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Processes in cognitive behavior therapy for social anxiety disorder: Predicting subsequent symptom change

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ABSTRACT

Although cognitive behavior therapy (CBT) is an effective treatment for social anxiety disorder, little is known about the processes during treatment that bring about change. The aim of this study was to investigate whether the proposed processes of change according to the cognitive model of social anxiety disorder predicted subsequent symptom reduction in CBT delivered as therapist-guided bibliotherapy. We analyzed data from patients with social anxiety disorder ($N = 61$) who participated in an effectiveness trial of CBT in primary care. Seven putative processes and outcome (i.e., social anxiety) were assessed on a weekly basis throughout treatment. We used linear mixed models to analyze within-person relations between processes and outcome. The results showed a unidirectional effect of reduced avoidance on subsequent decrease in social anxiety. Further, we found support for reciprocal influences between four of the proposed processes (i.e., estimated probability and cost of adverse outcome, self-focused attention, and safety behaviors) and social anxiety. The remaining two processes, (i.e., anticipatory and post-event processing) did not predict subsequent social anxiety, but were predicted by prior symptom reduction. The findings support that several of the change processes according to the cognitive model of social anxiety disorder are involved in symptom improvement.

1. Introduction

The core feature of social anxiety disorder (SAD) is an excessive fear of scrutiny by others, associated with feelings of humiliation and embarrassment (Stein & Stein, 2008). SAD is one of the most common psychiatric disorders with an estimated lifetime prevalence of 12.1% in the general population (Kessler et al., 2005). It leads to marked impairments in quality of life, social functioning, and academic and occupational performance (Katzelnick et al., 2001). Further, SAD is highly persistent and rarely remits without treatment (Wittchen & Fehm, 2003).

Cognitive behavior therapy (CBT) in different delivery formats, i.e., face-to-face, group or self-help, has substantial empirical support in treatment of SAD (Mayo-Wilson et al., 2014). One of the most studied versions of CBT for SAD is individual cognitive therapy (Clark et al., 2003). This treatment is based on a cognitive model of SAD focusing on processes – in the present paper under the broad labels negative cognitions, self-focused attention, and behavioral patterns – that are hypothesized to maintain or exacerbate social anxiety (Clark & Wells, 1995; Rapee & Heimberg, 1997). Although this treatment has been shown to be effective in several randomized controlled trials, there is still limited knowledge as to whether the treatment achieves its effects through these proposed processes. As described by Kazdin (2007), enhanced understanding of what makes therapy work is important to develop more efficient treatments and improve outcomes. In the following outline the processes of the cognitive model of SAD are described.

Negative cognitions include various cognitive distortions and biases in judgment in, and in relation to, social situations (Clark & Wells, 1995; Rapee & Heimberg, 1997). Individuals with SAD tend to overestimate the probability that a negative social event will occur (e.g., acting in an unacceptable way) and also overestimate the cost of such

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an event (e.g., “people will think I’m odd and avoid me”). Another cognitive bias according to the cognitive model of SAD is anticipatory processing, which means reviewing a social event in detail before entering it. This includes thoughts of prior failures and predictions about poor social performances, which puts the individual in an anxious and self-focused mode. Further, after a social event the individual often moves on to post-event (sometimes referred to as post-mortem) processing, that is, to review the social interaction in detail. Because most social interactions are ambiguous in nature, the individual is left with internal clues (e.g., feelings of anxiety or shame) to infer the quality of the social performance.

Self-focused attention refers to a shift in attention when an individual with SAD enters a social situation (Clark & Wells, 1995; Rapee & Heimberg, 1997). This includes to carefully monitor and observe oneself, not least bodily sensations (e.g., racing heart and sweating), and to use this interoceptive information to draw conclusions about thoughts and judgments of others (e.g., “they think I look extremely anxious”). This prevents the individual from making accurate assessments about their actual social performance and reduces the ability to detect possible signs of being accepted by others.

Behavioral patterns include avoidance and safety behaviors, which are problematic because they prevent the individual from disconfirming unrealistic beliefs about the risk and consequences of feared social events, such as being negatively evaluated (Clark & Wells, 1995; Rapee & Heimberg, 1997). Safety behaviors refer to (often subtle) behaviors that are used in social situations to prevent a feared outcome. For example, an individual who fears shaking and spillage while drinking coffee among others might hold the cup tightly. This not only prevents disconfirmation of negative beliefs, it might also increase the actual risk of the feared outcome (e.g., increased tremors).

Several studies on change processes in CBT for SAD support the cognitive maintenance model. For example, pre-to-post reductions in probability estimates (McManus, Clark, & Hackmann, 2000), cost estimates (Foa, Franklin, Perry, & Herbert, 1996), post-event processing (McEvoy, Mahoney, Perini, & Kingsep, 2009), and use of safety behaviors (Goldin et al., 2016) have been found associated with pre-to-post improvements in social anxiety. However, a limitation in previous research is that a vast majority of process and mediational studies have not been designed to investigate temporal precedence, that is, whether change in processes occurred before change in outcome. It is possible that changes in the proposed processes reflect prior symptom change, e.g., that reductions in social anxiety lead to reductions in cognitive distortions and not vice versa. Only a few studies (Gregory, Peters, Abbott, Gaston, & Rapee, 2015; Hedman et al., 2013; Hoffart, Borge, & Clark, 2016; Mörtberg, Hoffart, Boecking, & Clark, 2015; Smits, Rosenfield, McDonald, & Telch, 2006) have used repeated (e.g., weekly) assessment of both processes and outcome throughout treatment to allow for an analysis of the timeline (Kazdin, 2007). Hoffart et al. (2016) investigated processes of change in cognitive therapy for SAD and found significant relations in both the presumed and reversed directions between self-focused attention, estimated probability and cost, and social anxiety. Only safety behaviors showed a unidirectional effect on subsequent social anxiety. In another study, Smits et al. (2006) investigated an exposure-based treatment and showed a reciprocal relationship between estimated probability and social fear, while estimated cost was predicted by prior reductions in social fear but not vice versa. Mörtberg et al. (2015) showed that cognitive therapy produced changes in self-focused attention that predicted social anxiety the following week, and that the reversed relation was non-significant. Further, negative cognitions related to social anxiety neither predicted subsequent social anxiety, nor were they predicted by prior social anxiety (Mörtberg et al., 2015). Hedman et al. (2013) found that improvements in both cognitive therapy and group CBT were mediated by prior reductions in self-focused attention. In addition, avoidance mediated subsequent improvements in cognitive therapy, while anticipatory and post-event processing mediated subsequent improvements in group CBT (Hedman et al., 2013). Gregory et al. (2015) found that in group CBT, estimated cost unidirectionally predicted social anxiety in the beginning of treatment and estimated probability unidirectionally predicted social anxiety by the end of treatment. Taken together, although some studies have analyzed the timeline of events in CBT for SAD, more research is warranted as to the temporal relations between processes and outcome over the course of treatment.

Moreover, a critique raised by researchers in the field (Hoffart et al., 2016) is that most studies have established a relation between the putative processes and treatment outcome across the study sample without separating within-person effects from between-person effects. Therapeutically, the within-person effect is of main interest, that is, whether change in a process leads to change in the outcome in that same individual. An interesting example that sheds light on the importance of analytic approach in this respect comes from Hoffart et al. (2016). This study showed that re-analyzing data from a prior process-outcome study of cognitive therapy for SAD (Hoffart, Borge, Sexton, & Clark, 2009) resulted in a contradicting conclusion regarding one of four investigated processes according to the cognitive model of SAD, when disaggregating within-person and between-person effects. In short, they found a unidirectional effect of safety behaviors on subsequent social anxiety in the updated within-person analyses (Hoffart et al., 2016), while this effect was bidirectional in the prior conventional analysis (Hoffart et al., 2009).

The aim of the present study was to evaluate if changes in the maintaining processes according to the cognitive model of SAD predicted subsequent symptom change in patients receiving guided self-help CBT (GSH-CBT). GSH-CBT consists of largely the same components as conventional face-to-face (i.e., individual or group) CBT and thus aims to target the same processes to attain change in social anxiety. Specifically, we investigated estimated probability, estimated cost, anticipatory processing, post-event processing, self-focused attention, avoidance, and safety behaviors as processes of change. Importantly, the present paper focuses on intraindividual effects of these processes on subsequent symptoms of social anxiety, that is, whether changes in a patient’s negative cognitions, focus of attention, and behavioral patterns during treatment lead to symptom change in that patient. We also investigated the reversed relation: if changes in social anxiety predicted subsequent changes in the processes. In addition, we analyzed between-person effects of processes on outcome, that is, if patients with higher scores on the process measures had more severe social anxiety (relative to those who had lower scores on the process).

2. Method

2.1. Design

Patients in the present study participated in a multi-site primary care study of CBT for common mental disorders (i.e., anxiety disorders, depression, insomnia or stress-related disorders) (Salomonsson et al., 2018). In the clinical trial, patients first received GSH-CBT for nine weeks within a stepped care framework: this first step of GSH-CBT is the focus of the present study. Patients with SAD ($N = 61$) as their principal disorder were included and analyzed regarding processes of change. The putative processes and treatment outcome were assessed weekly throughout treatment. The clinical trial was approved by the regional ethics review board in Stockholm and preregistered at Clinicaltrials.gov (Identifier NCT01667822). All participants provided written informed consent.

2.2. Recruitment, treatment context and patients

Patients were consecutively recruited at four primary care clinics in Stockholm, Sweden. Assessment included use of the Mini International Neuropsychiatric Interview (MINI) (Sheehan et al., 1998) by licensed

psychologists. Patients fulfilling full diagnostic criteria for SAD according to DSM-IV were included in the present study. The sample consisted of 37 (60.7%) women. The mean age of the sample was 33.3 (SD = 10.5) and the mean age of onset of social anxiety was 15.2 (SD = 7.5). More than one third of patients (n = 23; 37.7%) fulfilled criteria for at least one comorbid disorder and depression was the most common comorbid disorder in the sample (n = 13; 21.3%).

2.3. Treatment

Patients received nine weeks of GSH-CBT, delivered via a self-help book for SAD (Furmark, Holmström, Sparthan, Carlbring, & Andersson, 2013) and brief guidance in the form of face-to-face sessions with a therapist. The self-help book has the same content as an internet-delivered program that has been shown to be effective in several randomized controlled trials (Andersson et al., 2006; Carlbring et al., 2007; Furmark et al., 2009; Hedman et al., 2011; Tillfors et al., 2008). It consists of nine chapters and patients were encouraged to read and work with one chapter per week. Chapters cover information regarding social anxiety disorder, the cognitive model and the maintaining factors outlined by Clark and Wells (1995), negative automatic thoughts, cognitive distortions and biases in judgment, behavioral experiments and exposure, self-focused attention and shifting of focus, social skills, and relapse prevention. All necessary information on how to carry out the treatment according to the CBT principles is included, as well as work sheets and explicit homework tasks connected to every chapter. Thus, treatment content is very similar to what patients are exposed to in face-to-face manualized CBT for SAD (e.g., the cognitive manual used in Clark et al., 2003) and the treatment aims to target the same processes to attain change in social anxiety. Guidance sessions with a psychologist, 30–45 minutes each, took place at treatment start and four weeks in to treatment. In the first session, patients received instructions on how to work with the self-help book. During the second session, patients were encouraged to continue working with the program, and problem solving was applied if there were obstacles preventing the patient from reading and working with exercises.

2.4. Assessment of outcome and processes

Outcome and processes were measured at treatment start and weekly throughout treatment via an online platform, which is indicated to be a valid method of measure administration (Hedman et al., 2010).

2.4.1. Outcome

The outcome, i.e., level of social anxiety, was measured with the Liebowitz Social Anxiety Scale self-report version (LSAS-SR; Baker, Heinrichs, Kim, & Hofmann, 2002; Liebowitz, 1987). The LSAS-SR consists of 24 items and measures fear and avoidance of social interaction and performance situations. Each item is rated on a 0–3 scale, and the sum of all items is calculated to a total score (range 0–144). In the present sample, the internal consistency, Cronbach's α, for the LSAS-SR at pre-treatment was .96.

2.4.2. Process measures

Estimated probability and cost of negative social events were measured by the Social Probability and Cost Questionnaire (SPCQ; Foa et al., 1996; McManus et al., 2000). Each item (e.g., "Someone will think I'm odd") was rated on a scale from 0 to 100 regarding both estimated probability and estimated cost, and a mean score (0–100) was used for each subscale. To limit the risk of overly burdening patients, four items from the original 33-item scale (items 3, 4, 5, 13) were chosen in line with a previous study of mediation in CBT for SAD (Hoffart et al., 2009: items from the standard scale that together had the highest Cronbach's alpha in a pilot sample were selected). In the present sample, internal consistencies for the SPCQ-probability and SPCQ-cost subscales at pre-treatment were .79, and .85, respectively.

The Social Phobia Weekly Summary Scale (SPWSS; Clark et al., 2003) was used to measure four maintenance factors, i.e., anticipatory processing, post-event processing, self-focused attention and avoidance, with one item each. Each item (e.g., "The extent to which your attention was focused on yourself or on the external situation for social situations that you found difficult") was rated on a 0–8 scale. Due to its brevity, the SPWSS has been used in previous studies to measure processes repeatedly over the course of treatment (Hedman et al., 2013; Hoffart et al., 2009; Mörtberg et al., 2015).

The Safety Behaviour Questionnaire (SBQ) was used to measure safety behaviors. The SBQ is unpublished, but has been used in previous trials (Hoffart et al., 2009; Stott et al., 2013). Each item (e.g., "Try not to attract attention") was rated on a scale from 0 to 3, and the mean score of the scale was used for analyses. Again, to reduce item overload we selected 10 out of 28 items from the original scale (items 2, 3, 5, 6, 8, 14, 15, 17, 21, 27) for use in this study. The items were chosen as they were judged to be of high clinical relevance and together covered a broad spectrum of safety behaviors. In the present sample, internal consistency for SBQ at pre-treatment was .86.

2.5. Assessment of treatment completion

After treatment, psychologists rated one of the following options for a broad estimate of how treatment was carried out: (a) completed entirely according to plan (active work during and between session, completed treatment), (b) partly completed (attended sessions, completed tasks to some extent), or (c) discontinued participation (premature treatment termination or no tasks completed).

2.6. Statistical analyses

Statistical analyses were conducted using SPSS version 25 (SPSS inc., Chicago). We used linear mixed effects modeling to model individual change over time (Singer & Willett, 2003). Our primary analysis was to investigate whether within-person change in the processes predicted subsequent change in the outcome. For this purpose, the time-lagged effects of the putative processes on outcome (social anxiety) were analyzed: the effect of the process variables (at time point t - 1) was modeled on the outcome the subsequent week (at time point t). To further investigate the temporality of change, we also investigated the reversed association, that is, if change in the outcome (at time point t - 1) predicted subsequent change in the process variables (at time point t). A separate mixed-effects regression model was computed for each process variable, both in the presumed and the reversed direction.

Modeling was built to specifically account for intraindividual change, that is, to examine within-person changes in processes and outcome. This is of central interest for investigating processes of change because analyses need to capture that process and outcome are related within individuals, as opposed to between individuals (Hamaker, 2012). To disaggregate within-person and between-person effects, each process variable was separated into two predictors and person-mean centered as recommended by Wang and Maxwell (2015). In data simulations, person-mean centering of predictor variables have been found to result in more precise and accurate estimates in models aiming to separate the effects within from that of between individuals (Wang & Maxwell, 2015). The first predictor was the time-varying person-mean centered process, accounting for the within-person effect of the process on the outcome. This variable was calculated by, for each individual, subtracting the individual's mean process value over time points from the individual's process value at each time point. The second predictor was the time-invariant person-specific process mean, accounting for the between-person effect (i.e., the difference between individuals on the pooled outcome across assessment points as a result of differences in the process). This variable constituted a single value for each individual over time, calculated by subtracting the grand-mean average of the process over time points and individuals, from the person mean process

value over time points. The predictor person-means were based on modeled data, meaning that one time point was omitted due to the time-lagged analyses.

To control for the effect of time on the outcome and obtain the net lagged effect of the processes on subsequent outcome, a time predictor was included in all models. Time corresponded to weeks in treatment and due to the time-lagged modeling included Week 0 through Week 8 for the processes, and Week 1 through Week 9 for the outcome in the models. Time was centered following recommendations by Wang and Maxwell (2015), i.e., the intercept represents the outcome value at midway into treatment.[1] We included random effects for the intercept and the time predictor[2] and consistently used an unstructured covariance structure, according to the recommendations by Barr, Levy, Scheepers, and Tily (2013)). The variance of the residuals was held constant over time points. Data were analyzed based on the intention to treat principle (i.e., patients were included in analyses irrespective of whether they completed treatment or not). All models were analyzed with restricted maximum likelihood (REML), meaning that all available data were used to estimate model parameters under the missing at random assumption concerning data loss (Enders, 2011). Patients providing at least one complete data point in the lagged models (i.e., both process measure and a subsequent week's outcome measure) contributed to the models.

Thus, we modeled change in social anxiety over time with respect to within-person effects and between-person effects of the putative processes. The equation for the model in composite form is provided in the Supplementary material. The estimate of main interest in the present paper, denoted γ_{10} in Tables 3 and 4, was the intraindividual effect of change in the putative processes on subsequent change in social anxiety. This unstandardized coefficient should be interpreted as the effect of a within-person deviation of one point from the individual's average process score on social anxiety the following week. To aid in interpretation of the magnitude of the within-person effects, we estimated pseudo-R^2, which was calculated as the proportion of residual variance explained by the within-person process predictor (Singer & Willett, 2003). Thus, we subtracted the residual variance in the model including the within-person process predictor from the residual variance in a model without the within-person process predictor. The difference was then divided by the residual variance in the model without the within-person process predictor. Consequently, we obtained an estimate of explained variance in symptom change by the within-person process. It is possible for residual variance to increase when a predictor is added to the model, resulting in negative explained variance. In these instances, pseudo-R^2 is essentially uninterpretable (Singer & Willett, 2003).

Additionally, the between-person effect, denoted γ_{01} in Tables 3 and 4, in the models can be interpreted as the strength of the association between the putative processes/maintaining factors and level of social anxiety between individuals over the course of treatment (i.e., if individuals with higher ratings on the processes have more severe social anxiety relative to those with lower ratings on the processes). This unstandardized coefficient should be interpreted as the predicted difference in social anxiety between two individuals across the course of treatment as a result of a one-point difference in the average process score for those individuals.

In sum, mixed effects models included social anxiety symptoms (LSAS-SR) as dependent variable and three predictors: a between-person process predictor, a within-person process predictor and a centered time predictor. For the reversed direction of change (i.e., the effect of change in social anxiety on subsequent change in the process), process and outcome switched roles in the models so that social anxiety (LSAS-SR) was the predictor variable (i.e., time-lagged and separated into within-person and between-person effects). For the reversed models, we only interpreted the within-person effects, but all model parameters are presented (in Table 4) to correspond to the models in the presumed direction (in Table 3). Our analytic plan involved to include processes that were significant in the presumed direction, but non-significant in the reversed, in the same model to investigate if they contributed with unique effects in the outcome.

In all main analyses the full LSAS-SR was used as a measure of social anxiety. However, as avoidance comprises one of two LSAS-SR subscales, we also conducted an analysis where the avoidance process variable (SPWSS avoidance) was modeled on the LSAS-SR fear subscale only (a corresponding reversed model was also conducted). This was done to evaluate if results concerning avoidance as a putative process in the original analyses remained when the avoidance part of the outcome was removed.

For descriptive purposes, we estimated the standardized effect sizes for improvements in social anxiety and processes. Unconditional growth models, with only time as a predictor, were used for this estimation. For social anxiety, the average weekly improvements in LSAS-SR was multiplied by treatment length (Week 1 through Week 9 was used to correspond to the time-lagged analyses) to calculate the average change over the treatment period, and the product was then divided by the observed standard deviation at Week 1 to obtain a standardized within-group effect. Correspondingly, Week 0 through Week 8 were used for estimation of change in processes over the treatment period, and these improvements were divided by standard deviations at Week 0.

3. Results

3.1. Data and treatment completion

Observed values for outcome and processes over the treatment time are displayed in Table 1. Patients completed 3510 out of a total of 4880 possible assessments, yielding a 72% completion rate. On average, patients completed 2.0 (SD = 0.4) of the two planned support sessions in the guided self-help. After the intervention, psychologists made assessments regarding treatment completion: 33 patients (54%) completed treatment entirely according to plan, 18 patients (30%) completed treatment to some extent, and 10 patients (16%) terminated treatment prematurely or did not carry out any treatment activities.

3.2. Change in social anxiety and processes over the treatment period

For descriptive purposes, mean change per week and standardized within-group effects for social anxiety and processes over the treatment period are displayed in Table 2. Social anxiety and all processes decreased significantly over time in the unconditional mixed effects models. Table 3 presents the effect of time on social anxiety in the conditional models, i.e., where the within-person and between-person effects of the process variables are also included in the models (see parameter γ_{20}). There was significant heterogeneity between patients in model intercepts, (u_{0i} in Table 3), and growth rates (u_{2i} in Table 3), $ps < .01$. Covariance between random effects was non-significant for all models (ps = .16–.72).

3.3. Within-person effects

3.3.1. Presumed direction

Results of the linear mixed effects models that examined the within-person effects of the processes on subsequent weekly symptom change are displayed in Table 3 (see parameter γ_{10}). Five out of seven

[1] Centering the time variable does not influence the interpretation of the within-person effect of process on subsequent outcome.

[2] We tested inclusion of random effects for the within-person predictors. However, 6 out of 14 models did not converge. For the remaining 8 models, these random effects did not alter the results qualitatively. Therefore, random effects for the within-person predictors were omitted.

Table 1
Observed means, standard deviations, and number of observations for outcome and processes over the treatment period.

Measure (range)	Week									
	0	1	2	3	4	5	6	7	8	9
LSAS-SR (0-144)										
M	62.7	63.7	60.2	58.9	55.2	56.2	49.7	47.3	43.3	44.1
SD	25.5	24.4	28.0	24.3	25.8	26.7	25.6	25.8	25.9	26.3
n	61	47	45	48	48	40	43	39	31	51
SPCQ prob. (0-100)										
M	62.2	61.4	61.3	57.4	54.3	61.5	55.1	54.7	52.1	50.2
SD	21.8	24.7	23.3	24.0	25.1	25.2	25.1	26.6	27.7	27.9
n	56	45	43	46	44	40	41	38	31	51
SPCQ cost (0-100)										
M	63.0	62.7	58.6	54.7	49.7	52.2	46.9	40.9	39.4	38.9
SD	24.1	24.4	26.6	26.8	28.3	26.4	26.6	27.8	25.8	28.8
n	56	45	43	46	44	40	41	38	31	51
SPWSS antic. (0-8)										
M	5.4	5.1	4.9	4.8	4.2	4.4	4.0	3.6	3.6	3.7
SD	1.7	1.8	1.8	1.9	1.9	2.1	2.0	1.9	2.0	1.9
N	56	45	43	46	46	40	41	39	31	51
SPWSS post. (0-8)										
M	5.1	5.5	5.2	5.1	4.7	4.6	4.5	4.5	4.1	4.4
SD	2.2	2.0	1.6	1.8	2.0	2.0	1.7	2.1	2.2	2.2
N	56	45	43	46	46	40	41	39	31	51
SPWSS focus (0-8)										
M	4.9	4.8	4.7	4.8	4.2	4.2	4.0	3.6	3.8	4.0
SD	1.9	1.7	1.7	2.1	2.0	2.0	1.8	1.8	2.1	1.9
N	56	45	43	46	46	40	41	39	31	51
SPWSS avoidance (0-8)										
M	3.9	3.6	3.3	3.3	3.2	3.4	3.0	3.0	2.7	2.5
SD	1.9	1.8	1.8	2.0	1.8	1.9	1.7	2.0	2.0	2.0
N	56	45	43	46	46	40	41	39	31	51
SBQ (0-3)										
M	1.9	1.8	1.7	1.6	1.6	1.5	1.4	1.4	1.3	1.3
SD	0.5	0.6	0.6	0.5	0.6	0.6	0.6	0.7	0.6	0.6
n	56	45	43	46	44	40	41	38	31	51

Note. LSAS-SR = Liebowitz Social Anxiety Scales self-report version; SPCQ = Social probability and cost questionnaire; prob. = probability; SPWSS = Social Phobia Weekly Summary Scale; antic. = anticipatory processing; post. = post-event processing; SBQ = Safety Behaviour Questionnaire.

Table 2
Mean change per week in outcome and processes, standard errors, 95% confidence intervals, standard deviations, and standardized effect sizes over the treatment period.

Measure	Change trajectories				Standardized effect size
	Mean weekly change	*SE*	95% CI	*SD*	
LSAS-SR	−2.79***	0.37	[-3.53, -2.05]	2.55	0.92
SPCQ prob.	−1.42**	0.48	[-2.39, -0.45]	3.08	0.52
SPCQ cost	−3.28***	0.48	[-4.24, -2.32]	3.02	1.09
SPWSS antic.	−0.25***	0.04	[-0.33, -0.17]	0.22	1.16
SPWSS post	−0.14**	0.04	[-0.23, -0.06]	0.23	0.51
SPWSS focus	−0.20***	0.04	[-0.28, -0.12]	0.22	0.84
SPWSS avoidance	−0.14***	0.04	[-0.21, -0.06]	0.18	0.58
SBQ	−0.09***	0.01	[-0.11, -0.06]	0.09	1.43

Note. Mean change per week for unconditional mixed effects models. Standard deviation (*SD*) refers to variability between patients in weekly change (i.e., the squared root of the models' random slope variances was calculated). Standardized effect sizes refer to the within-group effects over the treatment period (i.e., Week 1 to Week 9 for social anxiety, and Week 0 to Week 8 for the processes). These were estimated by multiplying the mean weekly change by treatment length, and the product was then divided by the observed standard deviation at Week 1 for social anxiety, and Week 0 for the processes. LSAS-SR = Liebowitz Social Anxiety Scales self-report version; SPCQ = Social probability and cost questionnaire; prob. = probability; SPWSS = Social Phobia Weekly Summary Scale; antic. = anticipatory processing; post. = post-event processing; SBQ = Safety Behaviour Questionnaire.

** $p < .01$.

*** $p < .001$.

processes, i.e., estimated probability, estimated cost, self-focused attention, avoidance, and safety behaviors, significantly predicted subsequent symptom change. Avoidance remained a significant process when modeled on subsequent change in social fear only (i.e., using the LSAS-SR fear subscale, omitting the avoidance subscale): $\gamma_{10} = 0.51$; *SE* = 0.17; 95% CI [0.17, 0.85]; pseudo-R^2 = 10%. All estimates were in the expected course, that is, the positive relationships indicate that reductions in the processes predicted reductions in symptoms the following week. To aid in interpretation of coefficients in Table 3: a within-person reduction of one point from the individual's average safety behavior score (i.e., SBQ) predicted a 3.70 point reduction in social anxiety (i.e., LSAS-SR) the following week. Anticipatory and post-event processing did not significantly predict subsequent symptoms ($p = 0.13$ for both processes). Table 3 also displays explained variance estimates (pseudo-R^2), which reflect the amount of change in social anxiety over the course of treatment that is explained by within-person

Table 3
Effects of processes on outcome (presumed direction): parameter estimates, standard errors, 95% confidence intervals and explained variance (n = 55).

Parameter	Estimated probability	Estimated cost	Anticipatory processing	Post-event processing	Focus	Avoidance	Safety behaviors
Fixed effects	Estimate (*SE*) [95% CI]						
γ_{00} (model intercept)	50.83‡ (2.75) [45.31, 56.35]	51.03‡ (2.90) [45.21, 56.86]	50.18‡ (2.99) [44.19, 56.17]	50.58‡ (3.28) [43.99, 57.17]	49.86‡ (3.21) [43.43, 56.29]	50.32‡ (2.26) [45.78, 54.86]	51.20‡ (2.32) [46.55, 55.86]
γ_{10} (within-person effect: lagged process → outcome)	0.10† (0.04) [0.03, 0.17]	0.11† (0.04) [0.03, 0.18]	0.52 (0.34) [-0.15, 1.19]	0.47 (0.31) [-0.14, 1.07]	0.96† (0.36) [0.25, 1.66]	1.04† (0.31) [0.43, 1,66]	3.70† (1.27) [1.20, 6.20]
γ_{01} (between-person effect: process → outcome)	0.69‡ (0.12) [0.44, 0.93]	0.57‡ (0.12) [0.32, 0.81]	8.29‡ (2.09) [4.09, 12.48]	4.53* (2.20) [0.13, 8.94]	5.65* (2.16) [1.33, 9.98]	13.41‡ (1.64) [10.12, 16.70]	37.16‡ (4.67) [27.79, 46.53]
γ_{20} (time effect: time → outcome)	−3.09‡ (0.37) [-3.84, -2.34]	−2.88‡ (0.38) [-3.64, -2.11]	−3.12‡ (0.38) [-3.87, -2.36]	−3.19‡ (0.38) [-3.95, -2.43]	−3.02‡ (0.37) [-3.77, -2.27]	−3.02‡ (0.36) [-3.74, -2.31]	−2.91‡ (0.37) [-3.65, -2.17]
Random effects	Estimate (*SE*)						
u_{0i} (variance intercept)	394.45‡ (80.98)	441‡ (91.18)	468.17‡ (94.92)	570.30‡ (116.21)	536.95‡ (108.68)	262.07‡ (53.41)	275.29‡ (57.07)
u_{2i} (variance slope of time)	4.72‡ (1.29)	4.42‡ (1.25)	4.74‡ (1.30)	5.00‡ (1.33)	4.60‡ (1.26)	4.33‡ (1.17)	4.12† (1.19)
Covariance intercept and slope	10.53 (7.55)	8.91 (8.10)	5.05 (8.46)	10.09 (9.76)	6.92 (9.04)	2.08 (5.74)	6.33 (6.34)
e_{it} (residual variance)	37.17‡ (3.49)	37.48‡ (3.53)	37.73‡ (3.54)	37.49‡ (3.51)	37.21‡ (3.49)	36.81‡ (3.44)	37.82‡ (3.58)
Explained variance							
Pseudo-R^2	16%	16%	15%	15%	16%	17%	15%

Note. Outcome is the Liebowitz Social Anxiety Scale self-report version (LSAS-SR). Unstandardized coefficients are presented. Model intercept (γ_{00}) corresponds to level of the outcome at Week 5 due to centering of time. Confidence intervals for random effects omitted for clarity in table. Pseudo-R^2 refers to the proportion of residual variance explained by the within-person process predictor.
* p < .05.
† p < .01.
‡ p < .001.

changes in processes. The significant within-person processes explained between 15% and 17% of the variance in symptom change.

3.3.2. Reversed direction

The reversed effects, that is, the within-person effects of social anxiety on subsequent change in the processes, are presented in Table 4 (see parameter γ_{10}). A decrease in social anxiety significantly predicted subsequent decreases in all processes except for avoidance (p = .06). The results regarding avoidance remained non-significant when social fear was modeled on subsequent avoidance (i.e., using the LSAS-SR fear subscale only, omitting the avoidance subscale): γ_{10} = 0.03; *SE* = 0.15; 95% CI [-0.00, 0.06]; pseudo-R^2 = 6%. Thus, a patient who experienced symptom reduction is predicted a reduction in six out of seven processes the following week. For example, a patient who decreased his or her social anxiety (i.e., LSAS-SR) by one point is predicted a 0.02 reduction in self-focus (i.e., SPWSS focus) the following week. Explained variance is also presented in Table 4. For estimated probability, estimated cost, anticipatory processing and safety behaviors, explained variance was below zero (pseudo-R^2 between −0.15% and −0.97%). Although this points to low explained variance of social anxiety on

Table 4
Effects of outcome on processes (reversed direction): parameter estimates, standard errors, 95% confidence intervals and explained variance (n = 55).

Parameter	Estimated probability	Estimated cost	Anticipatory processing[a]	Post-event processing[a]	Focus[a]	Avoidance[a]	Safety behaviors
Fixed effects	Estimate (*SE*) [95% CI]						
γ_{00} (model intercept)	54.47‡ (2.63) [49.19, 59.75]	47.25‡ (2.82) [41.59, 52.91]	4.16‡ (0.18) [3.80, 4.52]	4.59‡ (0.20) [4.19, 5.00]	4.10‡ (0.20) [3.71, 4.50]	3.06‡ (0.15) [2.75, 3.36]	1.47‡ (0.05) [1.36, 1.57]
γ_{10} (within-person effect: lagged outcome → process)	0.17* (0.07) [0.03, 0.32]	0.23† (0.08) [0.08, 0.38]	0.02* (0.01) [0.00, 0.03]	0.02† (0.01) [0.01, 0.04]	0.02* (0.01) [0.00, 0.03]	0.01 (0.01) [-0.00, 0.03]	0.01‡ (0.00) [0.00, 0.01]
γ_{01} (between-person effect: outcome → process)	0.60‡ (0.10) [0.39, 0.80]	0.55‡ (0.12) [0.31, 0.78]	0.03‡ (0.01) [0.02, 0.05]	0.02* (0.01) [0.00, 0.04]	0.02* (0.01) [0.00, 0.04]	0.04‡ (0.01) [0.03, 0.06]	0.02‡ (0.00) [0.01, 0.02]
γ_{20} (time effect: time → outcome)	−1.00 (0.51) [-2.02, 0.02]	−2.71‡ (0.52) [-3.76, -1.67]	−0.17† (0.05) [-0.27, -0.07]	−1.11* (0.05) [-0.21, -0.01]	−0.15† (0.04) [-0.24, -0.06]	−0.08 (0.04) [-0.17, 0.00]	−0.06‡ (0.01) [-0.09, -0.03]
Random effects	Estimate (*SE*)						
u_{0i} (variance intercept)	337.99‡ (73.46)	396.39‡ (84.13)	1.37‡ (0.33)	1.82‡ (0.44)	1.80‡ (0.41)	0.89‡ (0.24)	0.11‡ (0.03)
u_{2i} (variance slope of time)	6.62† (1.95)	7.11† (2.10)	0.05* (0.02)	0.04* (0.02)	0.03* (0.01)	0.02* (0.01)	0.01† (0.00)
Covariance intercept and slope	17.09 (8.98)	−3.07 (9.44)	0.02 (0.05)	0.07 (0.06)	0.01 (0.06)	0.06 (0.04)	0.01 (0.01)
e_{it} (residual variance)	86.37‡ (8.03)	90.26‡ (8.43)	1.33‡ (0.12)	1.37‡ (0.13)	1.21‡ (0.11)	1.37‡ (0.13)	0.08‡ (0.01)
Explained variance							
Pseudo-R^2	–	–	–	4%	4%	6%	–

Note. Outcome is the Liebowitz Social Anxiety Scale self-report version (LSAS-SR). Unstandardized coefficients are presented. Model intercept (γ_{00}) corresponds to level of the outcome at Week 5 due to centering of time. Confidence intervals for random effects omitted for clarity in table. Pseudo-R^2 refers to the proportion of residual variance explained by the within-person outcome predictor. Residual variance increased in some models when adding the within-person predictor (the lagged outcome variable in these reversed models), resulting in negative pseudo-R^2. In these instances, explained variance was considered uninterpretable.
[a] n = 56.
* p < .05.
† p < .01.
‡ p < .001.

these processes, the negative values render the pseudo-R^2 to be uninterpretable. For the remaining processes (i.e., post-event processing, focus of attention and avoidance), the within-person effect of symptom change explained between 4% and 6% of subsequent changes in the processes.

3.3.3. Summary: direction of change

Our results point to a reciprocal influence between within-person changes in four of the putative processes (i.e., estimated probability and cost, focus of attention and safety behaviors) and outcome over the course of treatment. Avoidance significantly predicted subsequent symptoms in the presumed direction of change, while the analysis of the reversed direction of change was not statistically significant. These results remained when the avoidance process variable was analyzed in relation to social fear as the symptom measure, omitting the avoidance subscale from the LSAS-SR. The magnitude of within-person effects followed a pattern with larger explained variance in the presumed direction of change. Two of the putative processes, i.e., anticipatory processing and post-event processing, were only significant in the reversed direction. In accordance with the analytic plan, no omnibus model including several processes was conducted, as only avoidance was significant in the presumed, but not in the reversed, direction.

3.4. Between-person effects of processes on symptoms

Table 3 displays differences between individuals in social anxiety as a consequence of different average levels on the processes over assessment points (see parameter γ_{01}). Patients differed significantly over the course of treatment on LSAS-SR as a consequence of different levels on all the processes. For example, a difference of one point on avoidance (i.e., SPWSS avoidance) between two individuals was associated with a 13.41 point difference on social anxiety (i.e., LSAS-SR). In sum, patients with higher scores on the process variables were predicted to have higher scores on social anxiety, relative to patients with lower values on these variables.

4. Discussion

The aim of the present study was to evaluate if intraindividual changes in processes according to the cognitive model of SAD predicted subsequent symptom change in guided self-help CBT. The main findings were that reductions in five of the investigated processes, that is, estimated probability, estimated cost, focus of attention, avoidance, and safety behaviors, significantly predicted subsequent reduction in social anxiety. However, we also found that reductions in social anxiety predicted subsequent reductions in four of these processes, with the exception of avoidance. This indicates reciprocal influences between these processes and outcome. The within-person analyses in the present study indicate that these processes are related to beneficial outcomes at the individual level. Avoidance might be of particular importance given the unidirectional effect on subsequent symptoms. The remaining two investigated processes, anticipatory processing and post-event processing, did not significantly predict subsequent social anxiety, but were predicted by prior symptom reduction.

The results regarding avoidance remained when analyzed in relation to social fear only (omitting the avoidance part of the outcome measure): avoidance significantly predicted subsequent social fear (10% explained variance), while social fear did not significantly predict subsequent avoidance (6% explained variance). These results are largely in line with a previous study that found changes in avoidance to unidirectionally predict subsequent social fear during the first eight weeks of group CBT (during the end of treatment, avoidance and fear predicted each other) (Aderka, McLean, Huppert, Davidson, & Foa, 2013). In the present study, the significance of reducing avoidance was emphasized early in the self-help book. Approach behaviors were then encouraged both within a behavioral experiment framework (testing negative assumptions) and through an exposure rationale (habituation). It is reasonable to believe that this emphasis had an impact on reducing avoidance that in turn lead to beneficial effects on social anxiety.

Four processes, namely estimated probability and cost, focus of attention, and safety behaviors, significantly predicted subsequent social anxiety but were also found to be predicted by prior symptom reduction. Concerning focus of attention, explained variance was 16% in the presumed direction of change and 4% in the reversed direction, while the remaining processes yielded uninterpretable values of explained variance in the reversed direction. These results of reciprocal relations between processes and outcome are in line with some previous studies (Hoffart et al., 2016; Smits et al., 2006). Although support for the cognitive model of SAD is increasing, the question of temporal precedence of the putative processes needs further investigation. As of now, it is difficult to disentangle the positive cycles between processes and outcome in treatment.

Two of the investigated processes in the present study, anticipatory and post-event processing, did not intraindividually predict subsequent symptom reduction, but were rather consequences of prior symptom improvements. Large emphasis in the self-help program was placed on identifying and challenging cognitions that occurred in social situations (e.g., through behavioral experiments and change to external focus of attention to enable investigation of actual social responses). Although biased processing before and after social events was addressed in treatment, limited attention was directed towards counteracting this kind of repetitive negative thinking directly. Thus, it seems plausible that changes in these processes were a consequence of reduced social anxiety, and not vice versa. The present results are in line with findings of Hedman et al. (2013), who did not find these processes to be significant mediators of subsequent symptom change in individual cognitive therapy. It should be noted, however, that both the present study and the study by Hedman et al. (2013) measured anticipatory and post-event processing by single items. More elaborate measurement of these constructs is warranted in future research.

Between patients, all processes were associated with symptom severity across the treatment period. These results are important from two perspectives. First, the present findings support that all the putative processes are correlated with social anxiety on a between-person level. The between-person part of the investigated models indicates the degree to which an individual's mean level in the process is related to their mean level of symptom, averaging across time. Thus, individuals who have consistently high levels on the process have consistently high symptom scores on social anxiety. Second, the findings indicate that processes relevant to understand social anxiety at the group level are not synonymous with the processes that drive therapeutic change for the specific patient. This is evident by the results concerning two of the processes, anticipatory and post-event processing; although associated on a between-person level, they did not predict subsequent symptom reduction intraindividually. These results point to the fact that within-person and between-person effects can differ, which motivates disaggregation of these effects in research (see e.g., Hamaker, 2012; Wang & Maxwell, 2015).

There are some important strengths of the present study. Weekly assessment of processes and outcome allowed for investigation of temporal precedence of the processes (i.e., whether processes changed before the outcome or vice versa). Further, the multilevel analytic strategy incorporated disaggregation of within-person and between-person effects, which provided data on relations between processes and outcome on the intraindividual level. Also, the study incorporated a broad scope of putative processes according to the cognitive model of SAD.

There are also limitations that should be noted. First, the absence of a randomized design precludes firm attributions of changes in processes and outcome over the treatment period to the GSH-CBT. However, SAD is a highly chronic condition with low rates of spontaneous recovery (Wittchen & Fehm, 2003), strengthening the assumption that

improvements found in the present study were related to treatment. Further, the present analytic approach investigated whether the proposed processes were related to treatment outcome within patients and does not imply that the processes are exclusive for CBT, as such claims would also require analyses of external factors (i.e., treatment type). Possibly, other forms of psychotherapy exert their effects through the same processes, as showed regarding negative cognitions related to social anxiety in a study comparing mediators of change in CBT and acceptance and commitment therapy for SAD (Niles et al., 2014). In this respect it should be noted that the effect of processes on outcome is susceptible to confounding (Valeri & Vanderweele, 2013). The present analyses do not preclude that unmeasured confounders are in fact the cause of changes in the outcome. Second, patient compliance with the self-help book was not monitored, which rules out rich understanding of how treatment was carried out by patients (e.g., to what extent patients were exposed to the different components of the treatment package). Third, the processes were measured either with only one item or by shortened scales. This was done to not overly burden patients, but more elaborate assessments of the putative processes would have been desirable. Fourth, missing data (28%) and non-compliance with treatment (16% of patients discontinued treatment and 30% of patients completed treatment to some extent) pose threats to the validity of our results (e.g., the accuracy of the estimated week-to-week associations between changes in processes and outcome, and the extent to which processes and outcome were influenced by treatment). Finally, although there are many advantages with the present analytic strategy, other statistical methods would have carried advantages. Specifically, with a larger sample size and/or number of assessment points, it would have been possible to model both directions of associations simultaneously by means of structural equation modeling (Hamaker, Kuiper, & Grasman, 2015). Also, the sample size precluded analyses of possible interrelations between processes over the course of treatment.

Even though the reciprocal influences between processes and outcome found in the present and some previous studies point to the importance of targeting these putative processes in treatment, more detailed temporal resolution would be informative. To further investigate processes of change in CBT for SAD, assessments of processes and outcome need to be on a tighter schedule and effects need to be examined using different time-lags as the effect is highly dependent on the lag that is used (Gollob & Reichardt, 1987). Further, process and mediational analyses are in a vast majority of cases conducted post-hoc clinical trials (including the present study). Future research should be explicitly designed to answer questions concerning potential mediators. This includes, for example, increasing sample sizes and/or assessment points to enable state of the art statistical methods. In this context, modeling change at the individual level is of importance. Also, experimental manipulation of processes (i.e., randomizing patients to different levels of a putative process) is, although difficult in many cases, essential to enable causal inferences of their effect on outcome (Lynch, Cary, Gallop, & Ten Have, 2008).

In conclusion, this comprehensive analysis of change processes according to the cognitive model of SAD shows that several of the proposed processes predict subsequent symptom improvement. First, reducing avoidance seems to be of importance as showed by a unidirectional effect on subsequent symptoms. Second, estimated probability and cost, self-focused attention, and safety behaviors seem to be part of positive reciprocal cycles, where improvements in processes and symptoms influence each other. The findings suggest that targeting these processes of change could be important for effective treatment of SAD. Finally, two of the investigated processes (anticipatory and post-event processing) were not supported by the present results as processes of change. Our results rather suggest that these processes changed as a consequence of prior symptom reduction.

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Declaration of Competing Interest

None.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.janxdis.2019.102118.

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