



Cognitive Flexibility of Smokers in the Context of Social Anxiety

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Abstract

Background and Objective: Cognitive dysfunction may be an important factor in smoking and nicotine abuse. However, there are very few studies that have examined the effects of psychiatric conditions on the cognitive flexibility of smokers. This research was conducted to examine cognitive flexibility (perceived controllability and cognitive alternatives) among smokers with social anxiety.

Materials and Methods: The present causal-comparative study was conducted on 60 smoker students studying at Arak University, Arak, Iran, in 2018-2019. The study participants were selected using the purposive sampling technique. At first, the participants completed the Social Phobia Inventory (SPIN) and Cognitive Flexibility Inventory. Then, based on the cutoff point scores of SPIN ($19 \leq$), the participants were divided into two groups of smokers with and without social anxiety ($n=30$ in each group). Finally, these groups were compared in terms of perceived controllability and cognitive alternatives using the multivariate analysis of variance.

Results: The results indicated a significant difference in the linear combination of the dependent variables in the two groups (Wilks' $\lambda=0.799$, $F_{50,2}=6.726$, $P=0.004$). The results of the univariate analysis of variance indicated that the smoker group with social anxiety had lower perceived controllability and cognitive alternatives, compared to the smoker group without social anxiety.

Conclusion: As the findings indicated, the level of cognitive flexibility in the smokers with and without social anxiety was different. Therefore, it is necessary to consider the evaluation and treatment of cognitive deficits in smokers based on their level of social anxiety.

Keywords: Cognitive flexibility, Smokers, Social anxiety

Background

Although the prevalence of smoking has declined in recent years, certain subpopulations continue to smoke at a high rate [1]. Cigarette smoking is a leading preventable cause of death not only in the Western world [2] but also worldwide [1]. This habit has a higher prevalence in individuals with psychiatric disorders. Some studies have indicated that individuals showing cognitive and affective impairments, particularly in the context of psychiatric conditions, are at a higher risk of smoking and tobacco addiction. In other words, because nicotine has been shown to improve cognitive and emotional processing in some conditions, including during tobacco abstinence, the self-medication of cognitive deficits or negative affectivity has been proposed to account for the high rate of smoking among people with psychiatric disorders [1].

One of the most important cognitive variables in this field is cognitive flexibility. According to the literature, cognitive flexibility includes the tendency to perceive difficult situations as controllable, the

ability to perceive multiple alternative explanations for life occurrences and human behavior, and the ability to generate multiple alternative solutions to difficult situations [3]. The construct of cognitive flexibility that is sometimes referred to as mental flexibility may be a subcomponent of psychological flexibility (but not necessarily a pre-requisite of it), which involves the ability to change behavior (either a thought or an action) in response to environmental changes [4].

Although the abusers of some substances have been shown to suffer from impairments in executive functions [5, 6], very few studies have examined the effects of smoking on cognitive flexibility. These studies have shown that chronic cigarette smoking is associated with decreased cognitive performance in the middle age period [7, 8] and increased risk of cognitive decline later in life [9]. Other researchers have also reported that smoking selectively impairs cognitive flexibility in high-dependent smokers [10]. The negative relationship reported between the severity of smoking dependence and cognitive

flexibility in psychiatric patients [11] and healthy individuals [7] indicates that cognitive dysfunction may be important in smoking and nicotine abuse [10]. Accordingly, there are studies confirming nicotine potentiality to induce cognitive enhancement in minimally deprived or non-deprived smokers [12, 13]. These results propose that nicotine can enhance or facilitate some aspects of cognitive processing [10]. However, there are contradictory reports regarding these effects. For example, West and Hack [14] reported smoking-induced improvement in the performance of smokers in an information processing task, while Rotheram-Fuller et al. [15] found no difference in cognitive flexibility between non-smokers and smokers. The cognitive flexibility of smokers may be impacted by other important variables, such as psychiatric conditions.

According to the literature, there is a strong relationship between anxiety disorders and tobacco smoking [1]. Accordingly, in a study, patients with anxiety disorders, such as social anxiety, exhibited more severe nicotine dependence at the baseline [16]. It is likely that social anxiety, as a persistent and excessive fear of one or more social or performance situations [17], accompanied by a high avoidance of social situations [18] can determine the level of cognitive flexibility in smokers. This probability is based on the fact that anxiety is a risk factor for cognitive decline [19], and that anxious people have lower estimations of their own competency in life [20].

According to the models of cognitive processing in anxiety disorders, socially anxious people display several distorted cognitive processes, such as social threat thoughts and social skill perception, which lead to the persistence of their anxiety [21]. According to a theory proposed by Rapee and Heimberg [22], socially anxious individuals are greatly concerned that they will be negatively evaluated and see others as inherently critical. They also tend to perceive themselves as less socially skillful [23, 24]. Therefore, based on the cognitive model of social anxiety disorder, individuals who are anxious in social environments have some dysfunctional thoughts and beliefs regarding themselves and ways of others to judge their behaviors [25].

The cognitive models of social anxiety disorder also emphasize post-event processing (involving repetitive negative thinking about perceived social failure) as a prominent maintaining factor that occurs after social-evaluative events [26]. Research on cognitive biases indicates these individuals may lack an accurate view of how they are perceived by others, especially in social situations when they

allocate important attentional resources to monitor their own actions, as well as the external threats [27]. Accordingly, the core of social anxiety appears to be a strong desire to convey a particular, favorable impression of oneself to others and marked insecurity about one's ability to do so [28]. These results may indicate an important deficit in the cognitive flexibility of these people, especially those smoking.

Cognitive flexibility has been investigated as a potential mechanism related to some anxiety disorders [29]. Social anxiety disorder can also be maintained by cognitive content and styles, including an inability to adapt or flexibly respond to unexpected conditions. Accordingly, the role of cognitive inflexibility in individuals with social anxiety is warranted [30]. Although nicotine can affect the cognitive functions of smokers, the beneficial effects of nicotine probably contribute to the maintenance of smoking in populations with mental health problems [1]. The level of cognitive flexibility in smokers can be determined depending on the level of their social anxiety. There are some studies addressing cognitive flexibility and anxiety disorders in smokers separately. However, to the best of our knowledge, no study has examined the cognitive flexibility of smokers with social anxiety.

Objectives

The present study was carried out to compare the cognitive flexibility of smokers with and without social anxiety.

Materials and Methods

The present causal-comparative study was conducted on 60 smoker students studying at Arak University, Arak, Iran, in 2018-2019. The study participants were selected using the purposive sampling technique. For a sampling purpose, at first, the researcher asked a general question from the students about the smoking status among the college students. After a brief conversation about this problem, the respondents were asked whether they were smokers. In case of receiving a positive response to this question, the students were asked to participate in a survey by answering two questionnaires.

The participants completed the Social Phobia Inventory (SPIN) and Cognitive Flexibility Inventory (CFI). Based on the cutoff point scores of SPIN ($19 \leq$), the study population was divided into two groups of smokers with social anxiety and smokers without social anxiety. The p-value for sample size calculation (the proportion of one trait in the population) was unknown, and it was relatively difficult to find smoker students with

social anxiety. Therefore, without the statistical calculation of the sample size, the minimum sample size required for a causal-comparative study was considered. In this regard, 30 cases were assigned into each of the study groups. The inclusion criteria were: 1) a one-year history of regular smoking, 2) lack of serious problems (e.g., severe physical or mental illnesses, except for social anxiety in the smoker group with social anxiety), 3) no substance abuse, and 4) personal desire to participate in the research. On the other hand, the exclusion criteria were deficit in the completion of the research instruments and nicotine withdrawal within the research period. Finally, the two groups were compared in terms of cognitive flexibility using the multivariate analysis of variance (MANOVA).

Social Phobia Inventory

The SPIN, developed by Connor et al. [31], includes questions that measure fear, avoidance, and physiological discomfort. This instrument consists of 17 items, rated on a 5-point Likert scale (0=not at all, 1=a little bit, 2=somewhat, 3=very much, and 4=extremely), with higher scores representing a greater level of distress. Therefore, this tool has a score range of 0-68. A SPIN score of 19 distinguishes between subjects with social phobia and those without such a disorder. The internal consistency of this test has been reported to range from 0.87 to 0.94 and 0.82 to 0.90 for individuals with social and those without this disorder, respectively. The construct validity of this inventory was also demonstrated by observing that the different severity levels of social phobia would be reflected by different SPIN scores [31]. In Iran, the reliability of this test was confirmed using Cronbach's alpha coefficient test and test-retest (0.98 and 0.84 respectively). In addition, the instrumental validity of this tool was estimated at 0.83 using the anxiety test of Symptom Checklist-90 as a criterion [32].

Cognitive Flexibility Inventory

The CFI was developed by Dennis and Vanderwall [3] to act as a brief self-report measure of the type of cognitive flexibility necessary for individuals to successfully challenge and replace maladaptive

thoughts with more balanced and adaptive thinking. It was designed to measure three aspects of cognitive flexibility, namely the tendency to perceive difficult situations as controllable, the ability to perceive multiple alternative explanations for life occurrences and human behavior, and the ability to generate multiple alternative solutions to difficult situations. However, this inventory has a reliable two-factor structure. In other words, the final version of the CFI is composed of 20 items with 13 items belonging to the alternatives subscale (cognitive alternatives) and 7 items being related to the control subscale (perceived controllability).

The items of this inventory are rated on a 7-point Likert scale ranging from strongly disagree (scored 1) to strongly agree (scored 7), with some items being scored reversely. The total score of this instrument is obtained by summing up the scores of all items. Higher scores are indicative of greater cognitive flexibility, which is predicted to be associated with greater cognitive adaptability when encountering stressful situations. The Chronbach's alpha coefficient of the two CFI subscales and total CFI estimated at two time points was reported to range from 0.84 to 0.91. The concurrent validity of the CFI with the Beck Depression Inventory-Second Edition was obtained as -0.39, and its convergent construct validity with the Martin and Rubin Cognitive Flexibility Scale was estimated at 0.75 [3]. The validity of the Iranian version of CFI is reportedly acceptable, and the Cronbach's alpha and test-retest coefficients of this inventory have been reported as 0.90 and 0.71, respectively [33].

Results

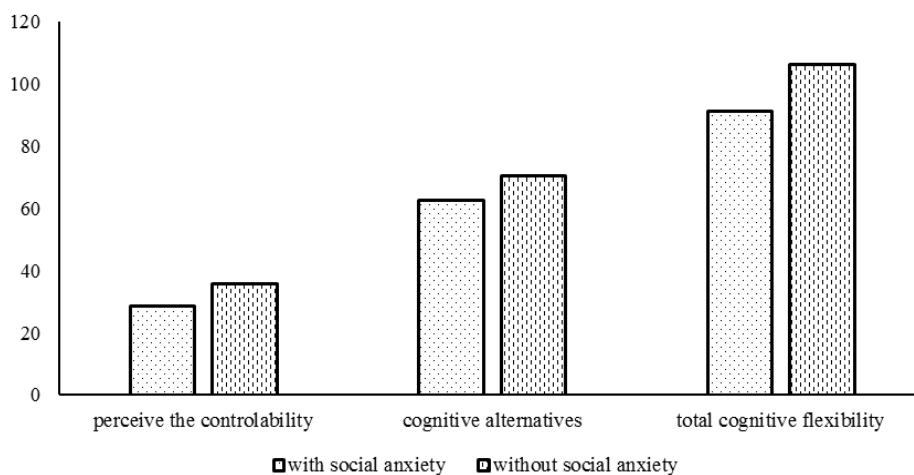
The collected data from the smoker groups with and without social anxiety were subjected to statistical analysis. The response rates in the smoker groups with and without social anxiety were estimated at 84% and 94%, respectively. The two groups were then compared in terms of cognitive flexibility (i.e., perceived controllability and cognitive alternatives). The study participants included undergraduate students; therefore, they were comparable in terms of age. However, the subjects were different considering the level of social anxiety, based on the results of the t-test analysis for two independent groups (Table 1).

Table 1. Results of t-test for comparing the two smoker groups in terms of age and social anxiety

Variable	Smoker group	Mean	SD	t	df	Sig
Age	With social anxiety	21.32	2.23	-0.708	51	0.482
	Without social anxiety	21.75	2.19			
Social anxiety	With social anxiety	31.64	9.43	10.38	51	0.001
	Without social anxiety	11.25	4.15			

Table 2. Descriptive results of cognitive flexibility and its components (perceived controllability and cognitive alternatives) in the two research groups

Variable	Smoker group	Mean	SD
Total cognitive flexibility	With social anxiety	91.36	17.36
	Without social anxiety	106.14	17.70
Perceived controllability	With social anxiety	28.72	7.61
	Without social anxiety	35.75	7.46
Cognitive alternatives	With social anxiety	62.64	12.10
	Without social anxiety	70.39	15.32

**Figure 1.** Mean values of total cognitive flexibility, perceived controllability, and cognitive alternatives**Table 3.** Results of MANOVA for perceived controllability and cognitive alternatives

Effect	Value	F	Df ₁	Df ₂	Sig	Partial eta squared	
Group	Wilks' lambda	0.799	6.276	2	50	0.004	0.201

Table 4. Univariate analysis of perceived controllability and cognitive alternatives

Score	Dependent variable	Type III sum of squares	Df	Mean square	F	Sig	Partial eta squared
Group	Perceived controllability	652.729	1	652.729	11.518	0.001	0.184
	Cognitive alternatives	793.863	1	793.863	4.109	0.048	0.075

According to Table 1, the two groups are not significantly different in terms of their mean age ($t = -0.708$, $df = 51$, $P = 0.482$). However, the results revealed a significant difference between the two groups regarding social anxiety ($t = 10.38$, $df = 51$, $P = 0.001$). Therefore, the two smoker groups were compared in terms of cognitive flexibility (i.e., perceived controllability and cognitive alternatives) as dependent variables. Table 2 shows the mean scores of these variables in the two research groups. Figure 1 also depicts the mean values of total cognitive flexibility, perceived controllability, and cognitive alternatives in the two groups.

Since the present research had two independent groups that were compared in terms of two dependent variables (i.e., perceived controllability and cognitive alternatives), the data were analyzed using MANOVA. The covariance matrices of the two groups were equal and had no significant difference (Box's $M = 5.44$, $P = 0.157$). Furthermore, the Bartlett's test of sphericity showed a significant

difference between the dependent variables (i.e., perceived controllability and cognitive alternatives) ($\chi^2 = 21.70$, $P = 0.000$). Therefore, since the assumptions of the MANOVA were fulfilled, this test was performed to analyze the differences between the two groups in terms of these variables. Table 3 presents the results of MANOVA for these variables.

Based on the results, the linear combination of the dependent variables was significantly different (Table 3). The results of the univariate analysis of these variables are indicated in Table 4.

According to the results, the obtained F values for perceived controllability and cognitive alternatives were significant (Table 4). Therefore, the mean scores of these variables were significantly different between the two groups. Based on the data presented in Table 2, the smoker group with social anxiety had lower cognitive flexibility (i.e., perceived controllability and cognitive alternatives), compared to the smoker group without social anxiety.

Discussion

The present research aimed to examine cognitive flexibility (i.e., perceived controllability and cognitive alternatives) in smokers with social anxiety. Accordingly, two smoker groups with and without social anxiety were compared in terms of cognitive flexibility. The results showed that the smokers with social anxiety had a lower level of perceived controllability and cognitive alternatives, compared to those without social anxiety. Therefore, social anxiety could be concluded as an important variable in the cognitive flexibility of smokers.

Previous studies claimed that cognitive dysfunction may be implicated in smoking and nicotine abuse [10]. Despite these examinations, there are very few studies that have examined the effects of psychological disorders, such as social anxiety, on the cognitive flexibility of smokers. To the best of our knowledge, there were no studies, comparing perceived controllability and cognitive alternatives in smokers with and without social anxiety. Most of the existing studies compared cognitive flexibility or social anxiety between smokers and non-smokers. However, the results of the present research are somewhat consistent with those of other studies.

Besson and Forget [1] expressed that individuals with psychiatric diagnosis continue smoking for the probable beneficial effects of nicotine on cognitive functions. These researchers mentioned that the use of self-medication for cognitive deficits or negative affectivity is proposed for high rates of smoking among people with psychiatric disorders [1]. Hence, a mental disorder, such as social anxiety, is associated with the cognitive functioning of smokers. In this situation, smokers with social anxiety are more likely to have less cognitive flexibility, and they even smoke more with the purpose of improving this cognitive impairment.

Some studies indicate decreased cognitive performance [7, 8] and increased risk of cognitive decline [9] in smokers. The results of some of these studies are consistent with those of the present research. The conclusion of the research performed by Martin et al. on psychiatric patients [11] is consistent with our findings. The cognitive enhancement smokers experience as a result of nicotine [12, 13] suggests that nicotine can facilitate some aspects of cognitive processing. This can justify smoking in people with low cognitive flexibility. However, the contradictory results in this context [14, 15] indicate the possible role of other variables in determining the level of cognitive flexibility in smokers. The patients with social anxiety exhibit severe nicotine dependence [16]. Moreover, in the present study, the smokers with

social anxiety had less cognitive flexibility. Therefore, social anxiety is likely to be an important factor in the cognitive flexibility of smokers.

The difference in cognitive flexibility between people with and without social anxiety can be explained due to the general status of their cognitive functioning. Socially anxious people display several distorted cognitive processes, such as social threat thoughts and perception of fewer social skills [21]. They are greatly concerned about negative evaluation [22] and perceive themselves as less socially skillful [23, 24]. These conditions may have an important role in the lower level of perceived controllability, especially in the context of social performance. They also have some dysfunctional thoughts and beliefs regarding themselves and ways of others to judge their behaviors [25]. They have post-event processing that involves repetitive negative thinking revolving around perceived social failure [26]. Furthermore, these people have a desire to show a favorable impression of oneself to others and marked insecurity about one's ability to do so [28]. These deficits in their cognitive functioning may also affect their ability to generate cognitive alternatives in difficult situations.

The fear of social or performance situations [17] and avoidance of these situations [18] in people with social anxiety, as well as having lower estimations of their own competency in life [20], do not permit them to perceive the controllability of difficult situations. Therefore, this component of cognitive flexibility is at a lower level in smokers with social anxiety, compared to that in smokers without social anxiety. The inability of people with social anxiety to adapt or flexibly respond to unexpected conditions [30] can also reduce cognitive alternatives as another component of cognitive flexibility in this group.

These explanations are confirmed by the fact that anxiety is a risk factor for cognitive decline [19]. This cognitive decline will certainly decrease cognitive flexibility in smokers. Therefore, as an important implication of this study, it can be stated that considering the effect that nicotine can have on cognitive functions in smokers, the level of cognitive flexibility in these people can be also determined based on the level of social anxiety.

Although these explanations are somewhat exact, it must be considered that the group with social anxiety in this research was not necessarily composed of the clinical samples or severe cases. They were only selected based on the cutoff point of the SPIN and may not have severe social anxiety. In other words, this research was conducted on smoker students that were separated based on self-report and non-clinical symptoms of social anxiety.

Accordingly, caution should be exercised in generalizing the obtained results to clinical samples and smokers diagnosed based on accurate clinical criteria and also the people with lower education.

The main limitation of the present study was difficulty in controlling all intervening variables and separating their role from the independent variables because of the nature of the causal-comparative design used in this research. Therefore, it is necessary to investigate the relationship between these variables using a more controlled research design and more accurate causal studies. Furthermore, considering that finding smoker students with social anxiety was relatively difficult, the low sample size was another limitation that should be considered in future studies. However, the results of this study can provide a guideline for public health caregivers by introducing social anxiety as an important psychological factor related to smoking and its consequences. They should prevent and cure social anxiety in general population, especially socially anxious smokers, by the implementation of preventive and therapeutic psychological programs.

Conclusions

Cognitive flexibility is an important psychological function that may be declined in smokers; regarding this, it is necessary to seriously consider this factor to better understand smoking. Furthermore, social anxiety may induce a decline in the cognitive flexibility of smokers. Accordingly, since the level of cognitive flexibility in smokers with and without social anxiety was different, it is necessary to consider the evaluation and treatment of cognitive deficits in smokers based on their level of social anxiety. These considerations will improve the outcomes of preventive and therapeutic programs for smokers.

Compliance with ethical guidelines

This research had no ethics code issued by an ethics committee. However, all ethical principles were considered during the course of the study. In this regard, the participants were informed about the general purpose of the research, freedom to participate in the research or leave the study, and confidentiality of information.

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Conflicts of Interest

The author declares no conflict of interest.

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