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# Perseverative cognitions, negative valence systems, positive valence systems, social disconnection, and suicide: testing a mediator model among university students

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## Abstract

Various studies have suggested that perseverative cognitions play an important role in the occurrence of suicide. However, the mediating mechanisms underlying the relationship between perseverative cognitions and suicidality remain largely unknown. Accordingly, the present study aimed to investigate whether positive and negative valence systems and social disconnection temporally mediated the association between perseverative cognitions and suicidal behaviors. 256 university students participated in this study. The data were collected using the Perseverative Cognitions Questionnaire (PCQ), Approach-Avoidance Temperament Questionnaire (ATQ), Social Connectedness Scale-Revised (SCS-R), and Suicidal Behaviors Questionnaire-Revised (SBQ-R). The results showed that perseverative cognitions had a direct and significant effect on suicide ( $p < .001$ ). Positive and negative valence systems and social disconnection significantly mediated the relationship between perseverative cognitions and suicide. Our findings showed that multiple factors including perseverative cognitions, positive and negative valence systems, and social disconnection may have a role in the occurrence of suicide among university students.

**Keywords** Perseverative cognitions, Positive valence systems, Negative valence systems, Social disconnection, Suicide

## Introduction

Suicide is a significant public health issue, ranking as the second leading cause of death among 10–34-year-olds in the United States [1] and globally accounting for more than 800,000 deaths per year [2]. In Iran, the prevalence of suicidal thoughts, planning, and attempted suicide is estimated at 12.7%, 6.2%, and 3.3% respectively, with an incidence of 5.7%, 2.9%, and 1% [3]. Suicide includes thoughts, plans, and attempts to end one's life. Suicidal ideation refers to thoughts about suicide, while a suicide plan involves specific methods of dying. A suicidal attempt is engaging in self-harm with the intent to die

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[4, 5]. Silverman and colleagues [6] colleagues proposed the term “suicidal behaviors” to encompass these aspects. Psychological factors play a significant role, as suicide involves a conscious decision to end one’s life [7]. The prevalence of suicidal behaviors remains high, making prediction clinically challenging [8]. These behaviors arise from a complex mix of risk factors, including cognitive and social elements, alongside negative life events. However, the interplay of these factors and their impact on suicide risk is still not fully understood [7].

### **Perseverative cognition and suicide**

In recent years, perseverative cognition has been identified as a potential cognitive factor associated with suicide [9]. Perseverative cognition refers to repetitive, intrusive, and generally negative thoughts [10, 11]. This persistent focus on stressors, along with feelings of uncontrollability, can negatively affect physiological systems, including the cardiovascular and immune systems [12]. It is seen as a transdiagnostic factor for various psychiatric disorders, such as depression [10, 11].

Perseverative cognition involves worry, rumination, and obsessions related to stress [11]. Worry is repetitive thinking about future fears [13], while rumination is focusing on one’s distress and its causes [14]. Obsessions are intrusive thoughts or impulses that cause significant distress [15]. Although the cognitive processes of worry, obsession, and rumination are similar, they differ in their focus [16]. Research indicates that worry and rumination can increase the risk of suicidal thoughts and behavior [17], both directly and indirectly [17–21]. These processes may hinder recovery from depression and contribute to relapse [16]. Suicidal ideation often resembles intense worry or rumination, with distressing thoughts frequently motivating suicidal behavior [22]. Additionally, worry is suggested as a long-term risk factor for suicide and a negative response to stress, influencing the frequency and nature of these thoughts [17].

### **Positive Valence systems, negative Valence systems, and suicide**

Traditional psychiatric diagnoses face challenges like collinearity, heterogeneity, arbitrary thresholds, and poor interrater reliability (e.g. [23–25]), which impede research progress. In response, the National Institute of Mental Health initiated the Research Domain Criteria Project [26, 27], aiming to understand mental health through a comprehensive integration of genetics, biology, behavior, and subjective experiences, to identify the fundamental factors influencing human behavior [28]. The Research Domain Criteria provide a framework for suicide research by moving beyond a sole focus on mental disorders. This approach is valuable because it (a) emphasizes meta-diagnostic dimensions, (b) identifies potential

predictors of suicidal outcomes, and (c) integrates diverse measures and analyses [29]. The framework is organized into five key domains: negative valence systems, positive valence systems, cognitive systems, social processes, and arousal and regulatory systems [28]. In this framework, depression involves two main areas: negative valence systems and positive valence systems [30]. Negative valence systems respond to aversive events, such as threats and losses, guiding our motivation to avoid discomfort [31, 32]. This area is critical in suicide research, focusing on experiences like interpersonal loss and adverse childhood experiences [29]. In contrast, positive valence systems pertain to processes linked to rewarding events, influencing motivation driven by rewards [32]. Recent research on diagnostic risk factors has begun to focus on elements of the positive valence system that may contribute to suicidal risk. Key factors include motivation to strive for rewards, early responses to reward acquisition, and difficulties adapting to new information for effective reward learning [29].

Research indicates that worry, obsession, and rumination are linked to negative valence systems. Physiological, neuroimaging, and clinical data show a connection between perseverative cognition and negative valence components [16, 33–35]. Additionally, some studies suggest that perseverative cognition may also affect positive valence systems, which regulate reward-seeking behaviors, potentially leading to dysfunctions [36].

Most research in this area focuses on predictors related to negative valence systems and theories of suicide [37–39]. However, new research [40] suggest that aspects of the positive valence system may also influence self-harming thoughts and behaviors. Understanding positive valence systems can reveal underlying risk factors for these behaviors. Elements like low positive affect and anhedonia have been linked to suicidal thoughts [41–44], indicating that both positive and negative emotions are crucial in developing suicidal thoughts and behaviors (see [29]). Suicide is often seen as an escape from overwhelming negative emotions [45, 46] and is associated with high levels of negative emotions in empirical research [47, 48].

### **Social disconnection, positive Valence systems, negative Valence systems, and suicide**

Social disconnection is a major public health issue linked to various negative effects, including early mortality [49, 50]. It involves the prolonged absence of family or social relationships and limited engagement in activities with others [51]. Many individuals facing social disconnection do not seek treatment and often do not meet criteria for mental health disorders, resulting in inadequate attention from healthcare providers [49, 50]. Additionally, the strong connection between social interaction and quality of life highlights that social disconnection can exacerbate

feelings of dissatisfaction, particularly in those with major depression [52]. Social relationships offer opportunities for rewards and punishments, including making meaningful connections with others or experiencing rejection.

Taylor and colleagues [52] investigated the impact of positive and negative valence systems on social disruption in depressive disorder. Their research indicates that the negative valence system helps manage avoidant behaviors and negative emotions, while the positive valence system focuses on rewarding experiences and positive emotions. They found that poorer social connections are linked to lower life satisfaction, independently of clinical symptom severity. Their analysis highlighted the connection between decreased positive valence and increased negative valence systems with social disconnection. They proposed that understanding social disconnection through this framework could inform new diagnostic and therapeutic strategies.

Positive and negative emotions significantly influence relationships and interactions [53]. High negative emotions can lead to avoidance behaviors, resulting in poor interpersonal outcomes [54, 55]. Conversely, positive affect promotes social engagement and enhances positive behaviors [56, 57]. Research indicates that positive emotions often increase with social interactions [58] and boost motivation for future communication [57–59].

Studies show a link between social disconnection and suicide risk, including suicidal thoughts and behaviors [60, 61]. Durkheim's social integration theory suggests that a lack of social connection increases suicide risk [62]. Conversely, strong social support has been shown to help prevent suicide [63, 64], reducing the chance of acting on suicidal thoughts [65], and is crucial for effective prevention programs [66]. Unfortunately, many individuals experiencing suicidal thoughts have limited social networks and often choose not to share their feelings [67, 68].

### Current study

The rising rates of suicide attempts and deaths in Iran over the past few decades indicate an increased risk [69, 70], particularly among young people aged 15 to 34, who account for 48% and 32.5% of attempts, respectively [70]. Suicidality is also a significant issue among college students [71, 72]. Therefore, investigating the factors related to suicide among Iranian youth is crucial.

The literature indicates that perseverative cognition may contribute to suicide, though not all such thoughts lead to it. Various factors can influence this outcome. The understanding of how perseverative cognitions relate to suicidality among Iranian youth remains limited, highlighting the need for a risk-protection framework. This research investigates the connections between

perseverative cognition, positive and negative valence systems, social disconnection, and suicidality among Iranian youth. Conducting this study is important for theoretical advancement, helping to understand mechanisms, and has practical implications for suicide prevention. In this regard, the study explores both direct and indirect associations but does not establish causality due to its atemporal nature [73]. This initial research addresses a critical gap in understanding suicide behavior in this demographic and suggests potential mediation pathways (cross-sectionally) for future studies.

In this regard, we illustrated the direct and indirect associations between perseverative cognitions and suicide behavior, through positive and negative valence systems, and social disconnection. The main objective of the present study was to determine the fitness of the proposed model (Fig. 1). Herein, the associations between perseverative cognitions, positive and negative valence systems, social disconnection, and suicide were investigated. In summary, the following hypotheses were proposed:

**Hypothesis 1** Perseverative cognitions are associated with suicide behaviors through positive valence systems.

**Hypothesis 2** Perseverative cognitions are associated with suicide behaviors through negative valence systems.

**Hypothesis 3** Perseverative cognitions are associated with suicide behavior through social disconnection.

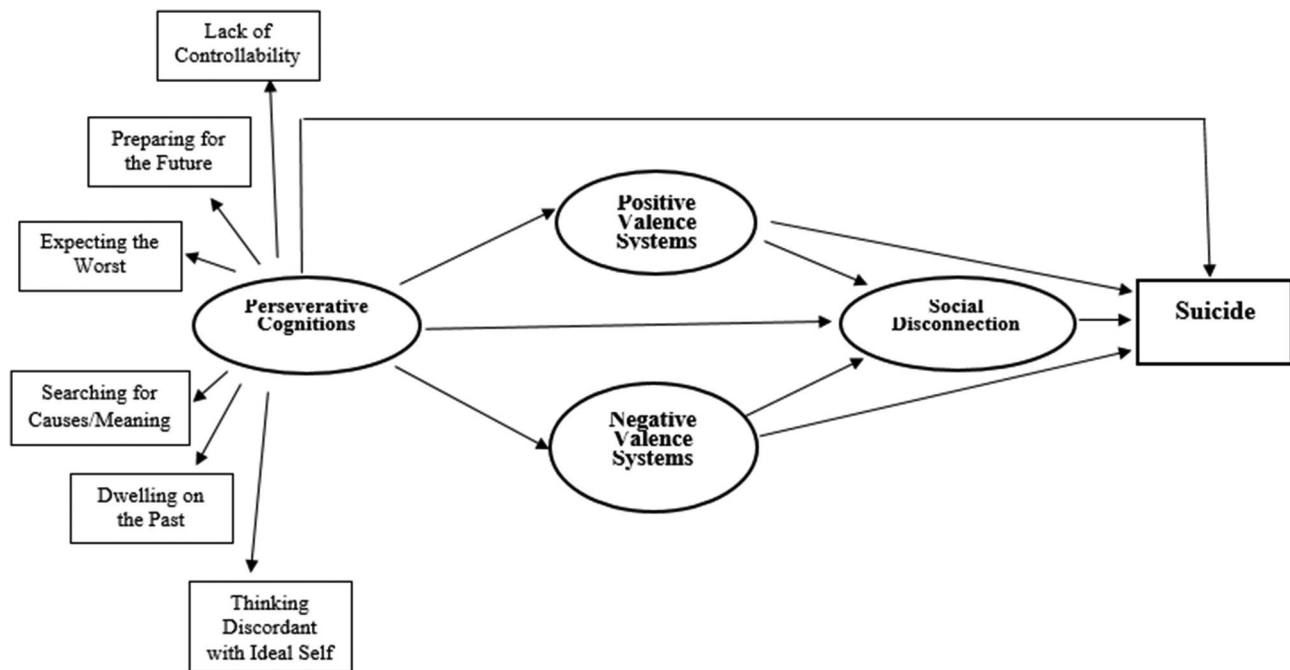
**Hypothesis 4** Perseverative cognitions are associated with suicide behavior through positive valence systems and social disconnection.

**Hypothesis 5** Perseverative cognitions are associated with suicide behavior through negative valence systems and social disconnection.

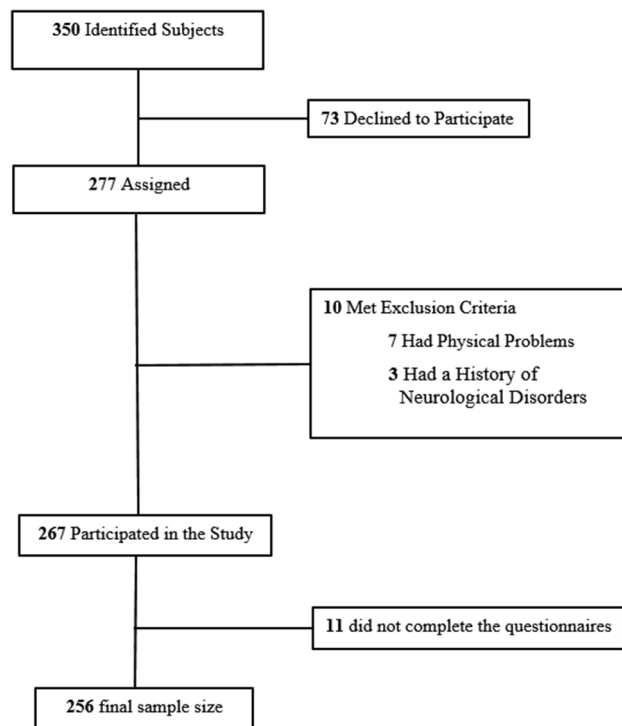
### Method

#### Participants and procedure

The Institutional Review Board of the Shiraz University of Medical Sciences approved the protocol (ID: IR.SUMS.REC.1402.079). In this exploratory cross-sectional study, the study's population contained all students of Shiraz University of Medical Sciences. The sample size for factor analysis is determined based on the number of factors. For structural equation modeling (SEM), about 20 subjects are needed for each factor (latent variable) [74]. Therefore, we determined that at least 220 people are needed for this study. In this research, 267 students who met the inclusion and exclusion criteria were selected from different faculties of Shiraz University of Medical Sciences using the convenient sampling method. The



**Fig. 1** The proposed model of suicidal ideation



**Fig. 2** Consort diagram

inclusion criteria included being aged between 18 and 65 years old and providing informed written consent for participating in the study. Exclusion criteria included having severe physical problems, visual or hearing deficiencies that may disrupt participation in the study,

and any history of neurological disorders (assessed via self-reports), as well as failing to fulfill the study requirements.

Prior to the study, research objectives and ethical considerations were explained to the participants. Participants then provided informed written consent and then completed the measures including the Perseverative Cognitions Questionnaire (PCQ), Approach-Avoidance Temperament Questionnaire (ATQ), Social Connectedness Scale-Revised (SCS-R), and Suicidal Behaviors Questionnaire-Revised (SBQ-R) in a group setting within the classroom. After collecting the data from 267 participants, 11 incomplete questionnaires were removed from the analysis, leaving a total of 256 participants included in the analysis (see Fig. 2).

At the end of study, we performed a post-hoc power analysis using G\*Power software to determine whether our sample size was sufficient. With an effect size of  $f^2 = 0.15$ , an alpha level of  $\alpha = 0.05$ , a total sample size of  $N = 256$ , and four predictors, the analysis resulted in a power of 0.9997 (99.97%). This value is significantly higher than the conventional threshold of 0.80, confirming that our sample size is adequate and supporting the robustness of our findings.

## Measures

### Perseverative cognitions questionnaire (PCQ)

The PCQ is a self-report questionnaire assessing characteristics of perseverative thoughts, such as worry, rumination, and obsessive thinking [75]. It is a 45-question self-report measure that aims to assess beliefs and

processes such as lack of controllability (LC), preparing for the future (PF), expecting the worst (EW), searching for causes/meaning (SC), and dwelling on the past. (DP) and thinking discordant with the ideal self (DT). Participants rate items 6-point Likert scales ranging from 0 (*completely disagree*) to 5 (*completely agree*). In order to get the score for each dimension, the total scores of that dimension are added together, and to obtain the overall score of the questionnaire, the sum of the scores for each dimension is calculated. Thus, higher scores indicate greater perseverative cognitions. The scale has a reported Cronbach's alpha of over 0.95, indicating good internal consistency and validity [75]. As there is no version specific to Iran nor in the Persian language, the measure was translated and back-translated by experts, and three independent expert translators confirmed its content validity. The internal consistency of this scale was evaluated through a pilot study ( $n=55$ ), which was found to be good, with Cronbach's alpha = 0.83.

#### Approach-avoidance temperament questionnaire (ATQ)

Elliot and Thrash [55] developed the ATQ, which has been widely used to measure the positive and negative valence systems. This questionnaire is a 12-item scale designed to measure sensitivity to positive (i.e. rewards; 6 items) and negative (i.e. punishment; 6 items) stimuli or contexts. The items related to each of these domains measure the components of emotional response, perceptual awareness, and behavioral approach of the temperament. The scoring of this questionnaire is based on a Likert scale ranging from 1 (*completely disagree*) to 7 (*completely agree*). To obtain a score for each component, the scores of that component are added together. The sum of points in each component ranges from 6 to 42, with higher scores indicating a dominant mood. Cronbach's alpha of this scale was calculated for positive and negative capacity systems as 0.87 and 0.82 respectively (ref needed). In the current study, Cronbach's alpha value was 0.79.

#### Social connectedness scale-revised (SCS-R)

The SCS-R is a 20-item self-report scale that measures how close or distant a person feels with others in interpersonal situations [76]. Out of the 20 items, 10 are negative and the remaining 10 items are positive. The questionnaire is scored using a Likert scale, where participants rate their agreement on scales from 1 (*completely disagree*) to 6 (*completely agree*). Scores for negative items are reversed and then combined with the scores of positive items. The total scores range from 20 to 120, with higher scores reflecting a stronger sense of social connectedness. This scale demonstrates good internal consistency as well as acceptable convergent and discriminant validity. The questionnaire's Cronbach's alpha

score was calculated as 0.92 in a sample of students [76]. As there is no version specific to Iran nor in the Persian language, the measure was translated and back-translated by experts, and three independent expert translators confirmed its content validity. The internal consistency of this scale was evaluated through a pilot study ( $n=55$ ), which was found to be good, with Cronbach's alpha = 0.79.

#### Suicidal behaviors questionnaire-revised (SBQ-R)

The SBQ-R consists of four items measuring suicidal thoughts and attempts throughout life, suicidal thoughts in the past year, threats of suicide, and the possibility of committing suicide in the future [77]. A total score is obtained by adding scores on the four items, with a higher score indicating a greater tendency to commit suicide. The creators of the questionnaire have set a cutoff score of 7 for this scale, which can be used for all individuals. This scale demonstrated good psychometric properties. The Cronbach's alpha coefficient for this questionnaire was 0.76 for adults with psychiatric problems and 0.76 for adults. Additionally, the concurrent validity of the questionnaire was assessed and confirmed using Beck's frustration questionnaire [77]. In Iran, Amini-Tehrani et al. [78] validated this questionnaire, reporting a cutoff point of 7 for normal individuals and 8 for clinical patients. Besides. Other studies reported an internal consistency of 0.80 [79] and 0.81 [80] for Iranian population. In the current study, Cronbach's alpha was 0.78.

#### Statistical analysis

To investigate the basic relationship between variables, the Pearson correlation test was used in SPSS version 26 software. Due to the existence of latent variables (e.g., perseverative cognitions, positive and negative valence systems, and social disconnection) and their indirect effects, the mediational hypotheses were investigated using structural equation modeling (SEM) in AMOS-26 software. Mediation (cross-sectionally) was considered using bootstrapping procedures. In this study, to evaluate the desirable fitness of the indices, the criteria presented by Kline [81] were utilized. The goodness of fit was assessed by the CMIN/DF (values of 3.0 or less show that the model adequately fits the data), goodness-of-fit index (GFI; values of 0.90 or greater indicate that the model adequately fits the data), comparative fit index (CFI; values of 0.90 or greater signify that the model adequately fits the data), incremental fit index (IFI; values of 0.90 or greater signify that the model adequately fits the data), Tucker-Lewis index (TLI; values of 0.90 or greater indicate that the model adequately fits the data), and the Root Mean Squared Error of Approximation (RMSEA; values of 0.08 or less show that the model adequately fits the data).



## Results

Regarding demographic characteristics, 65.2% of the participants were women and 34.8% were men. The average age of the participants was 23.12 years, with a standard deviation of 3.49 years, and ranged from 18 to 39 years. Regarding marital status, 84.8% were single and 15.2% were married. In terms of education level, 43.8% had a BA degree, 5.5% had an MA degree, 49.6% had an MD degree, and 1.2% had a PhD degree. In terms of living conditions, 75.4% lived in Shiraz, and 24.8% lived in dorms. Concerning economic status, 6.3% were classified as poor, 53.9% as average, 33.2% as good, and 6.6% as very good. The descriptive statistics for the measured variables can be found in Table 1.

In Table 2, the results indicate significant relationships between the variables. The findings reveal that perseverative cognitions have a negative correlation with positive valence systems and a positive, significant correlation with negative valence systems, social disconnection, and suicide behavior (all  $p < .001$ ). Furthermore, there were negative, significant correlations between positive valence systems and negative valence systems, social disconnection, and suicide behavior (all  $p < .001$ ). Additionally, there were positive, significant correlations between negative valence systems and social disconnection and suicide behavior (all  $p < .001$ ), and a positive, significant correlation between social disconnection and suicide behavior ( $p < .001$ ).

In order to test the hypotheses of this research, we used the mediator role test in structural equation modeling to analyze multiple models (see Fig. 3).

This study tested two models to examine the fundamental relationships among the variables (see Table 3). The first model, a direct structural model without mediating variables, served as a baseline for comparison and resulted in a chi-square value of 91.27 ( $df = 13$ ,  $p < .001$ ) with a relative chi-square ( $\chi^2/df$ ) of 7.02, indicating poor fit. Although the absolute fit indices, including GFI (0.92), CFI (0.94), IFI (0.94), TLI (0.90), and SRMR

(0.044) were within acceptable ranges, the RMSEA value (0.154) exceeded the recommended threshold. In contrast, the mediator structural model, incorporating mediating variables, substantially improved fit. Modification indices were used to release covariance errors between  $e_2$  and  $e_6$ ,  $e_3$  and  $e_4$ , and  $e_5$  and  $e_6$ , further enhancing model fit. This model yielded a chi-square value of 53.83 ( $df = 25$ ,  $p = .001$ ) with a relative chi-square ( $\chi^2/df$ ) of 2.15, indicating good fit. Additionally, all fit indices, including GFI (0.96), CFI (0.98), IFI (0.98), TLI (0.97), SRMR (0.033) and RMSEA (0.067), met or exceeded the recommended thresholds, confirming model robustness. The comparison highlights the critical role of mediating variables in improving model fit, offering deeper insights into the mechanisms underlying the observed relationships, and emphasizes the importance of considering mediation effects in statistical analyses, validating the superiority of the mediator structural model in explaining the studied constructs. The results of the regression coefficients between the variables in the direct and mediating structural models are summarized in Table 4.

In the direct structural model, the results in Table 4 indicate that perseverative cognition had a positive and significant association with suicide behavior ( $\beta = 0.338$ ,  $p < .001$ ). Upon further examination of the mediator structural model (full model), it was found that the effect of perseverative cognition on positive valence systems was negative and significant ( $\beta = -0.268$ ,  $p < .001$ ). The effect of perseverative cognition on negative valence systems ( $\beta = 0.665$ ,  $p < .001$ ) and Social Disconnection ( $\beta = 0.290$ ,  $p < .001$ ) were both positive and significant. However, the effect of perseverative cognition on suicide behavior was not significant ( $\beta = -0.103$ ,  $p = .162$ ). The effect of positive valence systems on social disconnection ( $\beta = -0.361$ ,  $p < .01$ ) and suicide behavior ( $\beta = -0.182$ ,  $p < .01$ ) was found to have a negative and significant association. Conversely, the effect of negative valence systems on social disconnection was found to have a positive and significant association ( $\beta = 0.197$ ,  $p < .01$ ). The effects of

**Table 1** Mean, standard deviation, and normal distribution of the variables ( $n = 256$ )

Variable type	Variables	Components	M $\pm$ SD	Skewness	Kurtosis
Independent	Perseverative Cognitions	Lack of controllability	13.97 $\pm$ 6.18	-0.175	-0.574
		Preparing for the future	21.39 $\pm$ 8.42	-0.255	-0.711
		Expecting the worst	9.10 $\pm$ 5.63	0.124	-0.932
		Searching for causes meaning	12.29 $\pm$ 4.61	-0.278	-0.373
		Dwelling on the past	42.67 $\pm$ 16.88	-0.156	-0.786
		Thinking discordant with ideal self	23.55 $\pm$ 12.20	0.224	-0.542
		score Total	120.18 $\pm$ 45.58	-0.104	-0.532
Mediator	Positive Valence Systems		29.97 $\pm$ 7.53	-0.553	-0.070
	Negative Valence Systems		25.93 $\pm$ 7.59	-0.028	-0.401
	Social Disconnection		81.29 $\pm$ 18.51	-0.340	-0.428
Dependent	Suicide behavior		6.21 $\pm$ 3.64	1.24	0.971

Note M = Mean, Sd = Std. Deviation

**Table 2** Correlation matrix among measured variables

Variables	1	2	3	4	5	6	7	8	9	10	11
Perseverative Cognitions	1										
1.Lack of controllability		0.655**	0.656**	0.669**	0.819**	0.812**	0.904**	-0.262**	0.644**	0.535**	0.298**
2.Preparing for the future		1	0.632**	0.665**	0.749**	0.573**	0.815**	-0.166**	0.571**	0.337**	0.267**
3.Expecting the worst			1	0.447**	0.674**	0.671**	0.783**	-0.459**	0.508**	0.469**	0.339**
4.Searching for causes meaning				1	0.690**	0.675**	0.781**	-0.105	0.453**	0.343**	0.251**
5.Dwelling on the past					1	0.693**	0.931**	-0.219**	0.655**	0.443**	0.261**
6.Thinking discordant with ideal self						1	0.872**	-0.288**	0.542**	0.530**	0.355**
7. Total Score							1	-0.284**	0.670**	0.519**	0.337**
8.Positive Valence Systems								1	-0.151*	-0.470**	-0.290**
9.Negative Valence Systems									1	0.455**	0.313**
10.Social Disconnection										1	0.326**
11.Suicide behavior											1

negative valence systems on suicide behavior ( $\beta = 0.197$ ) and social disconnection on suicide behavior ( $\beta = 0.197$ ) were not significant. After including the mediating variables (positive and negative valence systems and social disconnection) in the relationship between perseverative cognition and suicide behavior, the value of  $\beta$  decreased from 0.338 (based on the results of the direct structural model) to 0.140 (based on the results of the mediator structural model). In the mediation model, unlike the direct model, the beta value was not significant ( $p = .080$ ). Therefore, we can conclude that positive and negative valence systems and social disconnection atemporally mediate the relationship between perseverative cognition and suicide.

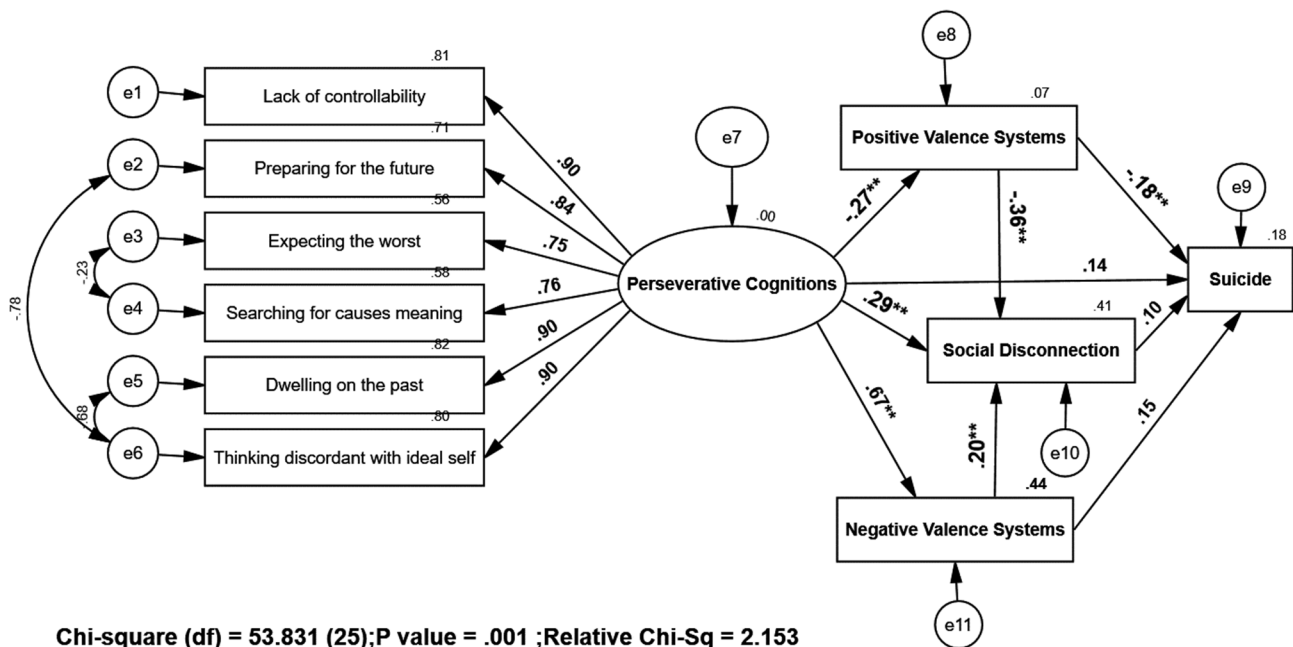
The maximum likelihood of the indirect effect (mediator) in the model was estimated using the bootstrap method, and its summarized results are presented in Table 5.

Using the bootstrap method, a sample of 1000 people was selected with a 95% confidence interval, as shown in Table 5. The results showed that the impact of perseverative cognition on suicide was statistically significant (indirect effect = 0.199,  $SE = 0.063$ ,  $p = .007$ ). The confidence interval for this effect was 0.081 to 0.323, and since the confidence interval does not include zero, the indirect effect is considered significant. The results indicated that the indirect effects of positive valence systems and negative valence systems were not significant.

## Discussion

The current study examined the mediating roles of positive and negative valence systems and social disconnection in the relationship between perseverative cognitions and suicidal behavior among Iranian adults. Our results indicated that the proposed model fit the data well. We found that perseverative cognitions, positive and negative valence systems, and social disconnection are all linked to suicidal behavior. Furthermore, these factors were directly associated with suicidal behavior. Additionally, perseverative cognitions displayed a significant indirect association with suicidal behavior through positive and negative valence systems and social disconnection.

The results indicate that perseverative cognitions are associated with an increase in suicidal ideations due to decreased activity in positive valence systems (cross-sectionally). Research has shown that rumination, a specific type of perseverative cognition, is linked to anhedonia, which is the inability to feel pleasure from activities that were once enjoyable [82]. Brain imaging studies have found that individuals who engage in excessive rumination display reduced activity in the reward-related areas of the midbrain when anticipating a reward [83]. Furthermore, those with high levels of perseverative cognitions often experience a significant gap between



**Fig. 3** Full mediating structural model based on standardized values

**Table 3** Goodness of fit indices for the mediating and direct structural models

Model	Chi-square $\chi^2$	df	p.value	$\frac{\chi^2}{df}$ $\geq 3$	GFI $\geq 0.9$	CFI $\geq 0.9$	IFI $\geq 0.9$	TLI $\geq 0.9$	RMSEA $\geq 0.08$
Direct structural mode	91.27	13	< 0.001	7.02	0.92	0.94	0.94	0.90	0.154
Mediation structural model	53.83	25	0.001	2.15	0.96	0.98	0.98	0.97	0.067

**Table 4** Regression weights between variables based on direct and mediating structural models

Model				Regression Weights	S.E.	Standardized Regression Weights	C.R.	p.value
Direct Structural mode	Suicide	<---	Social Disconnection	0.114	0.021	0.338	5.537	< 0.001
Mediating Structural model	Positive Valence Systems	<---	Perseverative Cognitions	−0.184	0.042	−0.268	−4.401	< 0.001
	Negative Valence Systems	<---	Perseverative Cognitions	0.460	0.036	0.665	12.733	< 0.001
	Social Disconnection	<---	Perseverative Cognitions	0.490	0.112	0.290	4.374	< 0.001
	Social Disconnection	<---	Negative Valence Systems	0.480	0.157	0.197	3.057	0.002
	Social Disconnection	<---	Positive Valence Systems	−0.890	0.123	−0.361	−7.247	< 0.001
	Suicide behavior	<---	Positive Valence Systems	−0.088	0.031	−0.182	−2.812	0.005
	Suicide behavior	<---	Negative Valence Systems	0.070	0.037	0.146	1.896	0.058
	Suicide behavior	<---	Perseverative Cognitions	0.047	0.027	0.140	1.753	0.080
	Suicide behavior	<---	Social Disconnection	0.020	0.014	0.103	1.398	0.162

**Table 5** The indirect effects of the variables based on the bootstrap method

			Standardized Indirect Effects	Standardized Indirect Errors	Bootstrap (CI 95%)		p
					Lower Bounds	Upper Bounds	
Suicide behavior	<---	Perseverative Cognitions	0.199	0.063	0.081	0.323	0.007
Suicide behavior	<---	Positive Valence Systems	−0.037	0.027	−0.093	0.016	0.144
Suicide behavior	<---	Negative Valence Systems	0.020	0.017	−0.002	0.066	0.077



expected rewards and actual reward experiences, a phenomenon known as reward prediction error. This suggests a diminished sensitivity to the value of rewards [36]. Worry, which is a significant aspect of perseverative cognitions, can interfere with the anticipation of rewards. It shifts attention away from expecting and experiencing pleasure, instead focusing on negative outcomes [84]. As a result, this preoccupation reduces the brain's response to rewarding stimuli and diminishes motivation for enjoyable activities [85]. Additionally, obsessive thoughts—another aspect of perseverative cognitions—can disrupt positive experiences by creating a bias toward negative information, potentially leading to anhedonia [86]. Individuals with obsessive tendencies often show a weaker initial reaction to rewards and may develop habits that cause them to overlook potential rewards [87]. Research has shown that obsessive thinking can reduce the activity of the dopaminergic reward system, leading to a decreased sensitivity to rewards and external stimuli. This insensitivity may prevent individuals from effectively pursuing rewards in their environment [88].

The second pathway in this mediation model suggests that positive valence systems are linked to suicidal behavior. Research has shown that individuals experiencing suicidal thoughts often exhibit a reduced response to rewards, leading to a diminished enjoyment of activities that are typically pleasurable [89]. This aligns with findings from a systematic review indicating that decreased reward learning, reward valuation, and reward response are associated with suicidal thoughts and actions [40]. It can be argued that suicidal thoughts arise from a diminished focus on the positive aspects of life, resulting in a perspective that views the world as less rewarding [40]. This can lead individuals to seek immediate relief from emotional pain through suicidal behavior, rather than considering the potential long-term benefits of persevering through challenging situations [40]. One meta-analysis [90] demonstrated that anhedonia is closely linked to current suicidal thoughts, even when controlling for the effects of depression. The three-factor perspective on suicide suggests that suicidal thoughts arise from psychological pain that outweighs an individual's connections to interests, life's purpose, meaning, and sources of joy. Therefore, active suicidal thoughts can be seen as an ineffective way of coping with pain that has surpassed feelings of pleasure [90]. Research has indicated that anticipatory anhedonia, or the inability to anticipate future happiness, is associated with suicidal thoughts [91]. This implies that feeling hopeless about the future—where one does not see value in potential sources of happiness—correlates with suicidal ideation [92]. It supports the notion that feelings of hopelessness, particularly when combined with stressful events, can elevate the risk of suicidal thoughts and behaviors [93].

The results of the present study support the second hypothesis, indicating that perseverative cognitions are associated with suicidality through their connection to negative valence systems (cross-sectionally). Research has shown that individuals who engage in high levels of rumination are more likely to perceive situations as threatening [94]. For example, one study found that dwelling on negative thoughts can lead to feeling overwhelmed in stressful situations, resulting in increased perceptions of threat and anxiety [94]. Similarly, excessive worrying is linked to the perception of threats and heightened anxiety when confronted with ambiguous situations [95]. Research suggests that negative emotions and experiences stemming from heightened activity in negative valence systems are associated with suicide [96]. From certain perspectives, suicide can be viewed as a means of escaping negative emotions [45], and there is experimental evidence that supports this viewpoint [47, 48].

Additionally, our research found perseverative cognitions is associated with increased suicide behaviors through heightened negative valence systems and diminished positive valence systems along with the increased social disconnection. Accordingly, reduced positive valence systems were associated with increased suicidal ideation through relationships with increased social disconnection (cross-sectionally). Anhedonia, as a component of positive valence systems, is generally divided into two types: social anhedonia and physical anhedonia [44]. Social anhedonia relates to the feeling of not belonging to a group and indicates the start of a pattern of social isolation that can potentially lead to suicide [44]. According to Loas et al. [97], anhedonia, specifically social anhedonia, may contribute to the interpersonal aspect of suicide behavior. This perspective suggests that suicide can result from unmet interpersonal needs [89]. In line with our findings, several experimental studies have shown that recent changes in anhedonia, particularly its social dimension, can predict suicidality [44]. In a study of physicians, Loas et al. [97] discovered that anhedonia fully mediated the connection between thwarted belonging, perceived social burden, and recent suicidal thoughts.

Our findings regarding the mediating role of social disconnection in the relationship between negative valence systems and suicidality are also consistent with Taylor et al.'s study [52], which highlights the impact of heightened negative valence systems and their emotional and motivational connections in anticipating perceived social connections. Research has shown that negative emotions can worsen avoidance and disgust behaviors, leading to social withdrawal and reduced participation in relationships [58]. Accordingly, our results align with Taylor et al. [52], who demonstrated that low activity in positive valence systems and increased activity in negative

valence systems are associated with social disconnection. This supports previous research by Ramsey and Gentzler [56] highlighting the significance of both systems in positive social functioning.

The second part of this mediation model, indicating that social disconnection is associated with increased suicidal thoughts and actions (cross-sectionally), is in line with the finding of Aboalshamat et al. [98]. Feelings of loneliness and social disconnection contribute to the emergence of suicidal thoughts and behaviors. According to the Stress-Buffering perspective, social support is considered an essential source of resilience against stress [99]. Emile Durkheim [100] has also highlighted the significance of social factors in the incidence of suicide by discussing the inverse correlation between suicide and social integration. He asserts that social isolation is a major contributing factor to suicide [91]. Additionally, Joiner [38], in the interpersonal theory of suicide, underscores the impact of social isolation and loss of a sense of belonging in the process of suicide.

Our finding that perseverative cognitions are linked to suicidal ideation through their association with social disconnection aligns with prior research showing a relationship between perseverative cognitions and social disconnection [101, 102]. Rumination is associated with focusing on oneself and negatively evaluating one's ability to initiate and maintain social relationships, while also expecting rejection. This can intensify feelings of loneliness and social disconnection [103]. A study also indicated that individuals with high levels of rumination experience more severe interpersonal stress, which can lead to increased social disconnection through negative reinforcement [104]. Research has shown that worry is linked to paying greater attention to threats and being more alert to threat [95]. Similarly, rumination is associated with a preference for negative stimuli, especially angry, sad, and unhappy faces [105]. This tendency to focus on threats in social situations and engage in avoidance behaviors can lead to social disconnection. Feeling unsupported and lacking a sense of belonging can contribute to suicidal thoughts as well.

Our findings indicated that while negative valence systems are directly associated with suicidal ideation, this relationship became non-significant when social disconnection was factored in. This suggests that negative emotions contribute to suicidal thoughts primarily through their interaction with social factors. Feelings of social isolation or a lack of support may have a more direct impact on suicidal ideation than negative emotions alone. This aligns with the Buffering Hypothesis, which posits that social support can mitigate interpersonal distress [106]. From a diathesis-stress perspective, negative emotions may serve as a vulnerability that interacts with stressors such as social disconnection to lead to suicidal ideation.

This effect may be amplified by the collectivist emphasis on social bonds in Iranian culture. Similarly, the relationship between perseverative cognitions and suicidal ideation also became non-significant when other mediating factors like social disconnection, and negative and positive valence systems were considered. This suggests that perseverative cognition influences suicidal ideation through a complex interplay of heightened negative emotions, increased social disconnection, and diminished positive emotions.

Cultural factors significantly influence how individuals perceive and respond to social disruption [107], so it is important to consider these influences when interpreting results. In Iranian culture, a strong emphasis is placed on family and social ties. Consequently, any reduction or severance of these connections can lead to feelings of shame or failure. This intense shame can worsen feelings of isolation, increasing the risk of suicidal thoughts and behaviors [108]. Additionally, there is a considerable stigma surrounding mental health issues within Iranian culture [109], with one study reporting stigma levels as high as 40% [109]. This stigma often prevents individuals from discussing their concerns or seeking help, resulting in increased social isolation and a heightened risk of suicide [110]. These cultural influences can exacerbate the relationship between perseverative cognitions and suicidal thoughts. Additionally, in Islamic culture, suicide is regarded as a sin, which can exacerbate psychological distress by instilling feelings of guilt and social condemnation in those who are struggling with suicidal thoughts [69]. Research also shows that the severity of anhedonia can vary significantly across cultures. For example, one study found that Iranian students reported levels of anhedonia that were twice as high as those of American students. While the connection between anhedonia and suicide risk was strong in both cultural groups, this indicates that the influence of anhedonia on suicidal thoughts remains significant regardless of cultural context [111].

To the best of our knowledge, this study is the first to propose a structural model exploring the mediating roles of positive and negative valence systems and social disconnection in the relationship between perseverative cognitions and suicide. Although the RDoC framework has the potential to deepen our understanding of suicide risk, research that investigates suicidality within this framework remains limited. Most existing studies have concentrated on negative valence systems, leaving the examination of positive valence systems in relation to suicide risk largely unexplored [29]. Our findings reveal a significant association between positive valence systems and suicidal behavior, aligning with the RDoC perspective that identifies deficits in reward systems as critical factors in psychological disorders. Furthermore, we found no relationship between negative valence and

suicidal behavior when considering social disconnection as a mediator. This indicates that negative emotions are primarily linked to suicidal ideation when they occur alongside social disconnection, underscoring the importance of social processes within the RDoC framework [112]. Additionally, our study demonstrated that perseverative cognitions did not significantly correlate with suicidal ideation when accounting for both negative and positive valence systems and social disconnection. This supports the RDoC's view of these three domains as transdiagnostic processes relevant to psychological difficulties, including suicidality [27]. Focusing solely on diagnostic risk factors has not enhanced our understanding of the causes of suicide or improved our ability to predict it [112]. Additionally, suicidal thoughts and behaviors can manifest across various conditions rather than being confined to a specific disorder [29]. If the findings of the current transdiagnostic study are replicated in future research, especially in clinical settings, it could have significant implications for explaining and preventing suicide.

### Clinical implications

Our findings have important clinical implications for clinicians working with individuals at risk of suicide. Our results support the idea that two systems—positive and negative valence systems—play a role in suicidal thoughts and behaviors. Therefore, treatment approaches should not only aim to reduce negative emotions but also to increase positive emotions. Emotion regulation skills, such as reappraisal, acceptance of negative emotions, mindfulness, and distress tolerance techniques—including distraction and self-soothing—can be utilized to help alleviate negative emotions. Treatment interventions designed to enhance positive emotions can include behavioral activation, which is particularly relevant given the connection between social disconnection and suicidal thoughts. These interventions may focus on promoting social interactions. Additionally, cognitive behavioral therapy that emphasizes positive experiences, such as Positive Awareness Training (PAT), can help lay the groundwork for positive emotional experiences by enhancing reward sensitivity [113]. Furthermore, our findings indicate that perseverative cognitions are linked to reduced activation in positive valence systems. On the other hand, mindfulness-based interventions have proven effective in decreasing persistent thoughts like rumination and worry [114], while also increasing positive emotions [115]. Therefore, the findings of this study underscore the effectiveness of mindfulness-based techniques—such as meditation, thought observation, and body scanning—in reducing suicidal thoughts and behaviors by alleviating rumination, obsession, and worry [114, 115]. Implementing these interventions in a group

therapy setting may be especially beneficial for addressing feelings of alienation and reducing suicidal thoughts. This can be achieved through therapeutic processes that foster a sense of coherence, community, and altruism [116]. Our findings also suggest the need to develop integrated treatment models that include interventions for both individual and social factors that contribute to suicidality, emphasizing the importance of addressing interpersonal as well as intrapersonal variables.

### Limitations

Given the limited research on the link between positive valence systems and suicide [117], one of the main strengths of our study is examining this relationship through a mediation model. However, the present findings should be considered given multiple limitations. The current cross-sectional study design cannot establish definitive causal relationships between variables. On the other hand, longitudinal designs that collect data at multiple time points can track the development of perseverative cognitions and their impact on suicidal behaviors over time. By examining whether increases in perseverative thinking occur before suicidal behaviors, longitudinal studies can help clarify causal relationships. These designs can also more accurately investigate mediating factors. Furthermore, other factors not examined in this study, such as hopelessness - which is associated with increased suicidal ideation and attempts [118, 119]- may have influenced the observed relationships. Therefore, future studies utilizing comprehensive clinical trials could evaluate additional key variables that might affect these relationships and determine if positive and negative valence systems, along with social disconnection, are risk factors for suicide. Additionally, participants in the current study were not assessed for any prior suicidal ideation or attempts. Addressing this issue in future research could lead to more accurate findings. This study included a higher proportion of female participants, suggesting that future research should consider the moderating role of gender. Additionally, given the RDoC framework's emphasis on using a variety of measurement tools, it is recommended that future studies incorporate non-self-report methods, such as neuropsychological assessments, to evaluate different dimensions of positive and negative valence. Moreover, the findings of this study were derived from a nonclinical population. Future research should focus on clinical populations at risk of suicidality to establish a foundation for timely preventive and therapeutic measures. It is also important to note that our study was conducted solely with students from one university, which raises concerns about the external validity and generalizability of the results. University students, particularly those in medical and health-related fields, may significantly differ from the broader Iranian

youth population, potentially impacting the outcomes. For instance, medical students often encounter unique stressors, such as academic pressures and professional responsibilities, which can affect factors like perseverative cognition and social disconnection. Therefore, findings from a single institution may not accurately reflect the cultural, socioeconomic, or educational diversity found in other Iranian universities or the general population. To address this limitation, future research should include a larger and more diverse sample.

#### Abbreviations

PCQ	Perseverative Cognitions Questionnaire
ATQ	Approach-Avoidance Temperament Questionnaire
SCS-R	Social Connectedness Scale-Revised
SBQ-R	Suicidal Behaviors Questionnaire-Revised
SEM	Structural Equation Modeling
LC	Lack of Controllability
PF	Preparing for the Future
EW	Expecting the Worst
SC	Searching for Causes/meaning
DP	Dwelling on the Past
DT	Thinking Discordant with the ideal self

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#### Author contributions

S. D. conceived the original idea, designed and directed the project, and developed the theoretical framework; S. D. and Z. Z. contributed to sample preparation; S. D. carried out the implementation; J. MB. performed the analytic calculations; S. D., Pourmohammad, P., & J. MB. wrote the article; L. J. conceived the study and was in charge of the overall direction and planning. All authors provided critical feedback and helped shape the research, analysis, and manuscript.

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#### Data availability

The data supporting this study's findings are openly available at <https://figshare.com>. The data that support the findings of this study are openly available at [https://figshare.com/articles/dataset/Perseverative\\_cognition\\_and\\_suicide\\_structural\\_equation\\_modeling/26962930?file=49064038](https://figshare.com/articles/dataset/Perseverative_cognition_and_suicide_structural_equation_modeling/26962930?file=49064038) (<https://doi.org/10.6084/m9.figshare.26962930>).

#### Declarations

##### Ethics approval and consent to participate

The Institutional Review Board of the Shiraz University of Medical Sciences approved the protocol (ID: IR.SUMS.REC.1402.079). Informed consent was obtained from all participants included in the study. All procedures performed in this study involving human participants were under the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

##### Consent for publication

Not applicable.

##### Competing interests

The authors declare no competing interests.

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