substantial research interest due to their significant implications for mental and physical health. Game addiction, as a contemporary issue emerging from technological advancements, has particularly drawn the attention of researchers and clinicians.

One of the pioneering studies on the diagnostic criteria for game addiction was conducted by Griffiths (2005), who proposed six criteria, including the prioritization of gaming over other activities, using gaming as an escape from negative emotions, playing in increasing amounts, experiencing withdrawal symptoms when gaming is reduced or stopped, conflicts arising from excessive gaming, and relapsing after attempting to quit. Subsequently, the American Psychiatric Association (APA, 2013a) expanded these criteria in the *Diagnostic and Statistical Manual of Mental Disorders (DSM-5)* to include nine criteria for diagnosing gaming disorder. Similarly, the World Health Organization (2018) outlined three main criteria: loss of control over gaming, prioritization of gaming over other life activities, and continued gaming despite negative consequences. These overlapping criteria

emphasize the pervasive and detrimental impact of gaming addiction on individuals' lives.

Given the rising prevalence of gaming addiction, researchers have sought to understand its correlates and consequences. Studies have demonstrated that game addiction is more prevalent among men compared to women (Kurt et al., 2018; Tejeiro Salguero & Moran, 2002), and is negatively associated with family life satisfaction (Taş et al., 2022) and life satisfaction (Baysak et al., 2020). Conversely, it is positively associated with alexithymia and social anxiety (Taş & Güneş, 2019), aggression and emotional eating (Caner & Evgin, 2021), and narcissistic personality traits and cognitive distortions (Zandi Payam & Mirzaeidoostan, 2019). These findings indicate that game addiction is associated with broader effects on emotional, social, and psychological well-being.

One significant consequence of excessive gaming is its impact on sleep quality. Problematic gaming is associated with adverse sleep status (Kristensen et al., 2021). Sleep disorders, defined as negative changes in sleep duration, quality, and patterns, are a growing concern in relation to game addiction (Kharisma et al., 2020; Tereshchenko et al., 2021). Sleep problems, such as insufficient sleep, sleep apnea, narcolepsy, and sleepwalking, adversely affect psychological and physiological health, as well as quality of life (Fusar-Poli et al., 2021). Mayda et al. (2012) emphasized that while sleep patterns can vary among healthy individuals, an average of 7–8 hours of sleep is necessary for optimal functioning. The disruption of this balance can impair social life, work, and family relationships, compounding the negative effects of sleep disorders.

Extensive research highlights the association of sleep disorders with various mental health problems, including depression (Lotfi Saeedabad & Basharpoor, 2022; Nutt et al., 2008; Zhang et al., 2022), attention deficit (Rodrigues & Shigaeff, 2022), sexual dysfunction (Agrawal et al., 2022; Lew-Starowicz, 2022), suicide risk (Yiyue et al., 2023), anxiety (Wang et al., 2022), stress (Susanti et al., 2022), quality of life (Nowowiejska et al., 2021), and aggression (Chervin et al., 2003). Sleep problems negatively affect individuals across all life stages, from infancy to old age (Schmitt, 1991; Guénolé, 2020). These findings underscore the importance of addressing sleep disorders as a pervasive health issue.

Technology use further compounds the impact of sleep disorders, with studies indicating that technological addictions, such as social media and gaming addiction, are strongly associated with poor sleep quality (Dinç, 2015; Moattari et al., 2017). Adolescents with high social media addiction scores report more problematic sleep habits (Güneş et al., 2018). Similarly, technology addiction correlates negatively with sleep quality (Shahbal et al., 2022). Specific to gaming addiction, studies have found significant associations with sleep problems, suggesting that excessive gaming may coincide with reduced sleep quality and duration (Birol, 2021; Lam, 2014; Tuncay & Göger, 2022; Zaman et al., 2022). Studies have identified associations between excessive gaming and sleep problems, such as reduced sleep duration and increased odds of poor sleep quality (Kristensen et al., 2021). While most evidence comes from cross-sectional studies, which cannot confirm causality, experimental research shows that prolonged gaming (e.g., 150 minutes of violent gameplay) increases physiological arousal and delays sleep onset (King et al., 2013).

On the other hand, research has found that resilience, defined as the ability to adapt positively to stress and adversity, is negatively associated with game addiction (Kim, 2016; Turan, 2021) and sleep disorders (Liu et al., 2021). Resilience encompasses coping skills, self-regulation, and positive thinking, which enable individuals to maintain mental well-being despite challenges (Joyce et al., 2018; Reivich & Shatte, 2002). Masten (2001) identified two key components of resilience: encountering difficulties and adapting positively to them. This capacity seems vital in mitigating the effects of addictive behaviors and sleep disturbances.

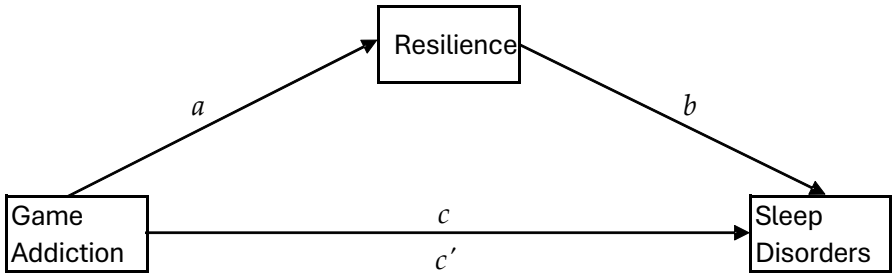
Studies show that resilience is inversely related to psychological problems, including depression (Edward, 2005), anxiety (Dolan et al., 2022), and emotional distress (Zheng et al., 2022). Moreover, resilience has been found to mediate the relationship between gaming addiction and empathy (Turan, 2021), highlighting its potential role in addressing complex mental health issues. However, there is limited research examining the mediating role of resilience in the relationship between game addiction and sleep disorders. This gap underscores the need for further investigation. While resilience has often been studied as a moderator, its inclusion here as a mediator is conceptually in line with “process-oriented” models focusing on

adaptation mechanisms. This perspective complements previous research by pointing to resilience not as a moderator, but as a part of a mechanism connecting behavioral and physiological outcomes.

In summary, previous research suggested that gaming addiction directly decreases resilience by promoting avoidance behaviors, impairing emotional regulation, and reducing adaptive coping strategies (Eker & Taş, 2022; Loton et al., 2016). This diminished resilience then increases vulnerability to sleep disorders (Kristensen et al., 2021; Peng et al., 2025). Longitudinal evidence shows gaming addiction precedes declines in resilience, which subsequently correlate with poorer mental health outcomes such as depression (Peng et al., 2025). This study aims to examine the mediating role of resilience in the relationship between game addiction and sleep disorders in university students. The proposed model (Figure 1) illustrates the pathways to be examined, with resilience hypothesized to mediate the impact of game addiction on sleep disorders. By framing resilience as a mediator rather than as a moderator, the model emphasizes process-oriented interventions (e.g., rebuilding resilience skills in addicted gamers) rather than merely identifying at-risk subgroups (Wong et al., 2024). This aligns with intervention studies showing resilience training improves both gaming addiction and sleep outcomes (Turan, 2021; Wong et al., 2024). Although resilience may be seen as a moderator variable as well, there are no conceptual obstacles to assume that it is a part of a pathway through which a specific behavioral dependence may influence sleep-related outcomes.

Figure 1

The Proposed Model: The Mediating Role of Resilience in the Relationship Between Game Addiction and Sleep Disorders



Note. The effect of game addiction on resilience is shown by path "a", the effect of resilience on sleep disorders is shown by path "b", and the direct effect of game addiction on sleep disorders is shown by path "c". Path "c^{1}" shows the effect of game addiction on sleep disorders after resilience is included in the model as a mediating variable.

Method

Participants and Procedure

The sample consisted of 320 college students, 220 (68.8%) women and 100 (31.3%) men. The participants' ages varied between 20 and 27, with a mean age of 22.22 years. We aimed to exclude individuals with clinical diagnoses and sleep disorders. By excluding participants with pre-existing sleep disorders, the study aimed to ensure that observed effects on sleep quality were more directly attributable to gaming addiction rather than being compounded by other clinical factors. Similarly, by excluding individuals with psychiatric diagnoses, we aimed to avoid introducing additional variables that could obscure the pathway between gaming addiction and resilience (Abdallat et al., 2024). Thus, the survey form was designed so that individuals who answer "yes" to the questions "Do you have any psychiatric diagnosis?" and "Do you have any sleep disorder diagnosis?" will be directed to the end of the survey. However, no one with any diagnosis was encountered.

The data were collected online, and the participation was voluntary. In the consent form, it was stated that the data obtained would be used only for scientific purposes, that the principle of confidentiality would be followed, and that personal data would not be shared anywhere. This study was conducted in strict accordance with the ethical standards of the Declaration of Helsinki and was approved by the Human Research Ethics Committee of Bülent Ecevit University (Project number: 21.12.2022/251619-436). Written informed consent was obtained from all participants.

Instruments

Internet Gaming Disorder Scale – Short Form (IGDS9-SF)

The scale was developed by Pontes and Griffiths (2015) and adapted to Turkish culture by Arıcak, Dinç, Yay, & Griffiths (2018). The measure is unidimensional and consists of nine items with a 5-point Likert-type scale as a response format. The response options range from 1 (Never) to 5 (Very often), with higher scores indicating a higher level of internet gaming disorder (a sample item: *Do you play games to temporarily escape or relax from negative emotions (e.g. helplessness, guilt, anxiety)?*). Within the scope of this study, we performed CFA and the results we obtained show that the construct validity of the scale was re-established (($\chi2$ (25) = 80.99, $p < .001$; $\chi2$/sd = 3.24; RMSEA = .084; GFI = .95; AGFI = .90; NFI = .95; RFI = .93; CFI = .96; SRMR = .031). The Cronbach's Alpha Coefficient of our study was found to be .91.

DSM-5 Sleep Disorder Scale

The *DSM-5* Sleep Disorder Scale was developed by the American Psychiatric Association (2013b) and adapted to Turkish culture by Yüzeren et al. (2017). The scale consists of 8 items and was designed to measure a single dimension. It uses a 5-point Likert scale as a response format, with response options ranging from 1 (Never) to 5 (Always). Higher scores indicate greater sleep disturbance. A sample item illustrating the instrument's scope is: *I get through difficult times with very little trouble?* Within the scope of this study, we performed CFA; the results showed that the construct validity of the scale was re-established (($\chi2(17) = 62.16$, $p < .001$; $\chi2$/sd = 3.66; RMSEA = .091; GFI = .95; AGFI =.90; NFI = .96; RFI = .93; CFI = .97; SRMR = .039).

Cronbach's Alpha Coefficient obtained within the scope of our study was found to be .90.

Brief Resilience Scale

This scale, developed by Smith et al. (2008) and adapted to Turkish culture by Doğan (2015), is used to measure the resilience of individuals. The measure consists of 6 items, with a 1 (Not suitable) to 5 (Completely suitable) Likert scale as a response format. Higher scores indicate higher levels of resilience. A sample item illustrating the instrument's scope is: *I get through difficult times with very little trouble?* Within the scope of this study, we performed CFA and the results we obtained show that the construct validity of the scale was re-established (($\chi 2$ (8) = 19.83, $p < .05$; $\chi 2/sd = 3.24$; RMSEA = .068; GFI = .98; AGFI = .95; NFI = .95; RFI = .93; CFI = .99; SRMR = .024). The Cronbach's alpha coefficient found in our study was .86.

Data analysis

The relationship between gaming addiction, resilience, and sleep disorders was tested with a simple mediation model. A simple mediation model refers to any causal system in which at least one causal antecedent variable (X) is proposed to influence an outcome (Y) through a single mediating (M) variable (Hayes, 2018). Mediation tests are tests that fully or partially require the presence of another variable in the relationship between two variables (Şimşek, 2007). A partial mediation occurs when the direct effect (c) remains significant in the model. In social sciences, given that behaviors often have multiple causes, partial mediation is considered a more plausible scenario compared to full mediation (MacKinnon, 2012). Given the cross-sectional nature of the data, the tested model should be interpreted as a process model rather than a strictly causal one. The PROCESS macro (model 4) in SPSS was used for data analysis. The PROCESS macro, an add-on using the nonparametric Bootstrap method, performs the analysis with a 95% confidence interval on a sample size of 5000 people with the resampling method (Hayes, 2018). The effect of the independent variable on the dependent variable was calculated with direct effect, indirect effect, and total effect scores. The effect of the mediating variable is determined based on the bootstrap confidence interval. The lower upper bound of the confidence interval (BootLLCI-BootULCI) should be below or above zero. In

other words, the absence of "0" between both values indicates that the intermediary variable mediates. In addition to the absence of "0" between both values, when the relationship between the dependent variable and the independent variable becomes insignificant, this indicates full mediation and when it decreases, this indicates partial mediation. The Bootstrap method is a powerful method as it reduces the TYPE II error (Preacher & Hayes, 2008).

Results

In the study, descriptive statistics and correlations were computed first. The values of Kurtosis and Skewness (Table 1) suggested that the data were normally distributed (George & Mallery, 2016). Regarding the interrelationships between the variables of interest, we found a significant positive relationship between game addiction and sleep disorders, and a significant negative relationship between game addiction and resilience and between resilience and sleep disorders.

Table 1

Descriptive Statistics and Correlation Coefficients

Variables	*N*	*M/SE*	*SD*	Skewness	Kurtosis	GA	SD	R
GA	320	13.57/.33	5.95	1.53	.1.47	-		
SD	320	19.79/.36	6.45	.377	-.557	.26**	-	
R	320	19.20/.25	4.57	.071	.136	-.17**	-.35**	-

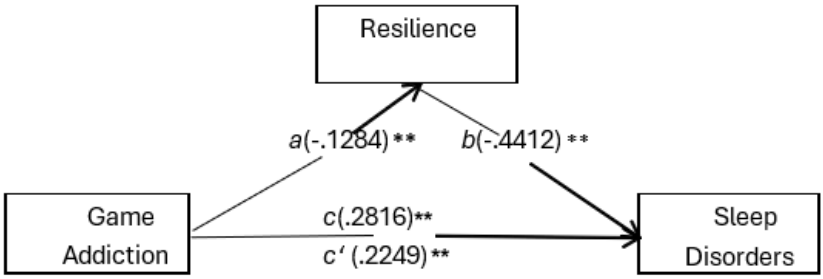
Note. GA - Game Addiction; SD - Sleep Disorder; R - Resilience.

**p <.01

The mediation analysis was then conducted, assessing the mediating effect of resilience in the relationship between game addiction and sleep disorders (Figure 2).

Figure 2

Mediating Effect of Resilience in the Relationship Between Game Addiction and Sleep Disorders



Note. **p < .001

Figure 2 shows the *a,b,c,* and *c'* paths and their unstandardized regression coefficients for the mediating effect of resilience in the relationship between game addiction and sleep disorders. When the model is examined, it can be seen that game addiction significantly predicted resilience in a negative direction (a = -.1284** 95% CI [-.2119, -.0448]); resilience significantly predicted sleep disorders in a negative direction (b = -.4412** 95% CI [-.5858, -.2965]) and game addiction significantly predicted sleep disorders in a positive direction (c = .2816** 95% CI [.1661, .3970]). When resilience, which was a mediating variable, was included in the analysis along with game addiction, the unstandardized regression coefficient between game addiction and sleep disorders (c'= .2249**; 95% CI [.1138, .3361]) decreased. In other words, a significant decrease was found when resilience was included in the mediating model (from c =.2816 to c'= .2249).

The direct effect, indirect effect, total effect, and bootstrap confidence interval were analysed to find out whether the intermediary variable had an effect on the decline that occurred after the intermediary variable was included in the model. The results showed that the total effect of game addiction on sleep disorders was .2816 (p < .000), the direct effect was .2249 (p < .000), the indirect effect was .0566, and the bootstrap

confidence interval (.0173, .1055) did not include zero. Together, our results suggested resilience had a partial mediating effect on the relationship between game addiction and sleep disorders.

Discussion

This study examined the mediating effect of resilience on the relationship between gaming addiction and sleep disorders among college students. Findings revealed that gaming addiction significantly predicted resilience in a negative direction and sleep disorders in a positive direction. Resilience, in turn, significantly predicted sleep disorders in a negative direction, and it mediated the relationship between gaming addiction and sleep disorders. This study positioned resilience as a mediator because it was hypothesized to operate as an internal mechanism through which the adverse effects of gaming addiction on sleep were filtered. This approach aligns with theoretical frameworks suggesting that resilience, as a dynamic process, evolves under the influence of stressors (such as gaming addiction) and subsequently impacts other outcomes, including sleep disorders (Kalisch et al., 2017; Luthar et al., 2000).

The study found that gaming addiction negatively predicts resilience. Such a finding aligns with prior studies (Keskin, 2019; Özmen, 2019; Turan, 2021; Yen et al., 2019), which highlighted that individuals struggling with gaming addiction often turn to games as a coping mechanism to escape from negative emotions and stressors (APA, 2013; Griffiths, 2005). Gaming addiction, characterized by excessive engagement and emotional dependence, depleted psychological resources necessary for adaptive coping (e.g., resilience). Resilience encompasses the ability to manage difficulties, engage in positive thinking, and adapt to adverse circumstances (Park et al., 2004; Reivich & Shatte, 2002).

Resilience negatively predicted sleep disorders, aligning with earlier research (Bilgin & Taş, 2022; Lenzo et al., 2022; Terao et al., 2022). Hughes et al. (2018) identified resilience as a buffer against sleep problems, while Terkeş et al. (2022) reported that individuals with low resilience experienced greater sleep disruptions. Resilience, as a dynamic process of positive adaptation (Luthar et al., 2000), mitigated the impact of stressors by fostering emotional regulation and coping strategies, thereby promoting better sleep.

Conversely, a lack of resilience might amplify the physiological and psychological vulnerabilities that led to sleep problems (Palagini et al., 2018).

The present study also revealed that gaming addiction positively predicts sleep disorders, consistent with previous findings (Cheraghi et al., 2021; Lam, 2014; Nguyen et al., 2021). Other studies, too, have suggested that individuals with gaming addiction often sacrifice sleep for extended gaming sessions (Tuncay & Göger, 2022) and that gaming addiction is linked to sleep issues, including diminished sleep quality and delayed sleep onset (De Rosa et al., 2024). According to APA (2013), gaming addiction itself involves not only prolonged screen time and mental preoccupation but also neglect of basic needs, including sleep. Moreover, sleep quality is intricately linked with mental health variables such as depression, anxiety, and stress (İyigün et al., 2017), which are also associated with gaming addiction (Anli & Taş, 2018; Brunborg et al., 2014). This co-occurrence suggests that gaming addiction and sleep disorders may share overlapping psychological and behavioral processes.

Resilience bridged the pathway from gaming addiction to sleep disorders by reflecting an individual's capacity to absorb, process, and respond to the psychological toll of gaming addiction. This conceptualization was grounded in stress-coping theories, which posited that resilience buffers the effects of stressors and determines adaptive versus maladaptive outcomes (Luthar et al., 2000). The results supported the hypothesis that resilience mediated the relationship between gaming addiction and sleep disorders. In other words, gaming addiction influenced sleep disorders indirectly through resilience. Prior studies provided support for these findings. For instance, Liu et al. (2016) demonstrated that resilience had a protective effect against sleep disorders, while Turan (2021) highlighted the mediating role of resilience in the relationship between empathy and video game addiction. The current study added to this body of knowledge by showing that although gaming addiction directly affected sleep disorders, this effect was predominantly channeled through resilience. Individuals with low resilience who were addicted to gaming were more likely to experience sleep disorders. This was consistent with evidence that resilience was negatively associated with both gaming addiction (Kim, 2016; Sert &

Sarıtepeci, 2024) and sleep disorders (Liu et al., 2021). Resilience functioned as a protective factor by enabling individuals to manage stressors and negative emotions effectively, thereby reducing reliance on maladaptive coping strategies such as excessive gaming. Increasing resilience among those at risk for gaming addiction could reduce the likelihood of sleep problems. Moreover, negative emotional states such as depression, anxiety, and stress, which were linked to sleep problems (İyigün et al., 2017), were also associated with gaming addiction (Anli & Taş, 2018; Brunborg et al., 2014). This overlap suggested that individuals with higher resilience were less affected by these risk factors, mitigating both gaming addiction and sleep disorders.

In conclusion, the findings demonstrated that resilience mediated the relationship between gaming addiction and sleep disorders, highlighting its critical role as a protective factor. Strengthening resilience in vulnerable populations could have served as an effective intervention strategy to address both gaming addiction and its associated sleep disturbances.

Limitations and Recommendations

This study had several limitations, which should be acknowledged when interpreting its findings. The first limitation pertains to the data collection tools, as data were obtained through self-report scales. Such tools are subject to limitations, including potential difficulties in item comprehension, tendencies to respond in a socially desirable manner, and influences of participants' momentary emotional states. To mitigate these issues, future researchers could utilize alternative data collection methods, such as interviews, and adopt diverse research approaches and techniques, such as longitudinal designs. Another limitation relates to the generalizability of the findings. Although the study included participants aged 20 to 27, the predominance of young adults in the sample limits the generalizability of the results to other age groups. The sample consists of university students. The high level of education of this group may be a limitation in generalizing the results to the general population.

Another limitation of the study may be the use of a mediation model within a cross-sectional design. In mediation models, collecting data at a

single point in time can be considered a limitation compared to collecting data at multiple time points.

Recommendations were also made for practitioners working in the field. Mental health professionals should consider gaming addiction as a significant factor when addressing sleep problems. Sleep disturbances affect individuals across various domains. Behaviorally, they manifest as lethargy, drowsiness, reduced responsiveness to external stimuli, increased reaction times, elevated arousal thresholds, and impaired cognition (Chokroverty, 2010). Addressing the underlying causes of sleep problems could help mitigate these adverse effects. Furthermore, the negative association of resilience with both gaming addiction and sleep problems highlights the need for professionals to focus on resilience-building interventions when addressing these issues.

The study encompassed a limited age range, and future research could investigate these relationships at different developmental stages, such as adolescence, young adulthood, and old age. Such research could provide valuable insights into how these variables interact across the lifespan. Additionally, educators and school counselors might consider integrating resilience-building modules into psycho-educational activities aimed at preventing gaming addiction. These modules could foster adaptive coping skills and emotional regulation to reduce the likelihood of gaming addiction and its associated negative outcomes.

Conflict of interest

We have no conflicts of interest to disclose.

Data availability statement

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

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Research Article

Daltonization Enhances Working Memory Performance in Color Vision-deficient Observers

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ABSTRACT

Daltonization methods are image adaptation techniques that adjust screen colors to aid people with color vision deficiency (CVD). Though their effectiveness in boosting the hue's dissimilarity has been documented, it was not entirely clear to what extent they improve color processing. The purpose of our study was to measure the direct contribution of daltonization to color working memory.

Two different types of daltonization methods were tested: severity–based (SB) enhancing red-green contrast, and type-based (TB) enhancing blue-yellow contrast. We used simple behavioral tasks while measuring speed and accuracy. Participants in our experiments were asked to find the target color among the two presented choices (2AFC task). The colors were either presented simultaneously (perception task) or sequentially (memory task).

Both daltonization methods significantly improved CVD participants' performance on both tasks and with both measures, with stronger effects found in the memory task. The effects of the TB method were robust across tasks, while the effects of the SB method were smaller and dependent on the level of enhanced red-green contrast when colors needed to be remembered.

We confirmed the previously reported effects of daltonization and demonstrated that these effects extend to the level of short-term retention of color information. Based on the differences in the effects of the two daltonization methods under varying cognitive demands, we identified the specific conditions under which each method supports cognitive functions. Consequently, our findings enable precise application decisions: using daltonization for promoting fast discrimination vs. enhancing memory during material learning.

Keywords: Color Vision, Color Vision Deficiency, Working memory, Daltonization, Color correction

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Introduction

Color is a fundamental cue for interpreting the visual environment, enabling efficient segmentation of the visual scene but also shaping our mental representations of the world. It plays an essential role in encoding, storing, and retrieving information, and aids in recognizing and categorizing important objects, such as identifying ripe food (Witzel & Gegenfurtner, 2018). However, approximately 8% of European males and 0.4% of females (Birch, 2012) experience some degree of color vision deficiency (CVD) – a condition that results in the reduced or lost ability to discriminate certain colors. Complex gene mutations prevent the functional expression of one or more photopigments in the retinal cones of CVD observers (Neitz & Neitz, 2011); thereby compromising the initial stages of color processing.

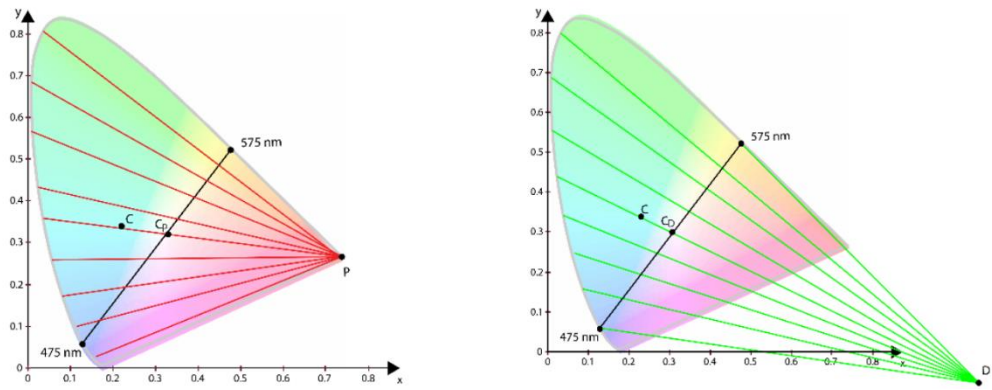
Almost 98% of CVD observers exhibit a deficit or dysfunction in M or L pigments, leading to reduced discrimination of greenish and reddish hues (Neitz & Neitz, 2011). The most severe reduction happens in the case of *dichromacy* when one type of cone pigment gene is absent – in *deuteranopia*, the cones that would normally express M opsin express L opsin instead, and vice versa in the case of *protanopia* (Davidoff, 2015). The milder and the most common form of CVD is called *anomalous trichromacy*, in which three cone types are present, but two of them are from the same class – S, and two M cone types in *protanomaly* and S and two L cone types in *deuteranomaly* (Davidoff, 2015). The peak spectral sensitivities of the two M or L cone types are closer together than usual, lowering the threshold contrast for color differences in the respective spectral regions. The proximity of these peak spectral sensitivities may vary among anomalous trichromats and can affect the extent to which their color discrimination ability is reduced (Boehm et al., 2014). Anomalous trichromacy is considered a mild to moderate deficiency, within which individuals have a reduced color gamut compared to individuals without color deficiency but can still retain some degree of red-green discrimination.

The hues whose discrimination is impossible or reduced for CVD observers (i.e., *confusion hues*) are located along specific lines within the CIE 1931 space known as confusion or pseudo-isochromatic lines (Figure 1). These lines connect the edge of the diagram to the confusion points specific to the CVD type. For instance, for the protanopes, the confusion point (P) is

the light that maximally stimulates the affected L cones (Figure 1a). Confusion hues are perceived as achromatic or as more/less saturated *residual hues*, i.e., hues that are distinguishable for CVD observers. In deuteranopia and protanopia, those hues are bluish and yellowish (for details, see Pridmore, 2014). They are represented in Figure 1 by a line connecting the white point and fixed monochromatic stimuli, which should correspond to the unique blue (475nm) and unique yellow (575nm) for whose perception the red-green color channel is irrelevant (Brettel et al., 1997). The confusion lines are slightly different for protanopes and deuteranopes due to the differences in the spectral sensitivities of M and L cones (Figure 1).

Figure 1

CIE 1931 Chromaticity Diagrams



(a) (b)

Note. CIE 1931 chromaticity diagrams showing confusion lines in red for protanopes (**a**) and in green for deuteranopes (**b;** Milić, 2016). The black line represents chromaticities that protanopes and deuteranopes easily discriminate. All colors along a confusion line are perceived as the same color, corresponding to the intersection of the confusion line and the chromatic line. For example, color C will be perceived as color C_D by deuteranopes and color C_P by protanopes.

In recent decades, humans have started to spend significantly more time not looking directly at natural objects but at their representations on

various screens. For individuals with CVD, this represents a unique opportunity to overcome their deficit as screen colors could be corrected. As a result, different methods of image adaptation, known as *daltonization methods*, have been developed (Kotera, 2012; Machado et al., 2009; Ribeiro & Gomes, 2019). To compensate for the reduced chromatic input, these methods usually enhance chromatic and/or lightness contrast between confusion hues (Commission Internationale de l'Eclairage, 2020). The success of these methods has been predominantly tested with computer simulations (Commission Internationale de l'Eclairage, 2020; Shen et al., 2021; Zhu et al., 2021). When human participants are involved, the tests primarily focus on simple color discrimination (Bonanomi et al., 2017) or the observers are asked to subjectively evaluate differences between the original and corrected images or the corrected images themselves (Chen et al., 2024; Shen et al., 2021; Zhou et al., 2024; Zhu et al., 2019). However, current findings are insufficient to conclusively determine the effectiveness of these methods for color information processing in CVD observers since this process involves more than simply discriminating between incoming hues. Knowing what the red color is, or recognizing all the red objects in the scene, requires that the incoming signal be related to previous knowledge stored as a mental representation. Given the complex mechanism of color processing, we can ask to what extent daltonization methods can facilitate this process beyond basic visual discrimination.

In this study, we focused on the color working memory (CWM) of individuals with CVD, which previous studies have not directly addressed. CWM temporarily retains and manipulates information for the ongoing task/behavior (Baddeley & Hitch, 1974) and serves as a critical interface between perception and long-term memory, where color knowledge is stored. The ability to maintain color information in CWM is fundamental for various everyday activities, such as performing targeted visual searches (e.g., identifying a red apple among green ones) or navigating effectively (e.g., locating a specific metro line while disregarding others). Here, we specifically aimed to investigate, in terms of accuracy and reaction times (RTs) in a cognitive task, the extent to which daltonization methods can improve short-term retention of color information for individuals with CVD. From a scientific perspective, understanding the cognitive benefits of on-screen color adaptation provides insights into the cognitive processing mechanisms of

individuals with chronically reduced visual input and probes their mental representation in comparison to the control group. From a practical standpoint, the obtained results could offer valuable insights into the efficacy of daltonization in supporting individuals with CVD.

According to the CATMET model (Bae et al., 2015), the retention of color information relies on both the continuous representation of a specific hue and its categorical classification, e.g., red or blue. In CVD individuals, reduced visual input obstructs the retention of continuous color information but also contributes to the shaping of distinctive mental representations of colors and unique patterns of color categorization (Bonnardel, 2006; Nagy et al., 2014; Uchikawa, 2014). In this study, we singled out the visual component of the CWM and examined how two recently proposed daltonization methods (Keresteš et al., 2023), which differ in their approach to enhancing discriminability, affect the memory of confusion hues for CVD observers. The **type-based (TB) method** enhances the blue-yellow axis by moving colors perpendicular to the confusion lines. By altering the chromatic content in this orthogonal direction, **TB** adaptation creates distinct color differences that all CVD individuals readily perceive. In contrast, in the **severity-based (SB) method**, colors are shifted along the confusion lines in the opposite direction of the simulated CVD projection, thereby boosting red-green contrast. This approach is conceptually straightforward—improving discriminability precisely where CVD individuals struggle the most and has proven especially beneficial for the most common group of milder CVDs.

We tested these methods in a task where participants were required to briefly retain a single color, rather than complex images, to minimize reliance on compensatory strategies commonly employed by CVD participants in more complex tasks (Gegenfurtner et al., 1996; Shepard & Cooper, 1992). To gain insights into the specific effects of daltonization on different levels of cognitive processing, we directly compared the performance in a memory task to the performance in a simple perceptual discrimination task. The novelty of our study lies not only in confirming that daltonization enhances discrimination along confusion lines—a finding that could be expected even when we add a memory component to the task — but also in conducting behavioral tests to evaluate the magnitude of these

effects for two distinct daltonization methods and, for the first time, directly comparing the effects in tasks with and without memory load.

The practical goal of our study was to behaviorally evaluate the **SB** and **TB** daltonization methods, both of which have shown promising outcomes in previous assessments (Keresteš et al., 2023). The **SB** method preserves the overall naturalness of a scene, which is critical for user acceptance, particularly with natural imagery, and milder CVDs. In contrast, the TB method has proven to be beneficial for artificial images, where naturalness is less of a priority (Keresteš et al., 2023). Although both methods have been shown to yield user-preferred outcomes under certain conditions, practical implementations must consider not just subjective preference and immediate perceptual gains, but also whether improved chromatic contrast translates into measurable cognitive benefits. Therefore, the results of our study could guide the selection of daltonization strategies tailored to the task — e.g., promoting speedy and accurate recognition of color-coded signals versus facilitating learning or memorization of color-labeled content, thereby providing a foundation for task-specific optimization of color accessibility solutions for CVD observers.

The idea that daltonization methods can be behaviorally evaluated through implicit measures in cognitive tasks is supported by a few prior studies with promising results. Flatla and Gutwin (2012) showed that their SSMR recolor method significantly increased accuracy and reduced RTs for CVD participants in a perceptual task. Simon-Liedtke and colleagues (2015) proposed a visual search task (VisDem) in which observers answered whether the presented image (with or without correction) matched the previously presented statement about the colors in the picture. The authors demonstrated that some of the available daltonization methods have the potential to improve participants' accuracy in this task but not their RTs (Simon-Liedtke & Farup, 2016). The VisDem task is relevant to our research as it incorporates a memory component. However, in this task, participants were not asked to memorize colors themselves but rather a text associated with images. Nevertheless, these studies provide a broader framework for comparing the effectiveness of the SB and TB methods with those previously tested in behavioral tasks.

In line with the practical goal of our study, our methodological decision was to achieve a high degree of ecological validity. We decided to conduct the testing under conditions typical for our participants – on the screens of the devices they regularly use (without any pre-configured software color corrections) rather than in laboratory settings. This approach allowed us to determine whether the selected methods can genuinely assist individuals with CVD in their everyday use of color content on screens.

Method

Participants

Participants were volunteers gathered through social networks. We estimated the number of participants using the G*Power 3.1 software (Faul et al., 2007). Due to the lack of prior studies with a comparable design, to determine the sample size for the within-between interaction, we used a medium effect size (f = 0.25; Cohen, 1988), an $\alpha = 0.05$, and a power = 0.95. The power analysis indicated a total sample size of 20. However, considering our decision to conduct the whole process in a natural environment for our participants, we opted for a larger sample than suggested and the one used in previous studies with CVD observers conducted in laboratory conditions (Flatla & Gutwin, 2012; Simon-Liedtke & Farup, 2016). We recruited 23 participants with CVD (M_{age} = 37.7; 1 female) and 23 matched participants with typical color vision (M_{age} = 37.3; 1 female) for the control group.

Participants were selected based on their results on the online color vision test which uses cone isolation to test the sensitivity of each type of cone (enchroma.co.uk). In the CVD group, 17 participants were classified as deutans, while 6 were classified as protans, which is consistent with the prevalence of the two types of red-green color vision deficiency (Neitz & Neitz, 2000).

Participants signed the informed consent before taking part in the study. The study was approved by the ethical committee of the Psychology Department at the University of Novi Sad and was conducted according to the ethical norms of the Helsinki Declaration.

Stimuli

We selected two sets of color pairs from pseudo-isochromatic lines (in further text: PL1 and PL2) in CIELab space, separately for protan and deutan conditions. Each line was derived by ensuring a controlled shift in hue, with a constant Euclidean distance along the b-axis (Δb=0.4). This approach was taken to maintain a consistent step in color appearance while holding lightness constant (L=0.5), as standardized luminance levels are crucial in isolating hue differences (Fairchild, 2013; Wyszecki & Stiles, 2000). By doing so, we minimized the influence of lightness cues and ensured that any difficulty in discrimination arose primarily from chromatic differences.

The precise values for the protan and deutan projections were calculated via rotation in a polar coordinate system with angles θ_{p} = -11.48° and θd = -8.11 (Kuhn et al., 2008). These angles correspond to known confusion axes for the respective types of CVD, allowing us to place stimuli precisely along and around lines where hue discrimination is known to be diminished for these observers. Color pairs were then selected from opposite sides of the dichromatic gamut plane such that their color difference (ΔE) measured 0.2 in CIELab space. For observers with typical vision, this ΔE ensures that colors are easily distinguishable. However, for dichromats—who map both colors onto the same confusion point—the effective difference (ΔEd) is zero, making them indistinguishable. For anomalous trichromats, the apparent color difference (ΔEat) lies between 0 and 20, depending on severity. Table 1 provides CIELab coordinates of the protan and deutan stimuli.

Table 1

CIELab Coordinates of Color Stimuli Pairs Selected From the Two Deutan and Protan Pseudo-Isochromatic Lines (PL1 and PL2)

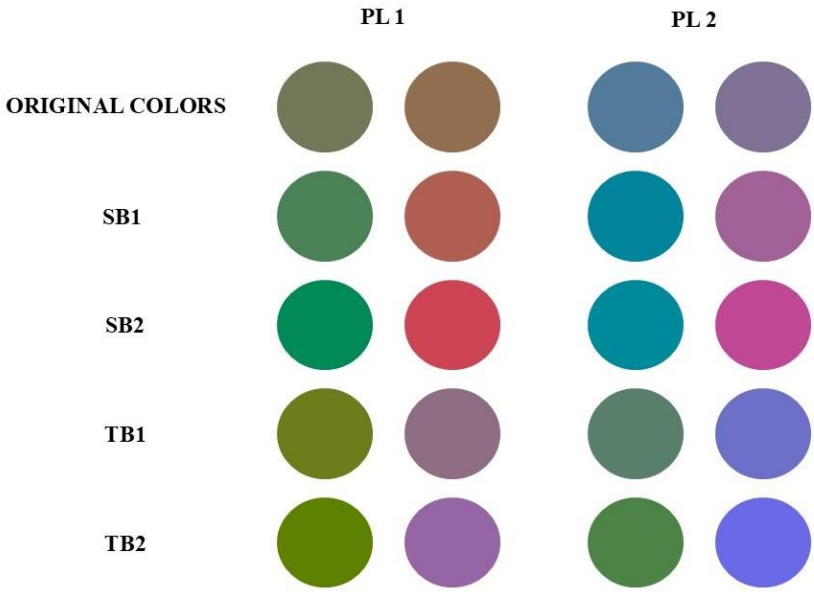
PL	Deutan						Protan					
	Color 1			Color 2			Color 1			Color 2		
	L	a	b	L	a	b	L	a	b	L	a	b
1	0.5	-0.09	0.19	0.5	0.11	0.21	0.5	-0.08	0.18	0.5	0.12	0.22
2	0.5	-0.09	-0.21	0.5	0.11	-0.19	0.5	-0.08	-0.22	0.5	0.12	-0.18

After selecting the original colors, we applied two daltonization strategies to increase their discriminability for CVD participants. In the SB method, colors were shifted along their original confusion lines, effectively increasing red-green contrast, while in the TB method, colors were moved perpendicularly to those lines to enhance blue-yellow contrasts. Both methods were applied at two levels to represent mild and more pronounced adjustments, with level 1 involving a moderate color shift (ΔE_{76} = 0.6) and level 2 a slightly larger shift (ΔE_{76} = 1.0).

Figure 2 illustrates an example of how the protan colors appear before and after daltonization at both levels. The CIELab coordinates of colors after daltonization are given in the Supplementary Materials.

Figure 2

Illustration of Color Pairs From the Protan Pseudo-Isochromatic Lines (PL1 and PL2) Before Daltonization (Original Colors), After SB Method (Levels 1 and 2), and After TB Method (Levels 1 and 2)



Procedure

The study was conducted online and hosted on a protected personal website. We used custom JavaScript code written for this purpose. The participants accessed the study via a computer (desktop or laptop). Access to the experiment was not available through other mobile devices. In the first step of the procedure, participants were directed to the EnChroma website and asked to take an online CVD test. After that, they were required to check the box with their results provided on the first page of the study.

According to their results, participants were assigned either to one of the experimental groups (deutan or protan) or to the control group (from

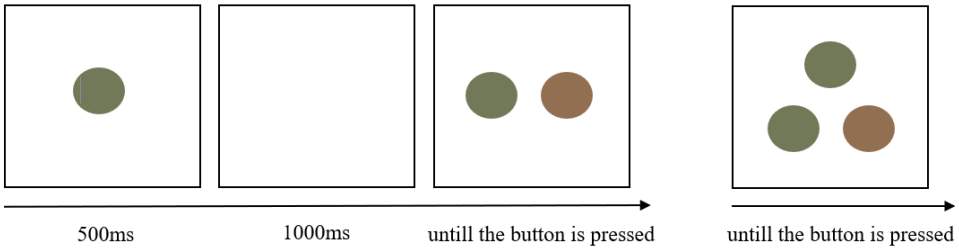
which they were randomly assigned to the deutan or protan condition). The conditions differed only in the colors used as stimuli. At the beginning of the study, participants provided demographic information (gender, age, occupation, and, in the experimental group, their personal experience with color vision deficiency).

In the experimental part of the study, participants performed four blocks of 2AFC tasks. In the first and third blocks, they performed a delayed 2AFC, which required retention of the target color in the working memory, i.e., a memory task (Figure 3a). A single target color was presented at the center of the white screen for 500ms, followed by the blank screen for 1000ms. After that, two colors would appear left and right from the screen center and participants had to indicate which of the colors matched the previously presented target by pressing the keyboard keys (S for left and L for right). The test colors stayed on the screen until the response was made. Before each target, a white noise screen was presented for 500ms to avoid the aftereffect of previously displayed color stimuli.

In the second and fourth blocks, stimuli were presented simultaneously, meaning that participants had to discriminate displayed colors perceptually. In this type of 2AFC task, the target color was presented centrally on the upper part of the screen, while the two test colors were presented below, left and right from the center of the screen (Figure 3b). Again, participants pressed S or L on the keyboard to indicate which test stimuli matched the target in color. They had no time limit for the answer. In this task, there was a white noise screen between the trials shown for 1000ms to prevent color aftereffects.

Figure 3

Procedure for (a) Memory (Delayed) and (b) Perceptual (Simultaneous) 2AFC Task



(a) (b)

Each block consisted of 40 trials. There were 10 color pairs: color pairs from PL1 and PL2 were shown in each of the five conditions – original colors, SB daltonization level 1 (SB1), SB daltonization level 2 (SB2), TB daltonization level 1 (TB1), and TB daltonization level 2 (TB2). Each color pair was shown four times so that both colors could become the targets, and that the correct answer could be once on the left and once on the right side of the screen. Within each block, trials were shown randomly for each participant. The whole procedure took about 30 minutes.

Results

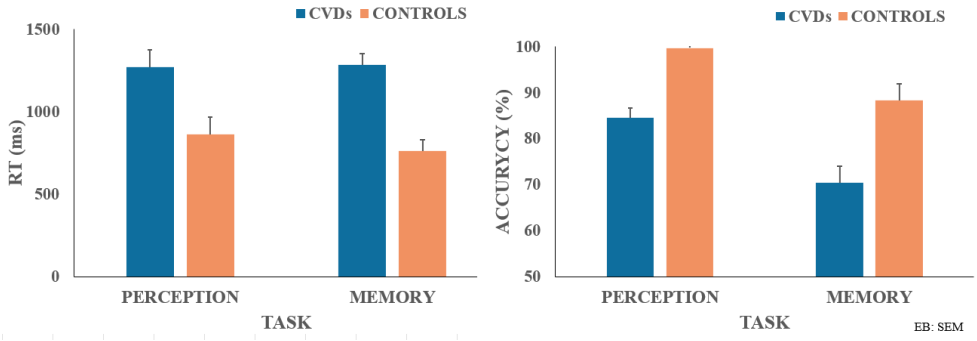
Participants' groups and tasks

The first analysis examined the performance of the experimental versus the control group across the two tasks (perception and memory) with the originally selected colors, before the corrections were made. This analysis was crucial for assessing whether implicit measures in the cognitive task accurately reflected the anticipated differences between the groups, given their color discrimination abilities. We conducted two mixed ANOVAs with the participants' group as a between-subjects factor and task as a within-subjects factor using two dependent variables: RTs (obtained only on the correct answers) and accuracy.

RTs. The analysis showed a significant main effect of the participants' group - CVD observers were significantly slower than controls in both tasks ($F(1,44) = 20.41$; $p = .00$; $\eta_p^2 = .32$). As shown in Figure 4, the differences in RTs between the two groups were pronounced, with the memory task showing up to 500ms advantage for the control group. There was no significant interaction between the group and task ($F(1,44) = .64$; $p = .42$; $\eta_p^2 = .01$).

Figure 4

RTs and Accuracy in Perception and Memory Task for CVD and Control Participants



Accuracy. The accuracy analysis also showed a significant main effect of the group; the CVD group was significantly less accurate in both tasks ($F(1,44) = 22.9$; $p = .00$; $\eta_p^2 = .34$). While accuracy in the perception task was nearly perfect for the control group, it dropped to 84% for the CVD group (Figure 4). We also observed a significant main effect of the task: as expected, both groups were more accurate in the easier perception task ($F(1,44) = 28.2$; $p = .00$; $\eta_p^2 = .39$). There was no significant interaction between group and task ($F(1,44) = .31$; $p = .57$; $\eta_p^2 = .01$) indicating that both groups performed comparably on the two tasks, albeit with notable differences in their levels of success.

Daltonization

Our main analysis focused on the effects of the two types of daltonization methods on participants' performance in both tasks. We conducted two mixed ANOVAs with the participants' group (CVD/controls) as a between-subjects factor and two within-subjects factors: task (perception/memory) and daltonization (original/SB1/SB2/TB1/TB2) using two dependent variables – RTs (obtained only on the correct answers) and the percentage of correct answers.

RTs. A significant main effect of the group was observed in the expected direction (F (1,44) =4.21; p=.04; η_p^2=.09), with the control group producing faster responses. We found a strong main effect of daltonization (F(4,176) = 89.23; p = .00; η_p^2 = .67) – in both tasks, all participants showed a significant performance enhancement after colors were corrected. This result was anticipated, given that daltonization increases the perceptual distance between colors. The main effect of the task did not reach statistical significance (F(1,44) = 3.43; p = .07; η_p^2 = .07). We also observed significant interactions between daltonization and the other two factors, which provided valuable insight into the specific effects of this method on participants' performance in cognitive tasks and which will be discussed in the following text.

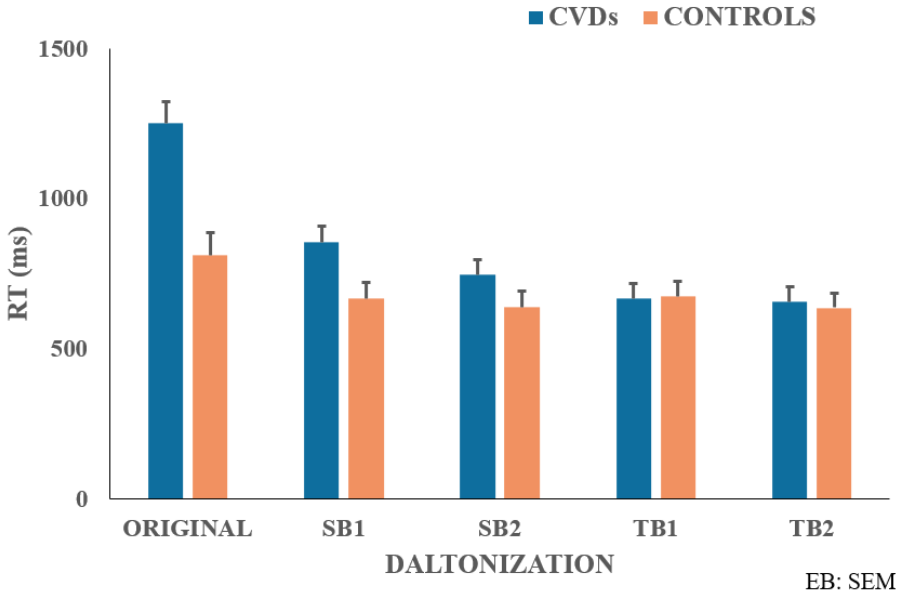
First, a significant interaction between daltonization and participants' group was observed: when colors were daltonized, RTs for CVD participants decreased to the level of RTs for control participants discriminating the original colors (F(4,176) = 28.79; p = .00; η_p^2 = .39; Figure 5). This was confirmed by an LSD post-hoc test, which showed no significant differences between the original color condition in the control group and all daltonization conditions in the experimental group.

For the CVD group, daltonization significantly reduced the task-solving time – TB method at both levels reduced RTs by as much as 600ms with no significant differences between the two levels (p = .74; Figure 5). On the other hand, the effect of the SB method depended on its level, favoring level 2 (p = .00). Moreover, even level 2 of the SB method showed a smaller effect than both levels of the TB method (both p = .01).

For the control group, the recorded acceleration due to daltonization was noticeably smaller – the greatest speed-up compared to the time required for original colors occurred with the TB2 method, amounting to about 180ms (Figure 5). This is possibly a ceiling effect; the initial RTs were already low, and there was not much room for improvement.

Figure 5

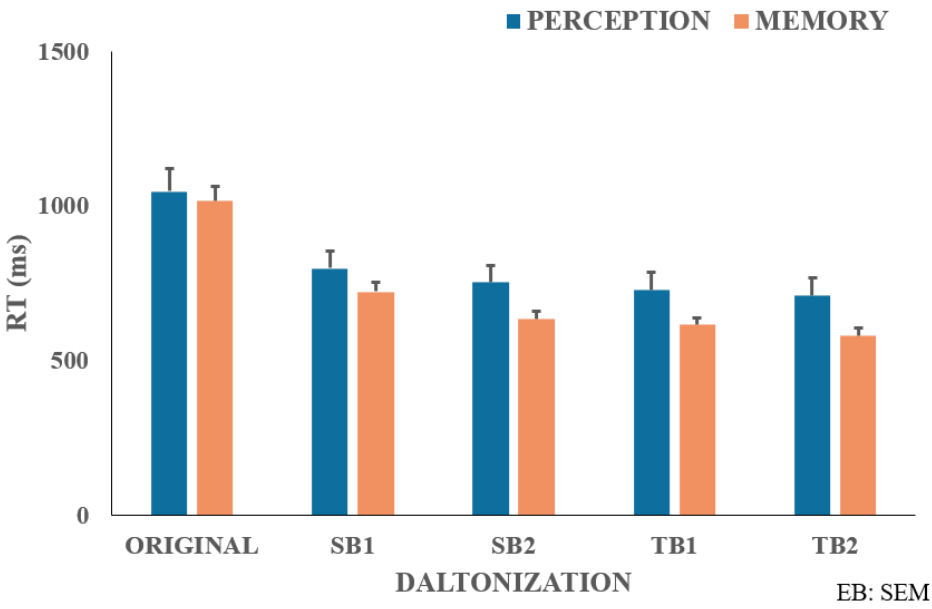
RTs for CVD and Control Participants With Original and Daltonized Colors



Daltonization also significantly interacted with the task – for both groups of participants, the RT enhancement after daltonization was more pronounced in the memory than in the perception task ($F(4,176) = 2.61$; $p = .04$; $\eta_p^2 = .06$; Figure 6).

Figure 6

RTs in Perception and Memory Tasks for Both Groups and With Original and Daltonized Colors



The LSD post-hoc test revealed that, on average, participants required the same amount of time for the perception and memory tasks with the original colors (p = .22) as the difference in task-solving speed between CVD participants and controls was similar in both tasks (see Figure 4). However, this interaction demonstrated a specific effect of color correction on the memory task, applicable to both levels of both types of daltonization (Figure 6).

Again, for the TB method, there was no difference in RTs regarding its level both in perception (p = .52) and the memory task (p = .18). For the SB method, participants were significantly faster with level 2 in the memory task (p = .00), while the difference in the perception task was not significant (p = .06).

The interaction between the participants' group and the task was not statistically significant ($F(1,44) = 3.43$; p = .02; η_p^2 = .04), nor was the three-

way interaction between the participants' group, task, and daltonization ($F(4,176) = .02$; $p = .99$; $\eta_p^2 = .00$).

Accuracy. We recorded all three main effects in the expected direction – the accuracy was lower in the CVD group ($F(1,44) = 8.8$; $p = .00$; $\eta_p^2 = .17$), the accuracy increased in each daltonization condition ($F(4,176) = 30.14$; $p = .00$; $\eta_p^2 = .41$), and participants were more accurate when performing the perceptual task ($F(1,44) = 23.41$; $p = .00$; $\eta_p^2 = .34$). Then again, the complex impact of daltonization methods on participants' performance becomes apparent only when considering the interactions observed between the factors.

As in the RT analysis, we recorded a two-way interaction between daltonization and participants group ($F(4,176) = 17.1$; $p = .00$; $\eta_p^2 = .41$) as well as a two-way interaction between daltonization and task ($F(4,176) = 14.29$; $p = .00$; $\eta_p^2 = .25$). These results confirmed our previous findings regarding the stronger effects of daltonization for CVD participants, especially in the task that required color memory. As in the RT analysis, the interaction between the participants' group and the task was not statistically significant ($F(1,44) = 0.13$; $p = .72$; $\eta_p^2 = .00$).

Finally, a significant three-way interaction between group, daltonization, and task was also recorded ($F(4,176) = 2.79$; $p = .03$; $\eta_p^2 = .06$). Figure 7 illustrates the different effects of daltonization on the performance of the two groups depending on whether the colors needed to be remembered or just perceptually discriminated.

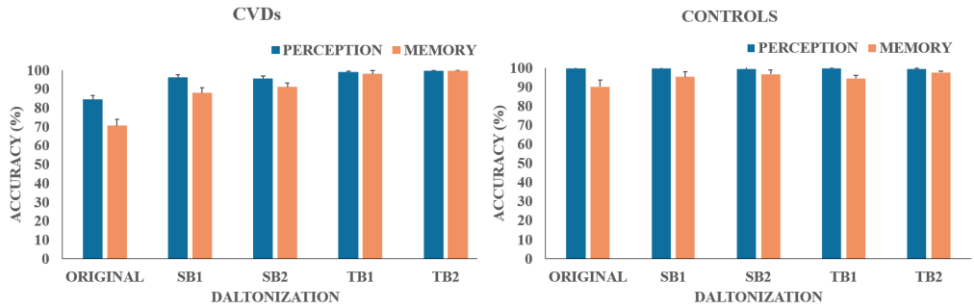
For the control group, we observed a ceiling effect for accuracy regardless of the type and level of daltonization. Still, in the memory task, level 2 of the TB method increased accuracy to 98% compared to 90% recorded for the original colors (Figure 7).

For the CVD group, we observed a significant increase in accuracy after applying daltonization in both tasks. Examining the effects of the two types of daltonization, we can see similar patterns observed in the RT analyses. Namely, for the SB method, there was no difference between level 1 and level 2 in the perception task ($p = .6$), but a stronger effect was recorded for level 2 in the memory task ($p = .00$). The TB method once again demonstrated a robust effect which remained consistent across two levels in both perception ($p = .72$) and the memory task ($p = .39$). Most importantly, Figure 7 depicts

how TB daltonization implemented at either level across both tasks elevates the performance of the CVD group to match that of the control group achieving almost perfect accuracy of 100%.

Figure 7

Three-Way Interaction Between Participants Group, Daltonization, and Task on Accuracy



Discussion

This study examined the impact of screen color correction (i.e., daltonization methods) on color processing in CVD observers, aiming to extend our understanding of this issue beyond basic visual discrimination. We questioned to what extent daltonization could enhance CVD performance in tasks engaging CWM, a critical cognitive component that bridges visual perception and mental representations. We tested two types of daltonization methods: severity–based (SB), enhancing red-green contrast, and type-based (TB), enhancing blue-yellow contrast, focusing on implicit measures of speed and accuracy in simple cognitive tasks with single color targets. To assess the practical efficacy of these methods, we conducted research in non-laboratory conditions, focusing on the ecological validity of the obtained results.

Our initial analysis with non-corrected colors showed the expected lower performance of CVD participants compared to the control group in both accuracy and response time in the memory task. This observed trend mirrored the trend present in the perceptual discrimination task. Based on

the absence of a significant interaction between the participants' group and task type, we can conclude that CVD participants in our study performed the memory task comparably to the control group, with performance differences attributable to CVD-related deficits, just like those observed at the level of perceptual discrimination. Notably, CVD participants achieved relatively high accuracy, with approximately 84% in the perception task and 70% in the memory task. These results align with the performance of CVD observers in previous studies (Flatla & Gutwin, 2012; Simon-Liedtke & Farup, 2016), indicating that most of our participants have mild to moderate deficiencies. Thus, our conclusions primarily concern this group of CVD observers.

Our main findings revealed strong effects of both daltonization methods on CVD participants' performance in the memory task – when colors were adjusted to accommodate their deficits, participants exhibited significantly faster response times and higher accuracy. The applied color corrections, contingent upon the type and level of application, accelerated CVD participants by 423ms to 645ms and increased their accuracy by 17 to 28 percent, thereby clearly demonstrating their effectiveness in tasks that require brief maintenance of color information. Moreover, in the TB condition, CVD participants reached performance levels comparable to those of non-CVD participants. Similar effects were recorded for the perceptual task – both levels of daltonization methods significantly accelerated CVD participants and increased their response accuracy. Given that daltonization increased the perceptual distance between the colors, it enhanced the performance of the control participants as well; however, the effect was considerably less pronounced, as they already performed near the accuracy ceiling with non-corrected colors.

Our findings suggest that adapting visual input significantly facilitates cognitive processing following perceptual discrimination, in an expected manner. Moreover, we found even stronger effects in the memory task, compared to the perceptual task. These findings are highly significant for future studies on CWM, especially in the context of CVD, as prior studies did not directly compare the effects of daltonization across tasks involving different cognitive processes. Within the CATMET model of CWM (Bae et al., 2015), this could mean that the color correction brought stimuli closer to category prototypes, making them easier to categorize and label. As a result,

both the continuous and categorical channels of CWM could benefit from daltonization, leading to a more pronounced effect in the memory task. This hypothesis is particularly supported by the finding that CVD participants experienced a significant memory benefit from the TB method. This method shifts colors away from the confusion line, aligning them more closely with color categories that are identifiable for these observers.

Our results indicated important differences between the effects of the two daltonization methods. The TB method showed robust effects, independent of its level, demonstrating excellent performance across both tasks. This method reduced participants' RTs by as much as 645ms, effectively halving them, compared to the results obtained with original colors. Moreover, it brought the performance of CVD observers to the level of the control group. The absence of significant differences between the two levels of application of this method shows that even a moderate color shift within this approach (in our study, a shift of $\Delta E_{76} = 0.6$) was sufficient to produce such an effect. In terms of accuracy, this method elevated the performance of CVD participants to nearly 100%. In the memory task, this represented an improvement of approximately 30%. We did expect that the enhancement of the blue-yellow contrast would particularly improve performance, especially with artificial stimuli like single colors. However, here we show precisely how much it was enhanced both in terms of time and accuracy. On the other hand, the SB method exhibited slightly lower efficacy: level 1 accelerated CVD participants by 400ms across both tasks, which is 200ms less than the improvement observed with level 1 of the TB method. Regarding accuracy, after level 1 of the SB method, accuracy in the perceptual task increased by 10% and in the memory task by slightly less than 20%. Importantly, the SB method also showed a dependence on both the daltonization level and the type of task—the level of daltonization significantly influenced both speed and accuracy in the memory task.

Our findings support existing attempts to evaluate daltonization methods behaviourally rather than solely through subjective user assessments. Like Flatla and Gutwin (2012), we found improvements in performance among CVD participants following color correction in the perceptual task on both measures, with the improvements being comparable. However, it is particularly noteworthy to compare our findings

with those of the study employing the VisDem task (Simon-Liedtke & Farup, 2016), where the most effective correction improved CVD accuracy by 15%, whereas we observed a nearly 30% improvement with the TB2 method. More importantly, while these authors found no effects of color correction on participants' RTs, our participants exhibited significant acceleration up to 650ms. Furthermore, we showed even stronger effects in the memory task compared to the perceptual task. The discrepancies between the two studies' results could stem from differences in daltonization methods, stimuli, or task demands. As noted earlier, VisDem required participants to remember the text, i.e., verbal content, while our task required participants to remember the color itself. Our task involved a visual component of the WM, potentially making the effect of daltonization more pronounced in participants' performance. These insights provide important guidelines for future studies on daltonization and color memory, highlighting the significance of the task-specific demands.

The observed differences between the SB and TB methods provide practical insights into optimizing color adjustments for CVD users, surpassing subjective preferences and mere perceptual improvements. Prior research indicates that CVD observers prefer the SB method for naturalistic imagery due to its red-green contrast enhancement which preserves global visual coherence (Keresteš et al., 2023). In these contexts, the TB method may distort object recognition and perceptual naturalness, making it less suitable. Conversely, in scenarios involving artificial color-coded materials—such as maps and charts, the TB method is often favored for its strong, orthogonal enhancement of blue-yellow contrasts. Our findings build upon these preferences by demonstrating that the choice of daltonization method should consider not only image type but also the cognitive demands of the task at hand.

For tasks centered on straightforward perceptual discrimination, especially where maintaining the natural appearance of an image is essential (e.g., viewing photographs or realistic scenes), the SB method may provide adequate improvements. However, the present results show that for more cognitively demanding tasks—such as those requiring the retention of color information—the TB method offers a distinct advantage. Although further research is needed to clarify the underlying cognitive mechanisms, our

findings already offer a preliminary guideline: when memory or learning from color-coded information is paramount, the TB method should be carefully considered.

The practical implications of our findings are further reinforced by our methodological decision to allow participants to complete the entire process in their natural environment using their personal computers. This approach also has limitations. Specifically, we did not conduct clinical testing to determine the CVD severity, nor did we have strictly controlled conditions, calibrated screens, and computers with known response times and accuracies. From a scientific standpoint, this indicates that our results represent a preliminary step in understanding the cognitive functioning of individuals with CVD and provide a foundation for further investigations under laboratory conditions. However, regarding the practical contributions of this study, the chosen methodology enabled us to assess the effectiveness of daltonization methods in real-world settings and conditions and across the widest possible population of individuals who experience any kind of CVD to make better generalization from results to everyday conditions. Most participants in our study, who benefited from the applied color corrections, had never undergone clinical testing for CVD and were unaware of their precise diagnosis, despite experiencing difficulties with hue discrimination. Thus, by showing the robust effects of TB and SB methods, we conclude that both methods are effective and hold substantial potential for commercial application without requiring a controlled environment. Future research should extend our work by testing the effectiveness of these methods under more complex conditions. This includes examining their impact on images containing multiple hues presented simultaneously and assessing how well observers recall color-coded information embedded in real-world scenes. By incorporating more natural viewing conditions and additional device types, future studies can refine the practical guidelines derived from this work.

To conclude, our study demonstrated that enhancing visual input improves not only perception but also the subsequent cognitive processing of color information in individuals with CVD, specifically in terms of memory. Despite their extensive experience with reduced visual input, under certain conditions of color correction, CVD participants' performance can match that of control participants in both reaction time and accuracy, which are

crucial indicators of cognitive processing. These findings have significant theoretical and practical implications. Theoretically, these findings suggest that, despite impaired visual input, individuals with CVD possess the necessary mechanisms for working memory function that are comparable to those of the control group. This could imply that the visual component of working memory in CVD participants remains intact, such that improvements in visual input led to enhanced visual working memory performance. However, the complete mechanism of CWM in CVD individuals is yet to be explored, particularly in terms of examining whether category-based naming tasks can further clarify how memory benefits arise. Consequently, an important direction for future research is to control for color naming in experiments, both within the control group and among CVD individuals. The primary practical implication of this study is that, regardless of the underlying WM mechanism, appropriate image correction can be highly beneficial for the cognitive processing of CVD individuals in real-world settings.

Conflict of interest

We have no conflicts of interest to disclose.

Data availability statement

Data files are available upon a reasonable request.

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Supplementary Materials

Table A

CIELab Coordinates of PL1 Color Stimuli Pairs After SB1, SB2, TB1 and TB2 Daltonization

Dalton.	Deutan						Protan					
	Color 1			Color 2			Color 1			Color 2		
	L	a	b	L	a	b	L	a	b	L	a	b
SB1	0.5	-0.28	0.19	0.5	0.32	0.21	0.5	-0.27	0.18	0.5	0.33	0.22
SB2	0.5	-0.47	0.18	0.5	0.53	0.22	0.5	-0.45	0.17	0.5	0.55	0.23
TB1	0.5	-0.16	0.45	0.5	0.16	-0.05	0.5	-0.17	0.47	0.5	0.17	-0.07
TB2	0.5	-0.25	0.62	0.5	0.27	-0.24	0.5	-0.27	0.65	0.5	0.29	-0.27

Table B

CIELab Coordinates of PL2 Color Stimuli Pairs After SB1, SB2, TB1 and TB2 Daltonization

Dalton.	Deutan						Protan					
	Color 1			Color 2			Color 1			Color 2		
	L	a	b	L	a	b	L	a	b	L	a	b
SB1	0.5	-0.28	-0.21	0.5	0.32	-0.19	0.5	-0.27	-0.22	0.5	0.33	-0.18
SB2	0.5	-0.47	-0.22	0.5	0.53	-0.18	0.5	-0.45	-0.23	0.5	0.55	-0.17
TB1	0.5	-0.16	0.05	0.5	0.16	-0.45	0.5	-0.17	0.07	0.5	0.17	-0.47
TB2	0.5	-0.27	0.24	0.5	0.25	-0.62	0.5	-0.29	0.27	0.5	0.27	-0.65

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Uloga otpornosti, emocionalne inteligencije, doživljaja smisla pandemije i solidarnosti u objašnjenju dobrobiti za vrijeme pandemije COVID-19

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SAŽETAK

Pandemija COVID-19 izazvala je rapidne promjene u svakodnevnici diljem svijeta. Osim nepovoljnih učinaka na mentalno zdravlje, izazovi koje je donijela mogu biti prilika za osobni rast i razvoj. Provedeno je istraživanje s ciljem utvrđivanja doprinosa emocionalne inteligencije, otpornosti, doživljaja smislenosti osobnog iskustva pandemije i percepcije osobne i građanske solidarnosti na dobrobit tijekom pandemije COVID-19. Podaci su prikupljeni online (travanj 2020. - siječanj 2021.). Sudjelovalo je 509 sudionika (70.5% žena, 29.5% muškaraca) u dobi 18 do 75 godina (M = 35.04, SD = 12.68) s područja Republike Hrvatske. Sudionici su svoju dobrobit procijenili relativno visokom. Hijerarhijskom regresijskom analizom utvrđeno je da su stupanj obrazovanja, emocionalna inteligencija, psihološka otpornost, zadovoljstvo solidarnošću društva i percepcija smisla osobnog iskustva tijekom pandemije prediktivne u objašnjavanju varijance dobrobiti. Tim skupom prediktora objašnjeno je ukupno 24.8% varijance dobrobiti, no potrebna su dodatna istraživanja mehanizama u pozadini povezanosti istraživanih čimbenika i dobrobiti.

Ključne riječi: dobrobit, emocionalna inteligencija, otpornost, smisao, solidarnost

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Uvod

Pandemija COVID-19 izazvala je rapidne promjene u svakodnevnici diljem svijeta. Rezultirala je zahtjevima za prilagodbom novim okolnostima s naglaskom na izbjegavanje fizičkog kontakta, ograničavanje kretanja, te poželjnost fizičkog distanciranja i izolacije u vlastitim domovima (Lades et al., 2020). Osim socijalnih i ekonomskih posljedica pandemije, osjećaja usamljenosti, izolacije i zarobljenosti, pandemija koronavirusa donijela je dugoročne i duboke učinke na mentalno zdravlje i dobrobit koji su se odrazili i na osobe koje nisu izravno bile izložene virusu (Holmes et al., 2020; Hotopf et al., 2020; O'Connor et al., 2021). Uz povišene razine anksioznosti, depresije i stresa kao obilježja s početka pandemije (Wang et al., 2020), longitudinalne studije zabilježile su i pad subjektivne dobrobiti u prvih 6 mjeseci pandemije (Zion et al., 2022).

Brojne studije (Holmes et al., 2020; O'Connor et al., 2021, Wang et al., 2020) usmjerene su na istraživanje negativnih učinaka pandemije na mentalno zdravlje, no neki autori (Sanchez-Ruiz et al., 2021) promatraju okolnosti izazvane pandemijom kao izazov te priliku za osobni rast i razvoj. Paradigma egzistencijalne pozitivne psihologije (Wong, 2011) je proširenje prvog vala pozitivne psihologije Seligmana i Csikszentmihalyia (2000), kao što navode Sanchez-Ruiz i suradnici (2021), te čini pomak od ideje kliničara o potrebi uklanjanja izvora uznemirenosti prema ideji da je stres neugodan ali nužan, te je prilika za osobni rast i razvoj. Perspektiva pozitivne psihologije često je kritizirana radi pretjeranog usmjeravanja na pozitivne emocije, dok neugodne emocije ignorira ili ih percipira kao odsutnost pozitivnih afekata (Sanchez-Ruiz et al., 2021). Ta kritika nije utemeljena, stoga što prema stajalištima pozitivne psihologije i nepovoljne okolnosti poput pandemije mogu doprinijeti osobnom rastu i razvoju. Učinkovite strategije suočavanja s novonastalim okolnostima mogu rezultirati povoljnim psihološkim ishodima, osobito u područjima doživljaja osobne dobrobiti (Bokhan et al., 2021).

Subjektivna dobrobit je složeni konstrukt koji je rezultat kombinacije kognitivne, afektivne i eudaimonične komponente (Vanhoutte & Nazroo, 2014). Radi se o subjektivnom doživljaju zadovoljstva različitim aspektima života, a koje može biti kognitivno (zadovoljstvo životom) i afektivno (doživljena raspoloženja i emocije; Diener, 1984; Diener et al., 1999). O složenosti konstrukta svjedoči i PERMA model (Seligman, 2011),

prema kojem dobrobit sačinjavaju pozitivne emocije (eng. *positive emotion*), uključenost (eng. *engagement*), pozitivni odnosi (eng. *positive relationships*), smisao (eng. *meaning*) i postignuće (eng. *accomplishments/achievements*). Iako se radi o složenom konstruktu, dobrobit je u istraživanjima često mjerena jednom česticom (Raudenská, 2023), a neki rezultati (npr. Atroszko et al., 2017) ukazuju na visoke korelacije tih mjera sa složenijim mjerama istog konstrukta. Potrebno je imati na umu i da jednom česticom obično zahvaćamo samo jednu od više faceta konstrukta dobrobiti (Raudenská, 2023). Čestica formulirana s fokusom na procjenu zadovoljstva životom općenito predstavlja kognitivnu komponentu subjektivne dobrobiti, dok čestica u kojoj je fokus na procjeni sreće reflektira afektivnu komponentu subjektivne dobrobiti (Strobel et al., 2011). Budući da su komponente PERMA modela važne za razvoj dobrobiti pojedinca, model se smatra dobrim polazištem za planiranje pozitivnih psiholoških intervencija usmjerenih ka sprječavanju dugoročnih nepovoljnih učinaka pandemije koronavirusa na mentalno zdravlje (Morgan & Simmons, 2021; Sun et al., 2024). Temeljem spomenutog modela, Sun i suradnici (2024) predlažu nekoliko mjera suočavanja s posljedicama COVID-a. Autori (Sun et al., 2024) predlažu osnaživanje pozitivnih emocija kroz psihoedukaciju. Slijedeće predložene mjere su organiziranje većeg broja ustanova u kojima se može primiti psihološka podrška, smanjenje stigmatizacije kroz edukaciju članova obitelji i cjelokupne javnosti o dugoročnim posljedicama COVID-a, psihološka podrška u pronalaženju osobnog smisla života, te podrška u doživljavanju osjećaja postignuća u svakodnevnim aktivnostima. Iako rad na komponentama PERMA modela može doprinijeti poboljšanju mentalnog zdravlja općenito (Kovich et al., 2023), važno je razmotriti i druge čimbenike čije bi osnaživanje moglo povoljno djelovati na dobrobit pojedinca suočenog s dugoročnim posljedicama pandemije. U ovom istraživanju posebna pozornost posvećena je komponenti smisla iz spomenutog modela, a koja se često istražuje i zasebno u okviru drugih teorijskih pristupa (npr. Wong, 1998).

Percepcija smisla ključna je za zaštitu i unapređenje mentalnog zdravlja i dobrobiti tijekom stresnih životnih okolnosti (Arslan et al., 2022; Karataş & Tagay, 2021; Russo-Netzer, 2023), te se može promatrati kao globalni ili situacijski doživljaj smisla (Karataş & Tagay, 2021). Globalna percepcija smisla odnosi se na pojedinčeve osnovne ciljeve i vjerovanja o sebi i o svijetu, dok se situacijska percepcija smisla odnosi na traženje smisla

u određenim životnim okolnostima ili ishodima (Zambelli & Tagliabue, 2024). Percepcija smislenosti života jedan je od medijatora veze između stresa izazvanog koronavirusom i dobrobiti studenata (Arslan & Allen, 2021), a povezana je s osjećajem svrhovitosti, te može ublažiti stres u složenim životnim situacijama, uključujući pandemiju (Park & Gutierrez, 2012; Schnell & Krampe, 2020). U savjetodavnome radu, upućivanje na otkrivanje smisla u prilagodbi pojedinca na stresne događaje iznimno je značajno, no ujedno je i kompleksno (Park & Gutierrez, 2012; Wong, 1998). Moguće je da podrška u vidu traženja smisla pomaže pojedincu da prevlada stresne događaje jer pomiče fokus s preživljavanja na razvoj otpornosti (Stark et al., 2020). Otpornost se može definirati kao proces adaptacije na nedaće, traume, tragedije, prijetnje i važne stresore (*The American Psychological Association* – APA, 2014), te je još jedan čimbenik koji značajno doprinosi dobrobiti. Otpornost se u različitim radovima operacionalizira na različite načine - kao „ukočenost“ (na način da nas težak događaj nije „dotakao“), vraćanje u prvotno stanje (tzv. *bouncing back*) i plastičnost, odnosno mijenjanje, tj. rast nakon teškog iskustva. Den Hartigh i Hill (2022) ističu da je druga navedena operacionalizacija najtočnija, odnosno da upravo ona odgovara fizikalnom poimanju otpornosti, a upravo je ta operacionalizacija primijenjena i u ovom istraživanju. Otpornost omogućava osobi da se suoči s osobnim poteškoćama, neugodnim događajima, kao i da se osnaži za buduće izazove, te je stoga važan izvor subjektivne dobrobiti (Liu et al., 2022). Dosljedno je povezana s dobrobiti (Satici, 2016; Tomyn & Weinberg, 2016), značajno je predviđa (Bajaj & Pande, 2016; Yıldırım & Arslan, 2020), a tijekom pandemije COVID-19 zabilježen je pad i u otpornosti i u dobrobiti (Metin et al., 2021). Otporni pojedinci skloni su pozitivnom promišljanju o svijetu i okolini, koje vodi većem kapacitetu za prepoznavanje prilika i pronalaženje rješenja u teškim situacijama (Wang, 2009). Otpornost doprinosi dobrobiti kroz više pozitivnih misli iz „pozitivne kognitivne trijade“, odnosno kognicija o sebi, svijetu i budućnosti (Mak et al., 2011). Sretne osobe sebe vide u pozitivnom svjetlu, prepoznaju prilike u svijetu oko sebe, te se znaju suočiti s izazovima, a na budućnost gledaju s optimizmom (Mak et al., 2011). Takav set misli moguće je predvidjeti i temeljem percepcije smislenosti života (Karataş & Tagay, 2021), što dodatno naglašava duboku povezanost dobrobiti, otpornosti i percepcije smisla.

Sanchez-Ruiz i suradnici (2021) izdvajaju emocionalnu inteligenciju kao jednu od ključnih osobina koje mogu pridonijeti održavanju subjektivne dobrobiti za vrijeme pandemije. Prema rječniku APA-e (2018), emocionalna inteligencija je vrsta inteligencije koja podrazumijeva sposobnost obrade emocionalnih informacija i njihove upotrebe u razmišljanju i drugim kognitivnim aktivnostima. Tako definirana emocionalna inteligencija mjeri se objektivnim testovima (Mayer & Salovey, 1997). Ipak, prethodna istraživanja pokazala su da je s važnim životnim ishodima povezan i način na koji osoba percipira vlastite sposobnosti obrade emocionalnih informacija, odnosno samprocjenjena emocionalna inteligencija. Istraživanja (Sanchez-Ruiz et al., 2021) su pokazala da osobe s višom samoprocjenjenom emocionalnom inteligencijom biraju strategije suočavanja sa stresorima koje između ostalog potiču veći osjećaj smislenosti doživljenog iskustva. Uz to, viša samoprocijenjena emocionalna inteligencija predviđa doživljaj veće dobrobiti i manje prijetnje. Osim povezanosti s dobrobiti, brojne studije (Cuartero & Tur, 2021; Droppert et al., 2019; Ononye et al., 2022) ističu pozitivnu povezanost samoprocijenjene emocionalne inteligencije i otpornosti, dok Zheng i suradnici (2021) nalaze dokaze u prilog dvosmjernosti tog odnosa. U ovom radu fokus je na samoprocijenjenoj sposobnosti emocionalne inteligencije.

Uz važnost ovdje spomenutih te brojnih drugih psiholoških varijabli, u promjenama doživljaja dobrobiti nakon kriznih situacija koje uključuju i pandemiju koronavirusa naglašava se i uloga solidarnosti (Hogan, 2020). Solidarnost se, prema Hoganu (2020), nalazi u samom centru suradničke pozitivne psihologije koja uključuje sagledavanje „šire slike“ i podržavanje naprednih oblika sustavnog razmišljanja s ciljem održive dobrobiti. Hogan (2020) naglašava ključnost neugodnih emocija za pozitivne transformacije unutar grupa. Naime, diljem svijeta ljudi su suočeni s brojnim krizama, pri čemu obični ljudi pronalaze hrabre i inovativne načine za dijeljenje resursa i podršku ugroženima (Spade, 2020). Na taj način neugodne emocije mogu dovesti do pozitivnih promjena. Na temelju istraživanja provedenog 2016. godine u 13 država članica Europske unije (EU; Gerhards et al., 2019) Europljani su se procijenili znatno više solidarnima nego što su mnogi političari i društveni znanstvenici dosad pretpostavljali, osobito primjerice u pogledu brige za osobe u potrebi. Većina građana EU sklonija je tome da se novac dobiven od poreza troši na pomoć vlastitim stanovnicima nego na pomoć drugim državama EU, među kojima prednost daju susjednim

državama (Cicchi et al., 2020). Također, europska solidarnost izraženija je kad su u pitanju egzogeni stresovi (poput svjetske pandemije), dok je manje izražena u slučaju endogenih stresova (poput zapadanja u osobne dugove). Prema Fetchenhaueru i suradnicima (2006), stupanj solidarnosti pojedine osobe ovisi o njezinoj definiciji situacije, a koja uključuje motivacijske i kognitivne aspekte (npr. Koji su moji ciljevi? Na što sam posebno osjetljiv?), te mentalni model odnosa (npr. Da li mi je drugi prijatelj ili neprijatelj? Jesmo li u natjecateljskom odnosu?), što možemo povezati i s poimanjima osobnog smisla i dobrobiti.

Nalazi dosadašnjih istraživanja ukazuju na složene međuodnose samoprocijenjene emocionalne inteligencije, otpornosti, različitih aspekata solidarnosti i percepcije smisla pandemije s percepcijom dobrobiti u periodu psihosocijalnih okolnosti izazvanih pandemijom COVID-19. U pronađenoj literaturi uloga tih varijabli nije istraživana istodobno, stoga se nastojalo utvrditi hoće li solidarnost, na koju se snažno pozivalo tijekom pandemije, i percepcija smisla vlastitog iskustva tijekom pandemije, kao svojevrstan okvir poimanja situacije, dodatno doprinijeti objašnjenju dobrobiti tijekom pandemije, u kontekstu psiholoških osobina koje su potvrđeno povezane s percepcijom dobrobiti. Cilj ovog istraživanja je, stoga, bio provjeriti hoće li primarno sociološka varijabla u kriznoj društvenoj situaciji (percepcija solidarnosti), doprinijeti dodatnom objašnjenju dobrobiti, nakon doprinosa dviju trajnijih psiholoških značajki (emocionalne inteligencije i otpornosti), kao i hoće li svjetonazorski okvir (poimanje smisla vlastitog života) u kriznoj društvenoj situaciji doprinijeti dodatnom objašnjenju varijance dobrobiti. Slijedom navedenog, istraživački cilj je istražiti ulogu emocionalne inteligencije, otpornosti, različitih aspekata solidarnosti i percepcije smisla pandemije u percepciji dobrobiti za vrijeme pandemije koronavirusa. U postizanju ciljeva istraživanja prvo će se opisati izraženost navedenih varijabli kod sudionika istraživanja, kako bismo ih mogli staviti u kontekst pred-pandemijskih i pandemijskih istraživanja. Nakon toga pristupit će se utvrđivanju zasebnog i zajedničkog doprinosa samoprocijenjene emocionalne inteligencije, otpornosti, percepcije smisla i dvaju aspekata solidarnosti na percepciju dobrobiti tijekom pandemije koronavirusa.

Metod

Sudionici

U istraživanju je sudjelovalo 509 sudionika u dobi 18 do 75 godina (*M* = 35.04, *SD* = 12.68), pri čemu je 70.5% sudionika ženskog spola i 29.5% sudionika muškog spola. Ukupno 49.5% sudionika živi na području Grada Zagreba, a ostali sudionici su iz različitih županija na području Republike Hrvatske. Uzorak je detaljno prikazan u Tablici 1.

Tablica 1

*Opis Uzorka (*N = *509)*

Obrazovanje	*f*	%
Dvogodišnja ili trogodišnja srednja škola	18	3.5
Četverogodišnja srednja škola	162	31.8
Viša ili visoka škola, preddiplomski ili diplomski studij	250	49.1
Magisterij i/ili doktorat znanosti	79	15.5
Veličina naselja		
< 500 000 stanovnika	263	51.7
≥ 500 000 stanovnika	246	48.3
Dob		
18-25	159	31.2
26-35	147	28.9
36-45	81	15.9
46-55	87	17.1
56-65	26	5.1
66-75	9	1.8

Instrumenti

Na početku istraživanja prikupljeni su sociodemografski podaci. Sudionici su odgovarali na pitanja o dobi, spolu, obrazovanju i veličini mjesta stanovanja.

Emocionalna inteligencija

Emocionalna inteligencija operacionalizirana je kao rezultat na Upitniku emocionalne kompetentnosti (UEK-15, Takšić, 2002). Upitnik se sastoji od 15 čestica na koje sudionici odgovaraju pomoću skale od 5 stupnjeva (1 - Uopće NE, 5 - U potpunosti DA). Sve čestice su pozitivno usmjerene, a ukupni rezultat izračunava se zbrajanjem svih odgovora po česticama, te viši rezultat ukazuje na višu samoprocjenu emocionalne inteligencije sudionika. Pouzdanost tipa unutarnje konzistencije u ovom istraživanju je zadovoljavajuća (Cronbach α = .83).

Otpornost

Otpornost je operacionalizirana kao rezultat na Kratkoj skali otpornosti (eng. *Brief Resilience Scale*; Smith et al., 2008; preveli Slišković i Burić, 2018). Skala se sastoji od šest tvrdnji na koje sudionici odgovaraju procjenom stupnja slaganja s pojedinom tvrdnjom (1-*Uopće se ne slažem*, 5 – *U potpunosti se slažem*). Ukupan rezultat formira se kao prosječan rezultat na svim česticama nakon obrnutog bodovanja negativno orijentiranih tvrdnji, pri čemu viši rezultat ukazuje na višu razinu otpornosti. U provedenom istraživanju utvrđena je zadovoljavajuća pouzdanost skale (Cronbach α = .87).

Percepcija dobrobiti

Percepcija dobrobiti operacionalizirana je kao odgovor na česticu „Koliko biste svoj život procijenili dobrim?“. Sudionici su odgovarali na skali samoprocjene sa stupnjevima od 1 do 10, pri čemu viši odgovor ukazuje na višu percepciju dobrobiti. Samoprocjene sreće i zadovoljstva životom pomoću jedne čestice u pozitivnoj su korelaciji s opsežnijim instrumentima za mjerenje dobrobiti (Atroszko et al., 2017; Cheung & Lucas, 2014; Jovanović i Brdar, 2018).

Solidarnost

Dva aspekta solidarnosti ispitana su pomoću dvije čestice: „Smatram da svojim djelovanjem tijekom ove pandemije doprinosim društvu.“ - koja se odnosi na osobni aspekt solidarnosti i „Zadovoljan/na sam razinom solidarnosti među građanima Hrvatske.“ - koja se odnosi na zadovoljstvo

percipiranom razinom solidarnosti u društvu. Sudionici su odgovarali procjenom stupnja slaganja s tvrdnjom (1 - *Uopće se ne slažem*, 5 - *U potpunosti se slažem*).

Percepcija osobnog smisla

Percepcija osobnog smisla u pandemiji operacionalizirana je kao odgovor na pitanje „Smatrate li da Vaše osobno iskustvo tijekom pandemije COVID-19 ima neki smisao?“, pri čemu su sudionici ponudili svoj odgovor na skali od 5 stupnjeva (1 - *Uopće se ne slažem*, 5 - *U potpunosti se slažem*).

Postupak prikupljanja podataka

Podaci su prikupljeni online, pomoću LimeSurvey platforme, te se sudionicima pristupilo putem *e-maila* i *Facebook* grupa, u periodu od travnja 2020. do siječnja 2021. godine. Ovo istraživanje provedeno je u sklopu istraživačkog projekta „Psihološki i sociološki prediktori dobrobiti u vrijeme i nakon pandemije COVID-19“, a kojeg je proveo multidisciplinarni istraživački tim Fakulteta hrvatskih studija Sveučilišta u Zagrebu. Istraživanje je provedeno u skladu s etičkim standardima Hrvatske psihološke komore, poštujući anonimnost sudionika, dobrovoljnost sudjelovanja, te pravo na odustajanje.

Rezultati

U svrhu odgovaranja na postavljena istraživačka pitanja provedene su deskriptivne analize te korelacijska i hijerarhijska regresijska analiza, čiji su rezultati prikazani u nastavku.

Tablica 2

Prikaz Deskriptivnih Podataka Svih Varijabli

	Min	Max	*M*	*SD*	Skewness (std. greška)
Procjena dobrobiti	1	10	7.65	1.53	-1.104 (.108)
Osobni smisao_COVID-19	1	5	3.40	.96	-.710 (.108)
Emocionalna inteligencija	25	75	55.38	6.61	-.311 (.108)
Psihološka otpornost	1	5	3.14	.69	-.169 (.108)
Solidarnost_osobni doprinos	1	5	3.56	1.06	-.710 (.108)
Zadovoljstvo solidarnošću društva	1	5	3.48	1.06	-.621 (.108)

Sve su distribucije negativno asimetrične, no ako apsolutna vrijednost statistika zakrivljenosti (eng. *skewness*) ne prelazi vrijednost 2, smatra se da nema bitnog odstupanja od normalnosti (Kim, 2013). Prema rezultatima vidljivima u Tablici 2, sudionici svoju dobrobit procjenjuju od osrednje prema višoj, dok se umjereno slažu kako pandemija COVID-19 za njih ima osobni smisao. S obzirom na negativno asimetričnu distribuciju, rezultati samoprocijenjene emocionalne inteligencije blago su pomaknuti prema višim vrijednostima. Psihološka otpornost sudionika nalazi se oko prosjeka s obzirom na teorijski raspon skale (min = 1, max = 5). Stav o vlastitom doprinosu društvu, te zadovoljstvo iskazanom solidarnošću društva za vrijeme pandemije, je također blizu prosjeka skale odgovora. T-testom nisu utvrđene spolne razlike u procjeni dobrobiti, niti u pogledu dva aspekata solidarnosti, no jesu u pogledu emocionalne inteligencije (M_m = 53.647, $M_ž$ = 56.086, $t(243.57) = -3.622$, $p < .001$), psihološke otpornosti (M_m = 3.264, $M_ž$ = 3.090, $t(507) = 2.645$, $p = .009$), te procjene osobnog smisla u situaciji pandemije COVID-a (M_m = 3.230, $M_ž$ = 3.470, $t(507) = -2.522$, $p = .011$), na način da žene iskazuju višu emocionalnu inteligenciju, te pronalaze viši osobni smisao u situaciji pandemije, no iskazuju nešto nižu otpornost od muškaraca.

Tablica 3

Matrica Korelacija (Pearson r) Varijabli Ispitivanih u Istraživanju

	1	2	3	4	5	6	7	8
1 - Spol	1							
2 - Dob	-.153**	1						
3 - Obrazovanje	.115**	.048	1					
4 - Emocionalna inteligencija	.169**	-.031	.138**	1				
5 - Psihološka otpornost	-.117**	-.032	.095*	.304**	1			
6 - Solidarnost_osobni doprinos	.006	.093*	.112*	.251**	.171**	1		
7 - Zadovoljstvo solidarnošću društva	.067	.027	.068	.073	.049	.130**	1	
8 - Osobni smisao_COVID-19	.111*	.058	.138**	.231**	.111*	.295**	.190**	1
9 - Dobrobit	.049	-.040	.208**	.343**	.359**	.126**	.142**	.295**

Napomena. *$p < .05$, **$p < .01$.

Dobrobit, odnosno procjena vlastite dobrobiti, značajno nisko do umjereno pozitivno korelira sa gotovo svim varijablama u istraživanju, osim sa dobi i spolom, čije su se korelacije pokazala niske i neznačajne (Tablica 3). Drugim riječima, procjena vlastite dobrobiti viša je što je viši stupanj obrazovanja sudionika, emocionalna inteligencija, psihološka otpornost, osobni doprinos društvu, zadovoljstvo s iskazanom solidarnošću društva i viši pronalazak osobnog smisla u pandemiji COVID-19. Gotovo sve prediktorske varijable su međusobno korelirane, no visina korelacija ne prelazi $r = .304$.

U svrhu određivanja prediktora koji najviše doprinose predviđanju osobne dobrobiti provedena je hijerarhijska regresijska analiza čiji su rezultati prikazani u Tablici 4. U prvi korak analize uvrštena je sociodemografska varijabla koja se odnosi na najviši završeni stupanj obrazovanja radi kontrole. U drugi korak uključene su samoprocijenjena emocionalna inteligencija i psihološka otpornost kao bazične i trajnije značajke pojedinca. U treći korak uvrštene su varijable vezane uz solidarnost, odnosno zadovoljstvo vlastitom

solidarnošću te solidarnošću drugih za vrijeme pandemije koronavirusa. U četvrtom koraku uvrštena je varijabla percepcije osobnog smisla pandemije. U prvom koraku završeni stupanj obrazovanja pokazao se značajnim prediktorom te samostalno objašnjava 4.1% varijance dobrobiti. Samoprocijenjena emocionalna inteligencija i psihološka otpornost u drugom koraku hijerarhijske regresijske analize, zajedno sa stupnjem obrazovanja objašnjavaju 20.6% varijance dobrobiti. Uvođenjem osobnog doprinosa društvu tijekom pandemije i zadovoljstva društvenom solidarnošću u trećem koraku analize objašnjeno je ukupno 21.4% varijance dobrobiti. Ipak, samo se zadovoljstvo društvenom solidarnošću pokazalo značajnim prediktorom percepcije dobrobiti u trećem koraku, pri čemu obrazovanje, samoprocijenjena emocionalna inteligencija i psihološka otpornost i dalje ostaju značajni prediktori. U četvrtom koraku uključena je varijabla koja se odnosi na osobni smisao koji pojedinac nalazi u pandemiji COVID-19, pri čemu se taj prediktor pokazao značajnim, dok je zadovoljstvo solidarnošću društva u tom koraku izgubilo značajnost. Temeljem svih prediktora zajedno objašnjeno je ukupno 24.8% varijance procjene dobrobiti.

Tablica 4

Rezultati hijerarhijske regresijske analize s procjenom dobrobiti kao kriterijskom varijablom

	Korak 1		Korak 2		Korak 3		Korak 4	
	B	β	*B*	β	*B*	β	*B*	β
Obrazovanje	.426**	.208**	.305**	.149**	.294**	.144**	.261**	.128**
Emocionalna inteligencija			.056**	.239**	.055**	.236**	.048**	.206**
Psihološka otpornost			.608**	.272**	.604**	.271**	.599**	.268**
Solidarnost_osobni doprinos					-.013	-.009	-.080	-.055
Zadovoljstvo solidarnosti društva					.148*	.103*	.106	.073
Osobni smisao_COVID-19							.323**	.203**

R^2	.043	.211	.221	.257
R^2_{adj}	.041	.206	.214	.248
ΔR^2		.168	.010	.036

Napomena. *p < .05, ** p <.01.

Rasprava

Istraživanje je provedeno s ciljem opisivanja izraženosti psiholoških čimbenika povezanih s dobrobiti tijekom pandemije COVID-19, te utvrđivanja koji od tih čimbenika najviše doprinose dobrobiti. Dobiveni rezultati pokazuju da je psihološka otpornost najbolji prediktor dobrobiti, slijede je samoprocijenjena emocionalna inteligencija, percepcija osobne smislenosti pandemije koronavirusa i stupanj obrazovanja. Zadovoljstvo društvenom solidarnošću za vrijeme pandemije koronavirusa vrlo malo doprinosi percepciji dobrobiti, dok osobni doprinos društvu nije značajan prediktor dobrobiti.

U kontekstu opisivanja istraženosti temeljnih psiholoških varijabli u ovom istraživanju, pokazalo se da sudionici iz uzorka iskazuju relativno visoku razinu osobne dobrobiti. Iako se radi o složenom konstruktu, dobrobit je u literaturi često mjerena jednom česticom (Raudenská, 2023), pri čemu u takvim mjerenjima fokus na procjenu zadovoljstva životom predstavlja samo kognitivnu komponentu dobrobiti (Strobel et al., 2011). U skladu s time, pretpostavka je da je u ovom istraživanju također mjerena kognitivna komponenta dobrobiti, budući da je kao mjera dobrobiti korištena samoprocjena pojedinca koliko je njegov život u cjelini dobar. Dosadašnja istraživanja utvrđuju slične rezultate na srodnim varijablama. Primjerice, prema podacima Pilarovog barometra hrvatskog društva (Institut društvenih znanosti Ivo Pilar, 2014, 2016) na skali od 1-10 postignuti su slični rezultati procjene zadovoljstva životom u pretpandemijskom razdoblju (M u rasponu od 6.02 do 6.51). Neka istraživanja pokazuju niže razine dobrobiti kod ženskih osoba te osoba mlađe životne dobi tijekom pandemije (Losada-Baltar et al., 2020; O'Connor et al., 2021), dok pojedine studije to ne pokazuju (Karataş & Tagay, 2021; Tomyn & Weiberg, 2016). U ovom istraživanju nisu utvrđene spolne ni dobne razlike u percepciji dobrobiti. U kontekstu opisa dobrobiti

važno je istaknuti da se u ovom istraživanju radi o nereprezentativnom uzorku u kojem je više od polovice sudionika visokoobrazovano, a više obrazovanje je povezano s dobrobiti (Lee & Yang, 2022). Psihološka otpornost sudionika u skladu je s onom dobivenom u validaciji Kratke skale otpornosti (Slišković i Burić, 2018) na prigodnome uzorku učitelja i nastavnika zaposlenih u srednjim školama. Za razliku od toga, Killgore i suradnici (2020) su na uzorku od oko 1000 odraslih Amerikanaca u prvim tjednima socijalnih restrikcija (*eng. lock down*) radi pandemije utvrdili da je prosječna otpornost niža od objavljenih normi. U ovom istraživanju utvrđene su spolne razlike u otpornosti, a koje su u skladu s dosadašnjim studijama (npr. Tomyn & Weiberg, 2016) prema kojima muškarci iskazuju veću psihološku otpornost. Percepcija osobnog doprinosa tijekom pandemije, kao i zadovoljstvo solidarnošću unutar društva nalaze se malo iznad prosjeka skale, te su gotovo identične (oko 3.5 na skali od 1 do 5) i nisu se pokazale razlikovnima u pogledu spola – dakle, muškarci i žene podjednako su zadovoljni svojim doprinosom društvu tijekom pandemije, kao i općom solidarnošću društva. Takvi rezultati mjerenja zadovoljstva solidarnošću u skladu su sa srodnim varijablama, poput društvene komponente zadovoljstva životom (Institut društvenih znanosti Ivo Pilar, 2016).

Sve prediktorske varijable su u značajnoj pozitivnoj korelaciji s percepcijom dobrobiti, a u prvi korak uključena je kontrolna sociodemografska varijabla koja se odnosi na završeni stupanj obrazovanja, koja se pokazala značajnim prediktorom u prvom, ali i u svim ostalim koracima hijerarhijske regresijske analize. Obrazovanje je socioekonomski čimbenik često koreliran s dobrobiti (Patria, 2022; Ruiu & Ruiu, 2019; Wilson Fadiji & Lomas, 2024), iako taj nalaz nije uvijek dosljedan, te ovisi o kombinaciji drugih sociodemografskih čimbenika (Wilson Fadiji & Lomas, 2024). Djelovanje obrazovanja na dobrobit vjerojatno proizlazi iz pozitivnog učinka obrazovanja na druge aspekte života, poput zdravlja, socijalnog statusa i prihoda (Wilson Fadiji & Lomas, 2024), stoga je doprinos obrazovnog statusa dobrobiti u ovom istraživanu očekivan. U drugi korak regresijske analize uključene su trajnije psihološke značajke, odnosno emocionalna inteligencija i otpornost. Emocionalna inteligencija i otpornost značajno doprinose dobrobiti, pri čemu se boljim prediktorom pokazala otpornost. Veza otpornosti i dobrobiti je očekivana, budući da se psihološka otpornost pokazala povezanom sa zadovoljstvom životom (Li et al., 2024;

Mayordomo et al., 2016; Slišković i Burić, 2018). Moguće je da otpornost doprinosi doživljaju pozitivnih emocija i zadovoljstva životom (Dagnall et al., 2019), te reducira stres i djeluje kao zaštitni čimbenik u suočavanju sa stresorima (Li et al., 2024). Subjektivnu dobrobit moguće je predviđati temeljem otpornosti, ali i neodgovarajućih emocionalnih obrazaca (Mayordomo et al., 2016). Pojedinci s višom emocionalnom inteligencijom imaju veću vjerojatnost uključivanja u adaptivne strategije suočavanja kada se suoče sa stresnim situacijama, što je povezano s većom dobrobiti (Keefer et al., 2018, prema Sanchez-Ruiz et al., 2021). Emocionalna inteligencija mjerena kao osobina ličnosti pokazala se negativnim prediktorom psihološkog stresa u kontekstu pandemije, koji djeluje kroz strategije suočavanja (Sanchez-Ruiz et al., 2021). Naime, regulacija emocija, ključna sastavnica osobine emocionalne inteligencije, omogućuje pojedincima da odaberu učinkovite načine suočavanja koje umanjuju njihove negativne emocije, te zadržavaju pozitivne emocije (Tugade & Frederickson, 2007).

U treći i četvrti korak regresijske analize uključene su varijable čije djelovanje se smatra manje stabilnim od djelovanja psiholoških konstrukata poput emocionalne inteligencije i otpornosti, a vezane su uz poimanje pandemije koronavirusa. U treći korak uključene su percepcija osobnog doprinosa društvu tijekom pandemije, te percepcija društvene solidarnosti, dok je u četvrti korak uključena varijabla vezana uz percepciju smislenosti osobnog iskustva u pandemiji koronavirusa. U trećem je koraku percipiranu dobrobit značajno predvidjelo zadovoljstvo društvenom solidarnošću, no ne i procjena osobnog doprinosa društvu, uz zadržanu značajnost dotadašnjih prediktora. Dodatno, uvođenjem percepcije smisla pandemije u analizu u četvrtom koraku, zadovoljstvo društvenom solidarnošću prestaje biti značajan prediktor dobrobiti.

Moguće je primijetiti da je osobni doprinos tijekom pandemije značajno koreliran s ranije uključenim prediktorima, samoprocijenjenom emocionalnom inteligencijom i otpornošću, te stoga možemo zaključiti da emocionalno inteligentnije i otpornije osobe imaju i veći kapacitet za davanje vlastitog doprinosa u kriznoj situaciji. Moguće je da upravo iz tog razloga sama varijabla osobnog doprinosa nije dodatno doprinijela objašnjenju dobrobiti osobe. S druge strane, zadovoljstvo solidarnošću društva nije povezano s navedenim trajnijim psihološkim značajkama osobe, te je stoga dalo dodatan

doprinos. Percepcija smisla vlastitog iskustva tijekom pandemije dodatno doprinosi psihološkoj dobrobiti, što je u skladu i s nalazima drugih autora (Krok & Zarzycka, 2020); štoviše, u nedavnoj studiji Eisenbecka i suradnika (2021) u 30 zemalja, pokazano je da suočavanje usmjereno na smisao ima središnje mjesto u mentalnom zdravlju tijekom pandemije. Iz istog istraživanja je razvidno da jedine dvije uključene varijable koje se tiču društva u cjelini (BDP i težina pandemije) nisu bile značajni prediktori depresije, anksioznosti ni stresa, dok individualni čimbenici, poput osobnog ekonomskog utjecaja pandemije i mentalnog zdravlja jesu. Ovakvi rezultati su u skladu i s ovdje dobivenim nalazom da percepcija smisla vlastitog iskustva tijekom pandemije „nadjačava" važnost zadovoljstva društvenom solidarnošću kao sociološke dimenzije. Percepcija smisla osobnog života u različitim, pa i vrlo teškim okolnostima, ima važniju ulogu od samih okolnosti koje nam nikada ne mogu oduzeti barem mali „prostor slobode" (Frankl, 2021). Važno je napomenuti i da visoka emocionalna inteligencija može pružiti temelje pojedincima da namjerno biraju strategije suočavanja usmjerene na smisao, poput cijenjenja života i uključivanja u smislene prosocijalne aktivnosti pred izazovima povezanim s pandemijom (Sanchez-Ruiz et al., 2021).

Na temelju rezultata regresijske analize možemo zaključiti da su trajnije značajke, poput samoprocijenjene emocionalne inteligencije i psihološke otpornosti, te sklonosti da se konkretna situacija percipira kao smislena, važnije u predviđanju dobrobiti osobe tijekom pandemije od sociodemografskih varijabli, poput „dvaju smjerova solidarnosti" (osobnog doprinosa društvu i zadovoljstva društvenom solidarnošću). Yang (2020) navodi da je pandemija COVID-19 snažno iskustvo koje je u nama osvijestilo našu prolaznost i nestalnost, nepredvidivost života, egzistencijalni vakuum, te međuovisnost života i smrti. No, ovo istraživanje je pokazalo da upravo percepcija smislenosti situacije, kao i trajne značajke poput psihološke otpornosti i emocionalne inteligencije imaju značajnu ulogu u dobrobiti tijekom pandemije, što ukazuje na važnost razvijanja tih značajki kao sredstva za osnaživanje u različitim životnim nedaćama. Ovi nalazi dodatno potkrjepljuju važnost intervencija za povećanje emocionalne inteligencije (Geßler et al., 2021; Kotsou et al., 2018) i otpornosti (Liu et al., 2020; Liu et al., 2022), te ukazuju na dodatno povećanje dobrobiti prepoznavanjem

smisla konkretne situacije (de Jong et al., 2020), s obzirom da sve navedeno može doprinijeti višoj percepciji dobrobiti i u kriznim društvenim situacijama.

Među nedostacima ovog istraživanja važno je istaknuti činjenicu da je provedeno online. To je utjecalo na povećanu nereprezentativnost uzorka u kojem je više od polovice sudionika visokoobrazovano, iako je učinjen dodatan trud da se uključe sudionici koji su bili podzastupljeni (npr. muškarci, stariji od 50 godina, stanovnici iz manje zastupljenih županija). Nisu prikupljeni podaci o socijalnim okolnostima u kojima sudionici žive, a pokazalo se da su ti čimbenici važni za dobrobit – kod osoba u nepovoljnim socijalnim i ekonomskom uvjetima zabilježeni su veći problemi mentalnog zdravlja vezani uz pandemiju koronavirusa u odnosu na ostale (O'Connor et al., 2021). Nadalje, iako mjerenje pomoću jedne čestice (eng. *single item measures*) ima prednosti (Allen et al., 2022; Atroszko et al., 2017; Cheung & Lucas, 2014; Jovanović i Brdar, 2018), takve je mjere potrebno dodatno validirati da bismo bili sigurni u njihovu valjanost. Potrebno je uzeti u obzir i da su sve mjere korištene u istraživanju temeljene na samoprocjenama sudionika. U daljnjim istraživanjima potrebno je fokusirati se na mehanizme u pozadini ovih povezanosti, poput nade, strategija suočavanja sa stresom, socijalne podrške, zatim uključiti i pojedine sposobnosti koje obuhvaća emocionalna inteligencija (a ne samo ukupan rezultat), percepcije smisla različitih aspekata života u kriznim nasuprot ne-kriznim situacijama te se usmjeriti na skupine koje su možda više bile pogođene pandemijom.

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The Role of Resilience, Emotional Intelligence, Perception of Pandemic Meaning, and Solidarity in Explaining Well-Being During the COVID-19 Pandemic

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ABSTRACT

The COVID-19 pandemic has caused rapid changes in daily lives around the world. Aside from the adverse effects on mental health, the challenges posed by the pandemic could be an opportunity for personal growth and development. A study was conducted to determine the contribution of emotional intelligence, resilience, perception of the meaning of personal experience about the pandemic, and two aspects of solidarity during a pandemic to well-being during the COVID-19 pandemic. Data were collected online (April 2020 - January 2021). There were 509 participants (70.5% women, 29.5% men) aged 18 to 75 (M = 35.04, SD = 12.68) from the territory of the Republic of Croatia. Participants rated their well-being relatively high. Hierarchical regression analysis showed that the education level, emotional intelligence, resilience, satisfaction with solidarity in society and perception of the meaning of personal experience during a pandemic significantly predicted well-being. A total of 24.8% of the variance in well-being was explained by the set of predictors, but further research is needed understand the mechanisms behind the association between these variables and well-being.

Keywords: wellbeing, emotional intelligence, resilience, meaning, solidarity

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Research Article

Predicting Whistleblowing Intention: The Role of Work Locus of Control, Fear of Retaliation, and Organizational Commitment

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ABSTRACT

Whistleblowing is the process by which employees report observed irregularities within the organization. Irregularities can be reported internally using reporting mechanisms within the organization or externally by contacting appropriate authorities or the media. This study explored the role that internal and external work locus of control, fear of retaliation, and organizational commitment play in reporting irregularities in the workplace among employees in Serbia. The Prosocial Organizational Behavior Model was used as the theoretical foundation. The convenience sample of 220 adults (*Mage* = 40.77 ± 12.87; 65.9% women) was recruited from the general population. First, we tested whether employees are more likely to report irregularities internally than externally. Then, we tested whether we could predict internal and external whistleblowing intention based on internal and external work locus of control, fear of retaliation, and organizational commitment after controlling for demographic variables. Our analysis revealed that internal whistleblowing intention is more pronounced than external one. After accounting for the demographic variables, we also found that internal work locus of control and organizational commitment positively predict internal whistleblowing intention, while fear of retaliation negatively predicts it. Finally, we found that fear of retaliation and internal locus of control predict external whistleblowing intention positively after controlling for demographic variables. One possible implication of this study is that increasing organizational commitment, fostering an internal locus of control, and ensuring employee safety may encourage whistleblowing;

however, the direction of influence may be reversed, or the third variable not included in our study may play a role.

Keywords: whistleblowing, locus of control, fear of retaliation, reporting wrongdoing, irregularities in the workplace

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Introduction

Organizations often face ethical issues such as theft, dishonesty, conflicts of interest, abuse, rule violations, and condoning unethical actions (Jennings, 2015). Whistleblowing is vital in addressing these issues. While rare, with an average of 3.49 reports per 100 employees globally (Penman et al., 2024), some individuals still report irregularities, highlighting the importance of whistleblowing in organizational ethics.

Near and Miceli (1985, p. 4) proposed one of the most accepted definitions of whistleblowing, defining it as "disclosure by organization members (former or current) of illegal, immoral, or illegitimate practices under the control of their employers, to persons or organizations that may be able to effect action". By pointing out organizational issues, whistleblowers allow employers to correct actions that could harm other members, consumers, or clients (Dozier & Miceli, 1985). A whistleblower can report observed wrongdoing to someone at a higher hierarchical level within the organization or to an official designated for that purpose. This is known as internal whistleblowing (Dhamija & Rai, 2018). On the other hand, external whistleblowing involves reporting wrongdoing to appropriate authorities (including police, audits, the prosecutor's office, the Ombudsman, anti-corruption agencies, and others), the media, or the public (Dhamija & Rai, 2018; Stojanović et al., 2015; Šabić, 2021). Whistleblowers more commonly choose internal channels first, turning to external ones only if previous attempts have been unsuccessful (Dhamija & Rai, 2018; Soeken & Soeken, 1987; Šabić, 2021). Considering this, the present study aimed to test whether internal whistleblowing intention is more pronounced than external whistleblowing intention among employees (H1).

Theoretical Background

Some authors proposed the Prosocial Organizational Behavior (POB) Model as a framework for understanding the motivations behind whistleblowing (Dozier & Miceli, 1985; Miceli et al., 2008). POB refers to behavior that extends beyond an individual's formal job responsibilities and involves actions aimed at benefiting another individual, a group, or the organization itself (Brief & Motowidlo, 1986). According to this definition, internal whistleblowing can be seen as a form of POB, as it is expected to

benefit the organization, just like other forms of POB (Dozier & Miceli, 1985). In contrast, external whistleblowing may be perceived as a threat to the organization and is, therefore, less likely to be classified as POB.

Miceli and colleagues (2008) use the POB model to describe three phases preceding whistleblowing. In each phase, an individual considers specific factors to decide whether to whistleblow. First, the person assesses if an ethical violation occurred and whether anyone is responsible for reporting it. If not, they lean toward whistleblowing. Next, they evaluate the impact of the violation on the organization and whether the organization typically responds to irregularities. The person is more likely to whistleblow if the organization fails to act or if they perceive that the misconduct could harm the organization. In the final phase, the individual weighs the potential gains and losses of reporting and considers whether it is their responsibility to act and whether it would lead to change.

Research findings on predictors of whistleblowing are generally inconsistent, making them difficult to compare and integrate (Chen, 2019). Despite this, five groups of factors associated with the intent to whistleblow or whistleblowing itself can be identified: demographic (e.g., gender, age, and education; Nicholls et al., 2021; Sims & Keenan, 1998), individual (e.g., locus of control, self-efficacy, and moral judgement; Chiu, 2003; MacNab & Worthley, 2008; Miceli et al., 2012, Nicholls et al., 2021), organizational (e.g., leadership, organizational commitment, retaliation; Mrowiec, 2022), social (e.g., laws; Chen, 2019; Nicholls et al., 2021; Park et al., 2005) and irregularity characteristics (e.g., seriousness of wrongdoing, frequency, and wrongdoer characteristics; Nicholls et al., 2021)[1].

This research primarily focused on work locus of control as a personality variable, while organizational commitment and fear of retaliation were considered organizational variables. Specifically, the study examines the roles of fear of retaliation, internal and external work locus of control, and organizational commitment in predicting the intention to report workplace irregularities among employees in Serbia. As such, this study represents a pioneering effort to investigate potential predictors of whistleblowing

[1] See Mrowiec (2022) and Nicholls et al. (2021) for comprehensive systematic reviews on the subject.

intention in Serbia. The study is unique within the Serbian context, not only due to its thematic focus but also because it provides questionnaires that can support future research in this area.

Fear of retaliation

An organization may respond to whistleblowing in one of three ways or some combination of these: by correcting the irregularity, ignoring the report, or retaliating against the whistleblower (Near & Miceli, 1986). Since employees' attitudes toward whistleblowing are often negative (Park et al., 2005), it is unsurprising that retaliation is a common organizational response (Dungan et al., 2015). Retaliation is "an undesirable action taken against a whistleblower in direct response to whistleblowing, who reported wrongdoing internally or externally, outside the organization" (Rehg et al., 2008, p. 222). In a study sample of U.S. companies that experienced financial fraud between 1996 and 2004, results showed that in 82% of cases of non-anonymous whistleblowing, whistleblowers reported experiencing retaliation (Dyck et al., 2010). Some forms of retaliation include social isolation, assigning trivial or overly burdensome tasks, and emotional, physical, and sexual violence (Garrick & Buck, 2020), and can lead to serious financial, physical, and mental health issues (Garrick & Buck, 2020; Soeken & Soeken, 1987).

When an individual perceives that the threat of retaliation is probable and/or severe, they may feel fear, apprehension, guilt, or shame (Khan et al., 2022; Ogungbamila et al., 2022). Research has found a negative correlation between the fear of retaliation and the intent to engage in internal whistleblowing (Dhamija & Rai, 2018; Khan et al., 2022) as well as the intent to engage in external whistleblowing (Dhamija & Rai, 2018; Park & Lewis, 2019). On the other hand, one research indicates that fear of retaliation positively predicts the intention to engage in external whistleblowing (Yang & Xu, 2020). In the present study, we tested whether fear of retaliation is negatively related to self-reported internal whistleblowing intention (H2). We expected that, on average, a higher fear of retaliation would be associated with weaker internal whistleblowing intention. Considering the inconsistent findings, we hypothesized that fear of retaliation would be related to external

whistleblowing intention without specifying the direction of this relationship (H3).

Locus of control and whistleblowing intention

Rotter (1966) defined the locus of control as a person's general belief about the cause-and-effect relationship between their behavior and the consequences of that behavior. The relationship between the locus of control and whistleblowing intention can be found in the abovementioned POB model. In the third phase described by the model, a person contemplates whether whistleblowing would lead to the desired change, which corresponds to the concept of locus of control (Miceli et al., 2008). Individuals with an internal locus of control—those who believe outcomes depend on their actions—are more likely to engage in whistleblowing (Chiu, 2003; Clyde et al., 2022; Hanjani et al., 2018; Trevino & Youngblood, 1990). In contrast, those with an external locus of control—who attribute outcomes to external forces—are less likely to take such proactive measures. Building on this, we propose that individuals with a higher internal work locus of control will show stronger intentions to report wrongdoing, both internally and externally (H4). Conversely, individuals with a higher external work locus of control are expected to demonstrate weaker whistleblowing intentions (H5). In line with the recommendations of Phares (1976) and Spector (1988), who emphasized the advantages of using domain-specific measures of locus of control over a general one, we opted to assess work locus of control in our study. This decision was further supported by Spector's findings, indicating that the work locus of control scale shows stronger correlations with work-related variables compared to measures of general locus of control (1988).

Organizational commitment and whistleblowing intention

The dominant approach in organizational commitment research is the one in which organizational commitment is conceptualized as an individual's psychological attachment to the organization (Meyer & Allen, 1984). In this conceptualization, organizational commitment includes three dimensions: affective, normative, and continuance. In short, employees with the strongest affective commitment stay within the organization because they want to, those with the strongest normative commitment stay within the

organization because they feel they should, and those with continuance commitment stay because they feel they have no choice (Meyer & Allen, 1991). Many studies have explored the differences between the three dimensions of organizational commitment (Allen & Meyer, 1990; Johnson & Chang, 2006; McGee & Ford, 1987; Meyer et al., 1990; Shore & Wayne, 1993). Based on the results of those studies, continuance commitment was not included in this study. Unlike affective and normative commitment, it primarily reflects a cost-based attachment to the organization rather than an ethical or emotional bond. Since whistleblowing intentions are more closely linked to employees' sense of moral obligation and identification with the organization, the focus of this study remained on affective and normative commitment.

Research on the relationship between organizational commitment and whistleblowing has produced mixed results. For instance, one study found that organizational commitment significantly predicted the intention to engage in internal whistleblowing but not external whistleblowing (Somers & Casal, 1994). Additionally, the relationship between organizational commitment and internal whistleblowing in this study was curvilinear. Another study showed that individuals with high organizational commitment were more likely to report issues internally, while those with low organizational commitment were more inclined toward external reporting (Alleyne, 2016). These mixed findings may reflect the use of different instruments across studies or indicate that certain moderator(s) should be tracked down in studies investigating the relationship between organizational commitment and whistleblowing.

Studies have established a connection between organizational commitment and POB (Grego-Planer, 2019; LePine et al., 2002), with some arguing that POB results from organizational commitment (O'Reilly & Chatman, 1986). Since internal whistleblowing may be a form of POB, we might expect that internal whistleblowing results from organizational commitment. At the same time, we could assume that those less committed to the organization may be more inclined to blow the whistle externally. Therefore, we hypothesize that organizational commitment is positively related to self-reported internal and negatively related to external whistleblowing intention. We expect that, on average, a higher organizational

commitment is associated with stronger internal and weaker external whistleblowing intention (H6).

Method

Sample and procedure

The sample comprised 220 participants recruited from the general population using the snowball/convenience sampling method. The participants' ages ranged from 19 to 66 years, with a mean age of 40.77 ± 12.87. The age structure of the sample implies that 29.2% of participants were in the early career stage (18-30 years), 46.1% were in the mid-career stage (31-50 years), and 24.7% were in the late career stage (51+ years). Most participants were women (65.9%). The participants in our sample had different levels of education; 18.20% had a high school education (secondary education diploma), 21.8% had a vocational (professional) degree obtained from colleges of applied studies (tertiary professional education), 55% had completed academic higher education (bachelor's or master's degree), and 5% held a Ph.D. degree. About 12% of participants had less than a year of work experience, 15.5% had up to five years of work experience, 9.5% had between five and ten years of work experience, and 62.3% had over ten years of work experience. The eligibility criterion was that participants had been employed for at least six months at their current workplace at the time of testing. Study data were collected anonymously in Serbia during March and April 2024 via the Google Forms platform. The link to the survey was shared via social media networks (e.g., Instagram and LinkedIn). The study was initiated by the first author. Before starting the survey, participants read an informed consent form that explained the purpose of the study and clarified that it was conducted solely for scientific purposes. Participation was anonymous, and respondents did not receive any compensation for it. Participants were explicitly informed that completing the questionnaire would be considered evidence that they had understood the provided information and agreed to participate. The process of completing the questionnaire required approximately ten minutes.

Instruments

The Whistleblowing Intention Scale (WIS; Park & Blenkinsopp, 2009)

The WIS is an eight-item scale used to measure internal and external whistleblowing intention. Participants were asked, "*If you found wrongdoing in your workplace, how hard would you try to do the following?"* (Park & Blenkinsopp, 2009, p. 549), and the responses were collected using a five-point Likert scale (1 = very unlikely, 5 = most likely). The scale was translated into Serbian and back-translated for this study. Confirmatory factor analysis (CFA; with robust Maximum Likelihood estimator) showed that the original correlated two-factor model had an acceptable fit (CFI = .964, TLI = .948, RMSEA = .095 [p = .799], SRMR = .064)[2]. The internal whistleblowing subscale score had excellent reliability (four items; ω = .92; α = .92), and the external whistleblowing subscale score had good reliability (four items; ω = .85; α = .84). The Serbian version of the scale can be found in Appendix A, and the graphical representation of the model with standardized factor loadings is in the Supplement A.

Fear of Retaliation Scale (FRS; Park et al., 2005)

The FRS was another scale translated into Serbian for this study (using the back-translation procedure; Appendix B). It is a short, five-item scale accompanied by a five-point response scale (1 = completely disagree, 5 = completely agree) typically used to measure fears and negative beliefs related to reporting unethical behavior in the workplace (e.g., *I would suffer as a result of my complaints*). Confirmatory factor analysis (with robust Maximum Likelihood estimator) yielded inflated estimates of the unidimensional model fit (CFI = 1.000, TLI = 1.000, RMSEA = .000 [p = .136], SRMR = .015). Some items are likely redundant, considering very high factor loadings (Supplement B). Because the aim of this study was not a detailed psychometric evaluation of the scale but simply checking whether we can

[2] CFI and TLI are considered acceptable if > .90 (Kline, 2015), RMSEA is acceptable if < .08 (Kline 2015; but Kenny et al., 2015 suggested that RMSEA should not be computed for models with smaller degrees of freedom and small samples because it tends to underestimate the model in those cases), SRMR is acceptable if < .10 (Kline, 2015).

use a total scale score as a measure of fear of retaliation, we did not modify the scale. The fear of retaliation total scale score had excellent reliability in our sample (ω = .91; α = .92).

The Work Locus of Control Scale (WLCS; Spector, 1988)

The WLCS is is a sixteen-item instrument that assesses the locus of control in the workplace on a six-point Likert scale (1 = completely disagree, 6 = completely agree). Originally, it was introduced as a unidimensional measure of general beliefs about control in the workplace (Spector, 1988). However, no factor analytical procedure was applied in Spector's study to test the proposed factor structure of the WLCS (Spector, 1988). In a study conducted by a group of Croatian researchers, the obtained results suggested that the Croatian version of the WLCS has a two-factor structure with one factor labeled as internal work locus of control (e.g., *A job is what you make of it.*) and another labeled as an external work locus of control (e.g., *Getting a job you want is mostly a matter of luck.*; Slišković et al., 2014). We relied on the results from the study conducted in a similar language (i.e., Croatian) context and tested a confirmatory correlated two-factor model for the Serbian translation of the WLCS. Due to a very poor model fit (CFI = .699, TLI = .649, RMSEA = .112 [p < .001], SRMR = .100), we proceeded with exploratory factor analysis (EFA) using Principal Axis Factoring as a method of factor extraction. After performing a parallel analysis using minimum rank factor analysis (MRFA[3]), we opted for a two-factor model. We also removed five items with nonsignificant factor loadings (i.e., standardized factors loadings < .35). The final version of the scale (Appendix C) contained two correlated factors (Promax oblique rotation method was used) labeled the same way as in Slišković et al.'s study (2014), except in our study the internal locus of control factor had only three items (these three items had the highest factor loadings in Croatian sample as well). The overall model fit was acceptable (CFI = .900, TLI = 837, RMSEA = .095, RMSEA 90%CI [.074 - .117], SRMR = .050). The pattern matrix is provided in Supplement C. The internal locus of control subscale score had acceptable reliability (n = 3, ω =

[3] MRFA was conducted in R, version 4.4.2 (R Core Team, 2024) using EFA.MRFA package (Navarro-Gonzales & Lorenzo-Seva, 2021).

.76; α = .74), and the external locus of control subscale score had good reliability (*n* = 8, ω = .82; α = .82).

The Revised Organizational Commitment Scale (OCS-AN; Meyer & Allen, 1991)

The OCS-AN represents a shortened and revised scale comprising six items that measure affective commitment (e.g., *I feel a strong sense of belonging to this organization.*) and normative commitment to an organization (e.g., *Even if it were to my advantage, I do not feel it would be right to leave*.). Responses were collected using a five-point Likert scale (1 = completely disagree, 5 = completely agree). Previous studies have shown that the Serbian version of the scale has good psychometric properties and can be used as a unidimensional measure of organizational commitment (e.g., Popov, 2013). The total scale score of commitment obtained in this study had acceptable reliability (*n* = 6, ω = .86; α = .85).

The Demographic Questionnaire

The Demographic Questionnaire assesses respondents' age, gender, education level, and work experience. Participants were instructed to select one of the following categories for education level: completed secondary school, completed college of applied studies, completed bachelor's/master's degree, or completed doctoral/magister degree. For work experience, the options were: less than one year, one to five years, five to ten years, and more than ten years.

Results

Statistical analyses were conducted using the open-source program JASP v.0.19.1 (JASP Team, 2024). Before testing the hypotheses, we calculated descriptive statistics for all variables we later included in the models. Table 1 provides the empirical minimum and maximum on all scales, along with the mean, standard deviation, skewness, and kurtosis. The values of skewness and kurtosis fall within the acceptable range for using parametric statistics (± 1.5; Tabachnick & Fidell, 2013).

First, we conducted a paired-sample *t*-test to test the first hypothesis that internal whistleblowing intention is, on average, significantly more

pronounced than external one. This hypothesis was supported ($M_{difference}$ = 4.14, SE = .38, $t_{(219)}$ = 10.86, p < .001) and medium-to-large effect was found (Cohen's d = 0.73, 95%CI [.58, .88]).

Relationship between study variables

Before testing whether internal work locus of control, external work locus of control, fear of retaliation, and organizational commitment were significant predictors of external and internal whistleblowing intention (hypotheses H2-H6), we calculated intercorrelations among these variables[4] (Table 1). As presented in Table 1, internal whistleblowing intention correlated significantly with all supposed predictors (except age) - positively with internal work locus of control, organizational commitment, and gender, and negatively with fear of retaliation and external work locus of control. The values of the correlation coefficients ranged from very weak to weak. On the other hand, external whistleblowing intention correlated significantly only with the fear of retaliation. This correlation was positive and, although significant, very weak.

All correlations between the key predictor variables were significant except for the correlation between external work locus of control and organizational commitment. There was a negative correlation between fear of retaliation, on the one hand, and internal work locus of control (very weak effect) and organizational commitment (weak effect), on the other hand. As expected, a significant negative correlation was found between external and internal work locus of control (very weak effect). A weak but significant positive correlation was found between fear of retaliation and external work locus of control, as well as between organizational commitment and internal work locus of control. Additionally, age correlated significantly only with the external work locus of control, while gender had a significant positive correlation with internal work locus of control and fear of retaliation.

[4] Given the ordinal nature of the education variable, we also calculated the Spearman rank correlation as a supplementary measure to account for potential non-linearities and unequal intervals between education levels. The differences between the Pearson and Spearman correlation coefficients were minor, indicating that both methods captured a similar strength and direction of the relationships. This suggests a stable, albeit very weak, association between education and the other variables (all coefficients were below .20, except for age).

Table 1

Descriptive Statistics and Correlation Coefficients

Variables	Min	Max	*M*	*SD*	Sk	Ku	1	2	3	4	5	6	7	8
1. Gender							—							
2. Education							.17*	—						
3. Age	19	66	40.77	12.87	-0.03	-1.13	.20**	.25***	—					
4. Internal work LOC	4	20	14.73	4.74	-0.75	-0.45	.01	.17*	-.01	—				
5. External work LOC	4	20	10.60	4.18	0.05	-0.81	.03	-.11	.14*	-.19**	—			
6. Fear of retaliation	5	25	16.01	5.46	-0.18	-0.82	.16*	-.10	.08	-.14*	.36***	—		
7. Organizational commitment	6	30	16.07	5.91	0.16	-0.70	.09	.12	.05	.27***	-.07	-.24***	—	
8. Internal WI	3	18	11.64	2.94	-0.31	-0.07	.17*	.14*	-.12	.33***	-.17*	-.32***	.31***	—
9. External WI	8	45	24.27	7.07	0.30	-0.07	-.05	-.13	.00	.09	.13	.17*	-.03	.20**

Note. LOC – locus of control; WI – whistleblowing intention.
*p < .05. **p < .01. ***p <.001.

Predicting internal whistleblowing intention

We conducted a hierarchical regression analysis to investigate whether internal and external work locus of control, fear of retaliation, and organizational commitment predict intentions to whistleblow internally, while controlling for age, gender, and education. The first model, which included age, gender, and education as predictors, explained 7.8% of the variance in the criterion and was statistically significant, $F_{(3, 215)} = 6.09$, $p = .001$. All three variables significantly predicted internal whistleblowing intentions (women, younger, and more highly educated employees scored higher on internal whistleblowing intentions; Table 2). Adding the remaining variables in the second model accounted for an additional 20.3% of the variance in the criterion, $\Delta F_{(4, 211)} = 14.93$, $p < .001$. In the second model, gender and age remained significant predictors, and organizational commitment, fear of retaliation, and internal work locus of control significantly predicted internal whistleblowing intentions after controlling for demographics (Table 2).

Table 2

Predicting Internal and External Whistleblowing Intention – the Hierarchical Regressions

Model		Internal whistleblowing		External whistleblowing	
	predictor	β	*p*	β	*p*
1	(intercept)		.070		<.001
	Gender	.18	.007	-.03	.652
	Age	-.20	.004	.04	.583
	Education	.16	.018	-.14	.054
		R = .28, R^2 = .08		R = .14, R^2 = .02	
2	(Intercept)		<.001		.001
	Gender	.22	<.001	-.06	.409
	Age	-.17	.007	.02	.782
	Education	.07	.290	-.13	.075
	Internal work LOC	.24	< .001	.15	.034
	External work LOC	.01	.915	.08	.264
	Fear of retaliation	-.27	<.001	.16	.038
	Organizational commitment	.16	.012	-.01	.864
		R = .53, R^2 = .28, ΔR^2 = .20		R = .27, R^2 = .07, ΔR^2 = .05	

Note. LOC locus of control. The results remained consistent when gender and education were entered as dummy variables instead of continuous predictors, with no change in the significance of their contributions to the model.

Predicting external whistleblowing intention

We conducted a second hierarchical regression to test whether internal and external work locus of control, fear of retaliation, and organizational commitment predict external whistleblowing intention after controlling for age, gender, and education ($H2_b$). In the first step of the model, we entered demographic variables, which explained 1.9% of the criterion's

variance ($F_{(3, 215)} = 1.42$, $p = .239$). In the second step (Model 2), adding internal and external work locus of control, fear of retaliation, and organizational commitment increased the percentage of explained variance of the criterion by 5.1%, $\Delta F_{(4, 211)} = 2.90$, $p = .023$. In Model 2, internal work locus of control and fear of retaliation significantly predicted external whistleblowing intention (Table 2). Considering the low and non-significant correlation between internal work locus of control and external whistleblowing intention ($r = .09$), the significant effect of work locus of control in the regression model may be the result of suppression (partial correlation between internal work locus of control and external whistleblowing intention is .15). Finally, according to the values of the variance inflation factor (VIF < 10; Bowerman & O'Connell, 1990; Myers, 1990) and Condition Index (< 30; Kim, 2019), there was no strong multicollinearity in models.

Discussion

This is a pioneering study when it comes to investigating whistleblowing intention in Serbia. It aimed to answer whether we could predict whistleblowing intention among Serbian employees based on their levels of internal and external work locus of control, fear of retaliation, and organizational commitment. Our results support the hypothesis (H1) that internal whistleblowing intention is more pronounced than external one. This finding is in line with the results of previous studies (Dhamija & Rai, 2018; Soeken & Soeken, 1987; Šabić, 2021) and suggests that employees are more willing to report wrongdoings to someone within the organization (e.g., a coworker, direct supervisor) than to authorities outside the organization (e.g., police, anti-corruption agencies, or public media). A potential explanation for this finding is that employees expect their work colleagues to perceive them as traitors if they use external reporting channels (Park et al., 2005). Additionally, earlier studies showed that retaliation is more likely in cases of external whistleblowing (Mesmer-Magnus & Viswesvaran, 2005). Besides that, perhaps employees simply act according to the law that states they should report any irregularities internally or to relevant authorities before informing the public (Šabić, 2021).

According to our study, fear of retaliation is, as expected, negatively associated with internal whistleblowing intention (Dhamija & Rai, 2018; Khan

et al., 2022; Ogungbamila et al., 2022), and it predicts internal whistleblowing intention after controlling for demographics such as age, gender, and education (H2). If employees are scared that they will be punished for filing a complaint about unethical actions (for example, afraid of being bullied, micromanaged, demoted, or getting fired), they may decide not to do it (Garrick & Buck, 2020; Soeken & Soeken, 1987), at least not internally. They may opt for external whistleblowing if they expect that their reporting within the organization will be covered up and that they will face detrimental consequences (H3). If an employee is afraid of retaliation within the organization, they may seek help outside of it by contacting the police, a prosecutor, an anti-corruption agency, and the like. Given that our data come from a cross-sectional study, the opposite course of events is also possible. Namely, those employees with a greater intention to whistleblow outside of the organization may be more afraid of retaliation because the organization may face more serious consequences (Dworkin & Near, 1987; Mesmer-Magnus & Viswesvaran, 2005).

Our results imply that internal whistleblowing intention is positively correlated with internal and negatively with external work locus of control, supporting the results of previous studies (Chiu, 2003; Clyde et al., 2022; Hanjani et al., 2018; Trevino & Youngblood, 1990). Employees with a high internal work locus of control may believe they will prevent future unethical behavior if they report misconduct they have observed. On the other hand, employees with a higher external work locus of control may be less likely to do so since they believe they have no control over the organizational dynamic. The relationship between these three variables is illustrated by the third stage of the POB model, in which an employee evaluates whether whistleblowing will lead to the desired change and chooses to act or remain passive based on that assessment. However, it is important to emphasize that although both correlations were statistically significant, the regression analysis revealed that only the internal work locus of control significantly predicted internal whistleblowing intention (H4 and H5).

Contrary to the findings of earlier studies (Chiu, 2003; Clyde et al., 2022; Hanjani et al., 2018; Trevino & Youngblood, 1990), external whistleblowing intention is neither significantly correlated with external work locus of control nor with internal locus of control. One possible interpretation

is that the sense of control that employees might have within the organization is no longer relevant when third parties outside the organization are brought into the equation. It also could be that the subscale we used to measure the external work locus of control has certain psychometric issues (a conclusion we can infer from the information presented in the instruments section about the factor structure of the WLCS). Yet, the regression analyses revealed that the internal work locus of control significantly predicts the external whistleblowing intention (H4 and H5). By considering this result, we could assume that the greater internal work locus of control leads to a greater probability of reporting irregularities to external channels in the same manner as when reporting it internally.

The results of our study showed that organizational commitment is positively correlated with internal whistleblowing intention, as expected. This aligns with previous research (Alleyne, 2016). Additionally, organizational commitment contributes to predicting internal whistleblowing intention after controlling for age, education, and gender (H6). Employees with high organizational commitment identify with their organization, feel connected to it, and wish to contribute to their own and other employees' well-being by pointing out irregularities that could cause harm so these issues can be resolved. They also may believe that reporting irregularities is correct and responsible, as they have a sense of duty toward the organization.

Contrary to previous research (Alleyne, 2016) and our hypothesis (H6), but aligning with the findings of Somers and Casal (1994), the results revealed that organizational commitment is does not correlate with the intention to whistleblow externally. This finding suggests that employees will determine their actions based on factors other than their levels of organizational commitment. It is also possible that individuals with higher organizational commitment may be less inclined to whistleblow externally because they understand that doing so could inflict more damage on the organization than reporting irregularities internally. Conversely, those with lower levels of organizational commitment may not report issues either, as they are less concerned about the happenings within the organization.

To summarize, our results showed that internal work locus of control and fear of retaliation are significant predictors of internal and external whistleblowing intention. Additionally, organizational commitment

significantly contributes to explaining internal but not external whistleblowing intention. The first regression model explains approximately 28% of the variance in internal whistleblowing intention, while the second regression model explains about 7% of the external whistleblowing intention. These findings suggest that, when it comes to external whistleblowing intention, the great amount of variance is likely explained by other factors we did not include in our study. Thus, future studies should investigate alternative predictors of external and internal whistleblowing intention (e.g., values and moral intensity). Our findings also suggest that employers and government authorities can encourage employees to engage in internal whistleblowing by reducing the fear of retaliation and increasing organizational commitment.

Limitations and directions for future research

This study has several limitations. First, the sample size is small, collected using a snowball method, limiting our findings' generalizability. Next, we measured whistleblowing intention, which may not always accurately predict actual behavior and can be influenced by socially desirable responses (Chen, 2019). Thus, we cannot claim that the same variables that predict whistleblowing intention also act as predictors when it comes to the act of whistleblowing. This issue could be addressed by studying whistleblowing that has already occurred (i.e., by asking participants whether they have ever actually reported irregularities). Second, we did not ask participants whether they were familiar with their organization's reporting channels, and perhaps a low score on the internal whistleblowing subscale reflects a lack of awareness or absence of internal reporting procedures rather than a low intention. Therefore, a recommendation for future research would be to examine the extent to which reporting procedures are formally established within organizations. Third, prior research indicates that whistleblowing intention may depend on characteristics of the irregularity, such as its severity, frequency, or the perpetrator's status (Nicholls et al., 2021). Without such contextual details in the questionnaire, respondents may have found it challenging to assess their whistleblowing intention. Therefore, it is recommended that future research include descriptions of specific irregularities. Related to this, a concept not examined in the present study but worth considering in future

research is the intensity of the moral issue. Not all individuals assess the seriousness or harm caused by ethical misconduct in the same way, and such variation may influence their willingness to engage in whistleblowing. Furthermore, our study did not consider social factors (e.g., cultural norms), which may also play a significant role in shaping whistleblowing intentions. Future research could also examine whether fear of retaliation is linked to factors that objectively justify it, for example, past instances where someone who reported irregularities experienced retaliation, as well as organizational culture or leadership characteristics, or whether it is, on the other hand, associated with personality traits such as neuroticism, general lack of trust, and paranoid tendencies. A further limitation of our study is the exclusion of continuance commitment from the measurement of organizational commitment. Therefore, we recommend that future research examine the potential relationship between this dimension and whistleblowing, particularly in contexts where employers emphasize employee loyalty based on continuance commitment. A final limitation we note is that the data were collected at a single point in time. Therefore, although some variables emerged as significant predictors, longitudinal and experimental studies are needed to determine whether these relationships reflect actual causal effects.

Practical implications

This research suggests that fear of retaliation may discourage internal whistleblowing while somewhat encouraging external reporting, which poses risks such as legal proceedings and reputational damage for organizations (Dworkin & Near, 1987; Mesmer-Magnus & Viswesvaran, 2005). Retaliation can also negatively affect employees' mental and physical health and lead to family and financial difficulties. To address these concerns, organizations should ensure employee safety in whistleblowing cases, promote support from superiors (Mesmer-Magnus & Viswesvaran, 2005), prevent retaliation by colleagues (Bjørkelo, 2013), and enable anonymous reporting mechanisms. Additionally, governments should strengthen whistleblower protection laws and ensure their consistent enforcement.

To increase the intention to report internally, leaders should foster greater organizational commitment among employees, for example, by

balancing employee needs with task demands and recruiting individuals who align with organizational values. Furthermore, employees with an external locus of control may benefit from developing skills that help them more rationally distinguish between situations they can and cannot influence. Such skills of distinction could empower them to act when they encounter misconduct, thereby encouraging a stronger sense of responsibility in reporting irregularities.

Conflict of interest

We have no conflicts of interest to disclose.

Data availability statement

Data used in this paper are available upon a reasonable request.

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Appendix A

Serbian version of the Whistleblowing Intentions Scale

Molimo Vas da na petostepenoj skali procenite koliko je verovatno da biste preduzeli navedene mere ukoliko biste primetili neregularnost na svom radnom mestu.

Brojevi na skali znače sledeće:

1 - vrlo malo verovatno

2 - malo verovatno

3 - nisam siguran

4 - verovatno

5 - vrlo verovatno

1	Prijavio/la bih ga nadležnim organima izvan organizacije.	1 2 3 4 5
2	Koristio/la bih kanale za prijavljivanje izvan organizacije.	1 2 3 4 5
3	Pružio/la bih informacije agencijama van organizacije (npr. Agenciji za sprečavanje korupcije).	1 2 3 4 5
4	Informisao/la bih javnost.	1 2 3 4 5
5	Prijavio/la bih ga nadležnim osobama u organizaciji.	1 2 3 4 5
6	Koristio/la bih kanale za prijavljivanje unutar organizacije.	1 2 3 4 5
7	Obavestio/la bih menadžera višeg nivoa o tome.	1 2 3 4 5
8	Obavestio/la bih svog direktnog nadređenog.	1 2 3 4 5

Ključ za skorovanje:

Namera za spoljašnjim uzbunjivanjem: stavke 1, 2, 3 i 4

Namera za unutrašnjim uzbunjivanjem: stavke 5, 6, 7 i 8

Appendix B

Serbian version of the Fear of Retaliation Scale

Molimo Vas da označite u kojoj meri se slažete sa svakom od navedenih tvrdnji.

Brojevi na skali znače sledeće:

1 – uopšte se ne slažem
2 – donekle se ne slažem
3 – nisam siguran/na
4 – donekle se slažem
5 – u potpunosti se slažem

Ukoliko bih prijaviola neregularnost na svom radnom mestu:

1	... bio/la bih izložen/a negativnim posledicama kao rezultat moje žalbe.	1 2 3 4 5
2	... bio/la bih osujećen/a u prijavljivanju na svakom koraku.	1 2 3 4 5
3	... bio/la bih stavljen/a u nepovoljan položaj.	1 2 3 4 5
4	... moja organizacija me ne bi pohvalila.	1 2 3 4 5
5	... posao bi mi možda bio ugrožen.	1 2 3 4 5

Appendix C

Serbian version of the Work Locus of Control Scale

Pitanja koja slede tiču se Vaših **uverenja o poslu uopšte.** Ne odnose se isključivo na Vaš sadašnji posao. Molimo Vas da, zaokruživanjem jednog broja na skali od 1 do 6 označite nivo u kom se slažete, odnosno ne slažete, sa svakom navedenom tvrdnjom.

Brojevi na skali imaju sledeće značenje:

1 – uopšte se ne slažem

2 – uglavnom se ne slažem

3 – donekle se ne slažem

4 – donekle se slažem

5 – uglavnom se slažem

6 – u potpunosti se slažem

1	Posao je onakav kakvim ga napraviš.	1 2 3 4 5 6
2	U većini poslova ljudi mogu ostvariti gotovo sve što požele da ostvare.	1 2 3 4 5 6
3	Kada znaš šta želiš od posla, onda možeš i pronaći posao koji će ti to pružiti.	1 2 3 4 5 6
4	Dobiti posao koji želiš je većinom stvar sreće.	1 2 3 4 5 6
5	Zaraditi novac prvenstveno je stvar sreće.	1 2 3 4 5 6
6	Da bi dobio posao koji želiš, potrebno je da imaš porodicu ili prijatelje na visokim pozicijama.	1 2 3 4 5 6
7	Unapređenja su obično stvar sreće.	1 2 3 4 5 6
8	Kada je u pitanju pronalaženje stvarno dobro posla, važnije je koga znate nego šta znate.	1 2 3 4 5 6
9	Da bi imao dosta novca, potrebno je da poznaješ prave ljude.	1 2 3 4 5 6
10	Potrebno je mnogo sreće da bi bio izvrstan radnik u većini poslova.	1 2 3 4 5 6
11	Osnovna razlika između ljudi koji zarađuju mnogo i malo je sreća.	1 2 3 4 5 6

Ključ za skorovanje:

Unutrašnji radni lokus kontrole: stavke 1, 2 i 3

Spoljašnji radni lokus kontrole: stavke 4, 5, 6, 7, 8, 9, 10 i 11

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