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A Preliminary Study on the Effect of Cognitive Bias Modification on the Attribution of Positive Social Outcomes in Socially Anxious Individuals

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Socially anxious individuals tend to disqualify positive social outcomes by attributing such outcomes to others rather than themselves. Previous research suggests that this tendency is a potentially important target of intervention. Thus, the present study aimed to examine the efficacy of cognitive bias modification (CBM) on attribution bias related to positive social outcomes among socially anxious individuals. A total of 159 undergraduate students were randomly assigned to the CBM or placebo group. Based on their level of social anxiety, participants were subsequently classified into either the high ($n = 75$) or low social anxiety groups ($n = 18$). Results showed that CBM was effective in reducing attribution bias related to positive social outcomes in socially anxious individuals. Social anxiety symptoms also diminished after the intervention. The findings of this study provide preliminary evidence regarding the efficacy of CBM for reducing attribution bias related to positive social outcomes and social anxiety.

Keywords: cognitive bias modification (CBM), attribution bias, disqualification of positive social outcomes, social anxiety

Social anxiety disorder is marked by excessive anxiety and fear of social situations (American Psychiatric Association, 2013). The cognitive model posits that socially anxious individuals demonstrate cognitive bias in information processing of negative social outcomes. For example, they may interpret ambiguous events negatively or inflate the probability of negative social outcomes (Clark & Wells, 1995). However, accumulating empirical evidence suggests that socially anxious individuals exhibit cognitive bias concerning positive social outcomes as well (Laposa, Cassin, & Rector, 2010).

Since socially anxious individuals tend to hold negatively biased mental self-representation, an etiological factor of social anxiety, they may disqualify positive social outcomes that are not compatible with their negative self-appraisals (Weeks, 2010). For example, when others give positive feedback, individuals with high social anxiety often disqualify their own contribution by attributing such outcomes to other's characteristics ("People will laugh at my jokes even if they aren't funny, simply because that is the polite thing to do) (Weeks, Heimberg, Rodebaugh, & Norton, 2008). Weeks (2010) has conceptualized this attribution bias as disqualification of positive social outcomes (DPSO). DPSO includes self-oriented DPSO as in failing to attribute positive social outcomes to oneself and other-oriented DPSO as in attributing such outcomes to exterior factors.

This tendency has been identified as an obstacle to treatment in clinical settings (Heimberg & Becker, 2002) because it interferes with challenging and revising their negative internal self-representation (Jeon & Park, 2011). Moreover, DPSO reportedly mediates the relationship between fear of positive evaluation (FPE) and negative automatic thoughts (Weeks & Howell, 2012) and also the

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relationship between social anxiety and low level of positive affect (Vassilopoulos & Banerjee, 2010). Negative automatic thoughts and diminished capacity to experience positive emotions are major risk factors for both anxiety (Talkovsky & Norton, 2018) and depressive disorders (Watson & Naragon-Gainey, 2010). Therefore, it can be postulated that DPSO may serve as a bridge between anxiety and depression. In fact, Hong and Park (2019) have shown that DPSO mediated the relationship between social anxiety and depression. Their results indicated that when individuals with high social anxiety disqualify positive social feedback, it can lead to depressive symptoms. Considering that DPSO plays a major role in sustaining and exacerbating social anxiety and comorbid depression, DPSO could be an essential intervention target.

One emerging intervention that targets cognitive processing is Cognitive Bias Modification (CBM; Mathews & Mackintosh, 2000). CBM modifies existing bias by training individuals to focus on more adaptive interpretations. The rationale is that repeated exposures to positive interpretation of situations that typically evoke negative interpretations in anxious individuals can modify interpretation bias and reduce anxiety symptoms. CBM has shown robust positive effects in modifying interpretation bias and a small treatment effect on anxiety in meta-analyses (Bowler et al., 2012; Cristea, Kok, & Cuijpers, 2015). The paradigm has also been applied to attention bias (Heeren, Mogoaşe, Philippot, & McNally, 2015) and meta-analyses have indicated that CBM has a reliable effect on reducing attention bias (Beard, Sawyer, & Hofmann, 2012).

CBM has focused on cognitive processes pertaining to negative social outcomes. However, as discussed previously, cognitive bias concerning positive social outcomes is a major risk factor for social anxiety and a possible target of intervention. Moreover, researchers have mainly used CBM to target interpretation or attention bias, but not attribution bias. Therefore, we applied CBM to DPSO – attribution bias with respect to positive social outcomes – in individuals with elevated social anxiety to examine whether CBM demonstrates effects on reducing attribution bias regarding positive social outcomes. We used the original paradigm that Mathew and Mackintosh (2000) utilized by presenting ambiguous scenarios with a fragmented word because a single session of this paradigm has shown to modify cognitive bias (Mobini et al., 2014; Yiend et al., 2014).

In this study, we examined whether (1) there will be a difference in DPSO measured by a recognition task between individuals with high versus low social anxiety, (2) CBM will reduce DPSO in individuals with high social anxiety compared to a placebo group, and lastly, (3) CBM intervention will improve social anxiety symptoms.

Method

Participants

Participants were 159 undergraduate students between the ages of 18 and 27 ($M = 21.23$, $SD = 1.96$) enrolled in psychology classes in the Republic of Korea. They received course credit for taking part in the study. We used the simple random assignment method using a computerized number generator to allot participants to the CBM ($n = 76$) or the placebo ($n = 83$) group. In the data analysis process, participants were classified in either the high or low social anxiety group. According to Heimberg, Mueller, Holt, Hope, and Liebowitz (1992), mean SIAS and SPS scores in a community group were 19.9 ($SD = 14.2$) and 12.5 ($SD = 11.5$), respectively. Based on these results, participants with scores one standard deviation higher than the mean scores were allotted to the high social anxiety ($n = 75$; CBM group = 33, placebo group = 42) group, while participants whose scores were less than or equal to the scores of the healthy community group were placed in the low social anxiety group ($n = 18$). The study was approved by the institutional review board of the university.

Measures

Social Interaction Anxiety Scale (SIAS; Mattick & Clarke, 1998)

The SIAS is a 19-item scale assessing fear of general social interaction using a 5-point Likert scale ranging from 0 (not at all true) to 4 (very true). In this study, the K-SIAS, translated and validated by Kim (2001), was used. Internal consistency measured as Cronbach's α ranged from .88 to .94. in Kim (2001) and was .91 in this study.

Social Phobia Scale (SPS; Mattick & Clarke, 1998)

The SPS is a 20-item scale measuring fear of being scrutinized by others using a 5-point Likert scale ranging from 0 (not at all true) to 4 (very true). The K-SPS, translated and validated by Kim (2001),

was used in this study. Cronbach's alpha was .92 in Kim (2001) and .90 in this study.

Disqualification of Positive Social Outcomes Scale (DPSOS; Weeks, 2010)

The DPSOS is a 13-item measure of self- and other-oriented attribution tendencies using a 10-point Likert scale ranging from 0 (not at all true) to 9 (very true). The Korean version of the DPSOS (Han, 2015) was used in this study. Internal consistency was .90 in Han (2015) and .89 in this study.

Fear of Positive Evaluation Scale (FPES; Weeks, Heimberg, & Rodebaugh, 2008)

The FPES is a 10-item measure of one's fear of positive evaluation using a 10-point Likert scale ranging from 0 (not at all true) to 9 (very true). The K-FPES, translated and validated by Park, Lee, and Oh (2010) was used in this study. Internal consistency was .85 in Park et al. (2010), and .77 in this study.

Fear of Negative Evaluation Scale (FNES; Leary, 1983)

Based on Watson and Friend (1969), the brief FNES was developed to assess fear of negative evaluation. It consists of 12 items rated on a 10-point Likert scale ranging from 0 (not at all true) to 9 (very true). Lee and Choi (1997) translated and validated the K-FNES, and Cronbach's α was .90. In this study, Cronbach's α was .90.

Center for Epidemiological Studies–Depression Scale (CES–D; Radloff, 1977)

The CES-D is a 20-item measure of depressive symptoms in the past week using a 4-point Likert scale ranging from 0 (not at all or less than 1 day) to 3 (nearly every day). Chon, Choi, and Yang (2001) translated and validated the scale. Cronbach's α was .92 in Chon et al. (2001), and .93 in this study.

Positive Affect and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988)

The PANAS is a 20-item measure of positive and negative affect including 10 items related to positive affect (e.g., enthusiastic and proud) and 10 items related to negative affect (e.g., distressed and nervous). The Korean version of the PANAS (Lee, Kim & Lee, 2003) was used in the present study. Internal consistency was .84 in both Lee et al. (2003) and this study.

CBM

The CBM intervention was made using PsychoPy3 version 3.0. and conducted using an Intel Core i5-5200U CPU, 8.0 GB RAM laptop computer. Because scenarios in CBM must induce cognitive bias, previous studies developed scenarios in accordance with the targeted bias and participant characteristics (Kim & Lee, 2019; Salemink, Kindt, Rienties, & van den Hout., 2014). In this study, scenarios were designed based on the Social Stress Questionnaire (Shon, 2001) and included situations that undergraduate students may experience as stressful. Each scenario contained three sentences that referred to (1) the situation, (2) any positive social outcomes, and (3) attribution (Figure 1). The last sentence remained ambiguous with a fragmented final word (e.g., "This is because your presentation was actually _xcellent") and participants were asked to fill in the blank. One hundred forty scenarios were presented to the participants. For the CBM group, there were 100 scenarios concerning situations in which people received positive social feedback (e.g., "The professor complimented you on your presentation") and 40 scenarios concerning general positive experiences in daily life (e.g., "You bought a delicious cake for your mother's birthday") to mask the purpose of the task. The placebo group performed a masking task which included 140 scenarios concerning positive daily life experiences. After filling in the blank, participants in the CBM group were asked with yes/no questions whether positive social outcomes in the scenarios are attributable to their own characteristics and abilities or to external factors. If they attributed the positive social outcomes to themselves, they received positive feedback ("Correct answer"). If they attributed the outcomes to others, negative feedback ("Wrong answer") was given.

Recognition task

Recognition task is an established way to measure cognitive bias (Mackintosh, Mathews, Yiend, Ridgeway, & Cook, 2006; Salemink, van den Hout, and Kindt, 2010). During the task, participants read a new set of scenarios that are similar to those in CBM. Then both biased and adaptive interpretations of the situations are presented, and participants rate the likelihood of each interpretation (Mobini,

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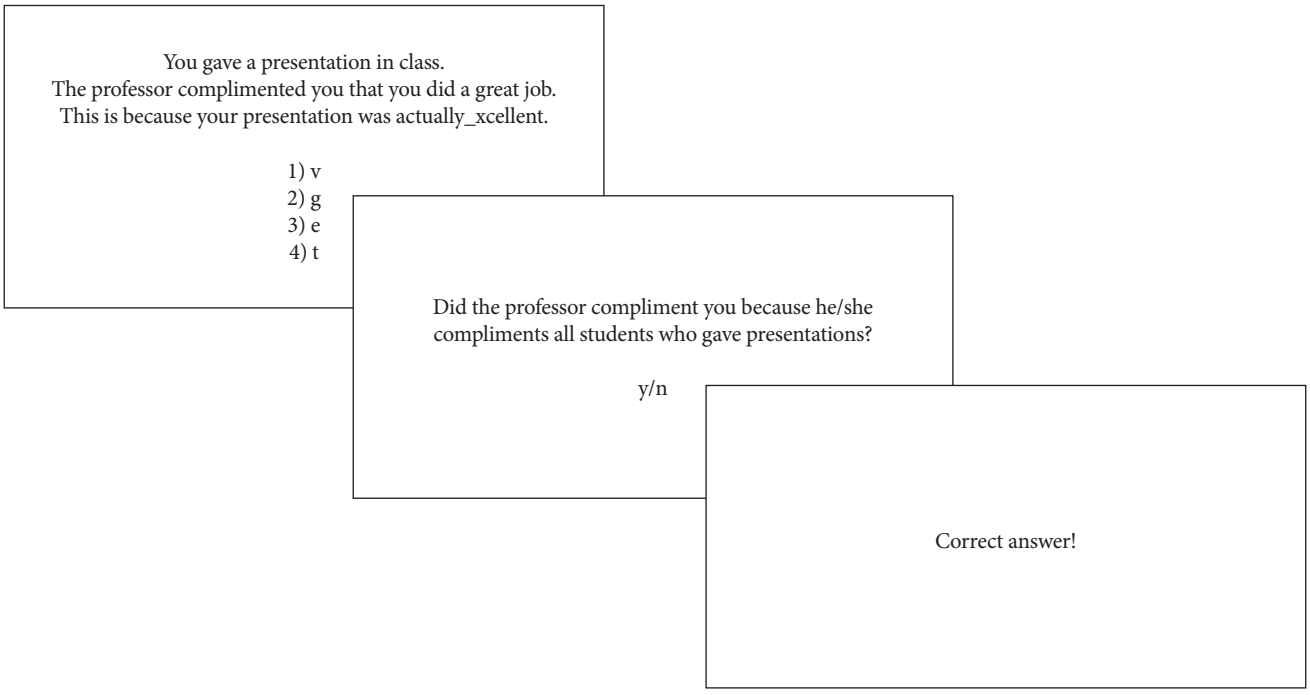

Figure 1. *Example of CBM intervention.*

Reynolds, & Mackintosh, 2013). In this study, ten scenarios were given and there were subsequent comprehension questions with yes/no answers to encourage participants to read scenarios thoroughly. For example, in the "Telling a joke to friends" scenario, participants read the phrase "You are having a dinner with your friends at an Italian restaurant. You told them a funny joke. Your friends say that it was _ilarious" (fill in the blank). Subsequently, they answered the question "Did you have a dinner with your friends at a Thai restaurant? (yes/no)".

After answering the comprehension questions, self-attribution and other-attribution of the situation were presented with the title of the scenario. To evaluate whether CBM affected the targeted attribution bias or the overall anticipation of social outcomes, positive and negative anticipation (termed "foils") that were not related to attribution bias were included. For example, for the scenario "Telling a joke to friends," the participants read the following statements: (1) Your friends genuinely found your joke funny, (2) Your friends said your joke was hilarious only because they did not want to hurt your feelings, (3) The food was delicious, and you had a great time, (4) The food was too expensive, and you did not like the restaurant. Participants rated the likelihood of each statement based on the scenario that they had read. All statements were answered using a 4-point Likert scale ranging from 1 (very unlikely) to 4 (very likely) and the mean scores for each of the 4 statements were calculated for analysis. If the mean self-attribution score increased and the mean other-attribution score decreased following the intervention, we assumed that the intervention was effective.

Procedure

Participants were told that the purpose of the study was to investigate the relationship between memory and positive feedback to prevent potential placebo effects. The participants were fully briefed on the nature of the study after the study. All participants completed self-report questionnaires as pre-intervention measures. The recognition task was then completed to measure participants' attribution bias. For the next 35 minutes, participants in the CBM group received the CBM intervention and participants in the placebo group performed the masking task that did not include any elements addressing cognitive bias. Post-intervention measures were subsequently collected. The study was completed in an hour.

Data Analysis

Data were analyzed using SPSS 25. We conducted an independent samples *t*-test to see whether there was a difference in attribution

bias between the high and low social anxiety groups based on the recognition task. Next, to assess the efficacy of CBM on attribution bias and social anxiety symptoms in the high social anxiety group, we conducted a two-way mixed-model ANOVA. Lastly, we used a paired samples *t*-test to further investigate the pre- and post-intervention differences in the CBM and the placebo groups.

Results

Baseline attribution bias

As shown in Table 1, there were significant differences in attribution bias measured with the recognition task between the high and low social anxiety groups. Individuals with high social anxiety demonstrated the tendency not to attribute positive social outcomes to themselves compared with individuals with low social anxiety ($t(91) = 2.89$, $p = .005$). In addition, individuals with high social anxiety had the tendency to attribute positive social outcomes to others compared with individuals with low social anxiety ($t(91) = -2.28$, $p = .025$). There was no significant difference in the general expectation of positive social outcomes between the two groups ($t(91) = -.08$, $p = .938$). However, the high social anxiety group reported that negative social outcomes were more likely to occur compared to the low social anxiety group ($t(91) = -3.45$, $p = .001$).

Table 1. *Cognitive Bias in the High versus Low Social Anxiety Group*

	High social anxiety ($N = 75$)	Low social anxiety ($N = 18$)	*t*	*p*
	M (*SD*)	*M* (*SD*)		
Self-attribution	3.46 (.38)	3.73 (.24)	2.89	.005**
Other-attribution	2.03 (.49)	1.75 (.41)	-2.28	.025*
Foil-positive	2.67 (.57)	2.66 (.69)	-0.08	.938
Foil-negative	1.73 (.45)	1.34 (.34)	-3.45	.001**

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

Table 2. *Measured Outcome Variables at Pre- and Post-Intervention*

Variables	Group (CBM $N = 33$, Placebo $N = 42$)	*M* (*SD*)		*t*(*p*)	Cohen's *d*	Group	Time	Group*Time	
		Pre-	Post-			*F*(*p*)	*F*(*p*)	*F*(*p*)	Partial η^2
Self-attribution	CBM	3.42 (.41)	3.65 (.33)	-4.14*** (.000)	-.72	0.78	11.55**	6.50*	.08
	Placebo	3.49 (.35)	3.52 (.38)	-0.62 (.538)	-.10	(.380)	(.001)	(.013)	
Other-attribution	CBM	1.98 (.56)	2.31 (.49)	-5.54*** (.000)	-.96	4.50*	108.56***	6.66*	.08
	Placebo	2.07 (.43)	2.62 (.35)	-9.42*** (.000)	-1.45	(.037)	(.000)	(.012)	
Foil-positive	CBM	2.55 (.49)	2.50 (.67)	0.53 (.597)	.09	2.54	0.73	0.003	.00
	Placebo	2.77 (.61)	2.72 (.68)	0.69 (.496)	.11	(.115)	(.396)	(.956)	
Foil-negative	CBM	1.73 (.51)	1.63 (.50)	2.50* (.018)	.44	0.83	0.08	5.52*	.07
	Placebo	1.72 (.39)	1.80 (.44)	-1.32 (.194)	-.20	(.366)	(.779)	(.021)	
Social interaction anxiety	CBM	40.48 (8.44)	36.70 (9.09)	3.72** (.001)	.65	0.87	24.28***	0.27	.00
	Placebo	41.88 (6.61)	38.81 (10.10)	3.27** (.002)	.50	(.355)	(.000)	(.608)	
Social phobia	CBM	22.33 (9.62)	20.45 (10.84)	1.85 (.074)	.32	1.45	4.68*	0.02	.00
	Placebo	25.57 (12.03)	23.90 (15.59)	1.38 (.177)	.21	(.232)	(.034)	(.897)	
Disqualif-ication of positive social outcomes	CBM	46.06 (19.76)	44.33 (21.53)	1.22 (.231)	.21	0.89	4.45*	0.10	.00
	Placebo	50.00 (12.85)	47.67 (14.46)	1.80 (.079)	.28	(.349)	(.038)	(.754)	
Fear of positive evaluation	CBM	28.12 (10.83)	25.70 (10.94)	2.60* (.014)	.45	12.22**	5.76*	1.26	.02
	Placebo	35.64 (9.87)	34.76 (10.92)	0.90 (.372)	.14	(.001)	(.019)	(.266)	
Fear of negative evaluation	CBM	40.03 (9.75)	38.21 (10.03)	3.37** (.002)	.59	0.18	10.34**	1.73	.02
	Placebo	40.33 (6.98)	39.57 (7.66)	1.33 (.190)	.21	(.671)	(.002)	(.192)	
Depression	CBM	21.03 (12.35)	20.48 (12.76)	1.36 (.184)	.24	0.20	4.75*	0.29	.00
	Placebo	19.98 (11.30)	19.07 (11.60)	1.82 (.077)	.28	(.656)	(.033)	(.591)	
Positive affect	CBM	20.55 (5.99)	20.21 (6.55)	0.28 (.780)	.05	1.85	0.14	0.64	.01
	Placebo	18.36 (5.36)	19.29 (6.07)	-0.90 (.375)	-.14	(.178)	(.706)	(.425)	
Negative affect	CBM	22.70 (8.17)	20.88 (8.59)	1.38 (.179)	.24	0.67	1.77	0.03	.00
	Placebo	23.64 (7.83)	22.21 (7.49)	0.75 (.456)	.12	(.418)	(.188)	(.874)	

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

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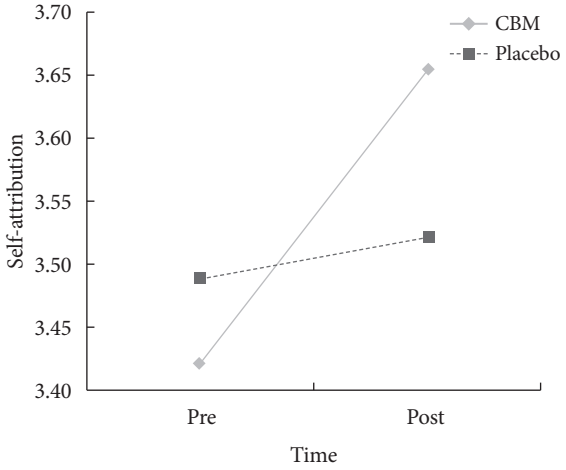

Figure 2. *Self-attribution at Pre- and Post-intervention.*

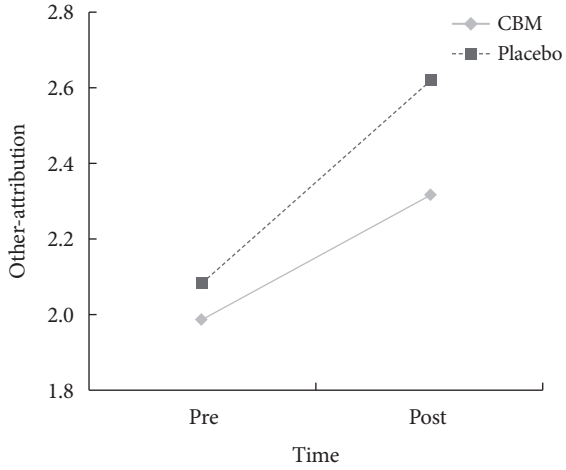

Figure 3. *Other-attribution at Pre- and Post-intervention.*

Attribution bias outcome measures

To evaluate the efficacy of CBM, we used a two-way mixed model ANOVA with group (CBM vs. placebo) as the between-subjects factor and time (pre- vs. post-intervention) as the within-subjects factor (Table 2). First, there was a statistically significant main effect of time on self-attribution bias ($F(1, 73) = 11.55$, $p = .001$) but not assignment ($F(1, 73) = .78$, $p = .380$). Also, there was a statistically significant interaction effect between group and time on self-attribution bias ($F(1, 73) = 6.50$, $p = .013$, partial $\eta^2 = .08$) (Figure 2), indicating that both groups demonstrated increased self-attribution tendency following the task. However , the CBM group showed a significantly larger increase in self-attribution tendency. Next, there were statistically significant main effects of time ($F(1, 73) = 108.56$, $p = .000$) and group ($F(1, 73) = 4.50$, $p = .037$) on other-attribution bias. In addition, there was a statistically significant interaction effect between group and time on other-attribution bias ($F(1, 73) = 6.66$, $p = .012$, partial $\eta^2 = .08$) (Figure 3). Prior to the intervention, there was no significant difference in other-attribution between the two groups. Following CBM, however, the CBM group exhibited a significantly lower level of other-attribution tendency. Interestingly, degrees of other-attribution tendency increased following the interventions in both groups. There was no significant main nor interaction effect on expectation of positive social outcomes. Also, the main effect of group or time was not significant for anticipation of negative social outcomes. There was, however, a significant interaction effect between group and time in anticipation of negative social outcomes ($F(1, 73) = 5.52$, $p = .021$, partial $\eta^2 = .07$).

Clinical outcomes measures

In respect to clinical outcome measures, the main effect of time on social interaction anxiety ($F(1, 73) = 24.28$, $p = .000$), social phobia ($F(1, 73) = 4.68$, $p = .034$), disqualification of positive social outcomes ($F(1, 73) = 4.45$, $p = .038$), fear of positive evaluation ($F(1, 73) = 5.76$, $p = .019$), fear of negative evaluation ($F(1, 73) = 10.34$, $p = .002$), and depressive symptom ($F(1, 73) = 4.75$, $p = .033$) was significant. However, the interaction effect between time and assignment was not significant. Hence, we used a paired samples *t*-test and calculated effect sizes in Cohen's *d* to further assess potential effects of the CBM intervention (Table 2). In the CBM group, there were statistically significant differences between pre- and post-CBM in social interaction anxiety ($t(32) = 3.72$, $p = .001$), fear of positive evaluation ($t(32) = 2.60$, $p = .014$), and fear of negative evaluation ($t(32) = 3.37$, $p = .002$). However, there were no statistically significant differences in social phobia, disqualification of positive social outcomes, and general emotional state. In the placebo group, on the other hand, the only statistically significant difference was in social interaction anxiety ($t(41) = 3.27$, $p = .002$) such that following the intervention, social anxiety symptoms in the placebo group significantly decreased.

Discussion

In this study, we examined the efficacy of CBM in modifying attribution bias related to positive social outcomes and associated social anxiety symptoms. First, individuals with high social anxi-

ety tended to disqualify positive social outcomes by attributing such outcomes to external factors rather than to themselves, which supports findings from previous studies (Hong & Park, 2019; Weeks, 2010). Individuals with high social anxiety also tended to anticipate that negative social outcomes were more likely compared to individuals with low social anxiety. The result is in line with studies which reported that socially anxious individuals expect that negative social outcomes will occur more frequently than individuals without social anxiety (Clark & Wells, 1995; Spokas, Rodebaugh, & Heimberg, 2007).

Secondly, we demonstrated the preliminary efficacy of the CBM intervention on attribution bias. The tendency to attribute positive social outcomes to oneself improved in both the CBM and placebo groups following the intervention, but the degree of improvement was significantly larger in the CBM group showing a medium effect size in regard to the interaction effect. There was no difference between the two groups in anticipation of positive social outcomes, indicating that the change in attribution bias did not stem from a change in general positive perception of social outcomes. The result of this study, although preliminary, holds potential clinical implications, because negative self-appraisal is one of the core features of social anxiety (Abbott & Rapee, 2004), and attributing positive social outcomes to oneself can help revising negative self-appraisal in a positive way. Moreover, CBM reduced anticipation of negative social outcomes in the CBM group, but not in the placebo group.

We expected that CBM would reduce the tendency to attribute positive social outcomes to others, but this tendency was increased in both the CBM and placebo group after the intervention. The degree of increase was significantly smaller in the CBM group than in the placebo group, yet the result needs further explanation. One possible explanation is that the result may have been due to the indirect effect of repeated reading of positive social scenarios. Self-attribution is associated with one's self-appraisal. Other-attribution, however, is implicitly related to the appraisal of both self and others because it implies that one fails to attribute positive social outcomes to oneself and instead attributes such outcomes to others. Therefore, we believe that reading positive social scenarios repeatedly during the CBM and placebo task may have not only positively affected participants' self-appraisal but also in part indirectly affected participants' appraisal of others positively, thus increasing other-attribution of positive social outcomes. Statements describing other-attribution such as "Your friend said thank you simply because he was moved by your efforts" may be judged to be more likely if one's appraisal of the other person was positive. However, the degree of increase in other-attribution was smaller while the degree of change in self-attribution was greater in the CBM group compared to the placebo group. These results indicate that CBM was still effective in increasing the tendency to attribute positive social outcomes to oneself rather than to others.

We also examined the efficacy of CBM on social anxiety symptoms, and there was no significant difference between the two groups as indicated by the interaction effect of time and group. However, the extent of change in symptoms varied depending on the group. In the CBM group, social interaction anxiety, fear of negative evaluation, and fear of positive evaluation decreased with medium effect sizes following the CBM intervention, whereas in the placebo group, only social interaction anxiety symptoms decreased. Therefore, our findings partially support the short-term efficacy of CBM on social anxiety symptoms.

However, disqualification of positive social outcomes measured with self-report questionnaires decreased but not at a statistically significant level in the CBM group, even though CBM showed efficacy as measured with the recognition task. When cognitive bias is measured with self-report questionnaires, there have been mixed results, showing less consistent efficacy compared to outcome measured with a recognition task (de Hullu, Sportel, Nauta, & de Jong, 2017; Steinman & Teachman, 2010). In the recognition task, participants read interpretations that the researcher provided, but a self-report questionnaire requires more in-depth cognitive reconstruction such as self-evaluation of their information processing (e.g., "I am able to take compliments easily") (Glass & Arnkoff, 1997). Hence, a single session of CBM may not be sufficient to engender enduring change in cognitive processes, which is necessary for significant change in self-report questionnaire responses.

In addition, the placebo group also showed improvement in social interaction anxiety, and this may have been the result of the priming effect. The masking task for the placebo group presented positive social situation scenarios to minimize the possible con-

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founding effects of negative or neutral scenarios. However, even in the absence of any significant improvement in overall mood, participants may have been primed to feel positive about social interaction as a result of having read positive social scenarios. Despite the mixed results, CBM did reduce fear of positive and negative evaluation as well as social interaction anxiety, whereas the placebo did not affect any variables other than social interaction anxiety.

This study holds several limitations. We applied a single session of CBM and did not collect data at follow-up. Secondly, although the results imply that change in self-attribution tendency was highly associated with improvement in social anxiety, we cannot make assumptions regarding the underlying mechanism. Therefore, future studies should conduct a mediation analysis to clarify this mechanism. Also, even though we examined socially anxious individuals, participants were all undergraduate students, thus not representing the general population. For future studies, comparing CBM with diverse placebo conditions including not only positive but also neutral and/or negative social outcomes, or with other established interventions such as traditional CBT is needed. In addition, comparing the effect of CBM that targets different cognitive biases such as interpretation, attention and attribution bias and examining their unique effect on social anxiety may also contribute to providing a better understanding of cognitive bias related to social anxiety.

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