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Perfectionism as a predictor of change in digital self-guided interventions for public speaking anxiety in adolescents: A secondary analysis of a four-armed randomized controlled trial

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ABSTRACT

Public Speaking Anxiety (PSA) interventions targeting adolescents exist; however, not all gain improvement. This exploratory study investigated whether PSA interventions resulted in a decrease in perfectionism and whether pre-treatment level and changes in perfectionism moderated the effects on PSA and social anxiety. The sample consisted of 100 adolescents from junior high schools randomized to four groups: 1) VR only ($n = 20$), 2) VR + online exposure program ($n = 20$), 3) online psychoeducation and online exposure program ($n = 40$), 4) waitlist and online psychoeducation program ($n = 20$). Self-reported symptoms of PSA, social anxiety, and perfectionism were measured at pre, week 3, post, and 3-months follow-up. Level and change in outcome variables were analyzed using latent growth curve modeling. Results revealed that the interventions did not lead to a reduction in perfectionism. Reduction in perfectionism was associated with a larger reduction in all outcome measures from post to follow-up. No interaction was found between pre-treatment perfectionism and PSA symptoms. High pre-treatment levels of perfectionism were associated with poorer outcomes on social anxiety symptoms from post to follow-up for online exposure groups. The results indicate that one should assess and address high pre-treatment levels of perfectionism during PSA interventions.

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Public speaking anxiety; virtual reality exposure therapy; internet-delivered interventions; perfectionism; predictor; self-guided interventions

Introduction

Public Speaking Anxiety (PSA) is one of the most common fears among adolescents and adults (Stein et al., 1996). PSA is a type of performance anxiety characterized by the fear

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of being negatively evaluated when speaking in front of others, and is a distinct subgroup of social anxiety disorder (SAD) (APA; American Psychiatric Association, 2013; Blöte et al., 2009). Excessive PSA can cause severe life impairment if not treated and is associated with the risk of school dropout (Monroe et al., 1992; Van Ameringen et al., 2003) depression, and substance abuse (Furukawa et al., 2014). Moreover, around 50% of the adolescents with PSA are at risk of developing the more severe form of generalized SAD (Hofmann et al., 1999). Therefore, there has been a need to develop prevention programs for SAD by intervening in PSA for this target group.

The National Institute for Health and Care Excellence (NICE; National Institute for Health and Care Excellence, 2013) guidelines recommend Cognitive Behavioral Therapy (CBT) for adolescents with SAD. However, a meta-analysis investigating the effectiveness of psychological interventions targeting adolescents with anxiety disorders in general, found that only one third gain remission at post-treatment (Baker et al., 2021). It is therefore important to investigate what predicts treatment outcomes to optimize and tailor the interventions for this age group.

There is robust evidence showing that perfectionism is positively associated with PSA (Calissano et al., 2021; Cox & Chen, 2015; DiBartolo et al., 2001; Wuthrich et al., 2020), anxiety and depression (Lunn et al., 2023). Perfectionism has been a subject of research for decades, with the concept emerging already in the 1960s (Hollender, 1965). The pioneers defined perfectionism as a unidimensional construct (Burns, 1980; Garner et al., 1983), and was considered as a negative personality trait including unrealistic high standards of performance towards themselves (Hollender, 1965). In the 1990s a new wave of research conceptualized perfectionism as a multidimensional construct (Frost et al., 1990; Hewitt & Flett, 1991; Slaney et al., 2001) that also included interpersonal aspects (Hewitt & Flett, 1991). Slaney et al. (2001) also defined the concept as three-dimensional but distinguished between the positive and negative aspects of perfectionism. Shafran et al. (2002), on the other hand, established the construct "clinical perfectionism" which refers to the type of perfectionism one might encounter in clinical practice and does not include the positive aspects of perfectionism. Although perfectionism has been widely researched, the exact dimensions and its structure and content are still a subject of debate in the literature (Başaran, 2022).

Despite the link between perfectionism and PSA (Calissano et al., 2021; Cox & Chen, 2015; DiBartolo et al., 2001; Wuthrich et al., 2020), little is known about how perfectionism predicts treatment outcomes in adolescents receiving a CBT intervention for PSA (Affrunti & Woodruff-Borden, 2014). To our knowledge, the existing research literature is limited to the investigation of the association between perfectionism and anxiety among children and adolescents receiving a CBT intervention for anxiety disorders in general (Essau et al., 2012; Mitchell et al., 2013; Nobel, 2012), demonstrating a positive association between anxiety and perfectionism. Studies also suggest that high baseline perfectionism may lead to an in-effective treatment or even deterioration during treatment (Shahar et al., 2004). High baseline perfectionism may cause difficulties in engaging with the therapist due to the self-critical evaluation, causing more distress and less improvement, thus hindering treatment response and affecting the therapeutic alliance (Miller et al., 2017). In anxiety disorders, adherence to high perfectionistic standards may be the core element to why some do not gain an optimal treatment outcome (Mitchell et al., 2013). As one of the main elements of CBT is to challenge the

thoughts through behavioral experiments, rigid adherence to perfectionism may make it more challenging to perceive the phobic stimulus alternatively as they are unable to meet their own high standards (Hewitt & Flett, 2002). Perfectionism may in the worst case lead to an avoidance behavior such as procrastination of conducting the behavioral experiments due to excessive concern for making mistakes (Flett & Hewitt, 2007). Thus, PSA interventions may benefit from targeting perfectionism, since high baseline perfectionism may hinder optimal treatment outcomes. CBT treatment targeting perfectionism has shown to be efficacious in reducing perfectionism, as well as symptoms of anxiety in general (Galloway et al., 2022). Although there are limited studies investigating how perfectionism affects CBT interventions for PSA, studies on anxiety in general may suggest a potential relationship between PSA and perfectionism and should be explored further.

Individuals with perfectionistic traits might also benefit from other treatment modalities (Shahar et al., 2004). During the last decades, technology-driven interventions for PSA have become more common (Kahlon et al., 2023). Internet-delivered interventions consist of modules that are assigned weekly with educational text about the disorder, including home assignments and worksheets (Titov et al., 2018). Virtual Reality Exposure Therapy (VRET) can create a virtual environment that makes exposure situations readily available for the patients, as well as the therapist (Lindner, 2020). Several meta-analyses have documented the clinical efficacy of internet-delivered interventions (Esfandiari et al., 2021) and VRET (Lim et al., 2022; Reeves et al., 2021) targeting PSA among adults. There is also some evidence that the modalities are efficacious for adolescents with PSA (Blanco et al., 2023; Joshua N.; Kelson et al., 2021; Wickersham et al., 2022). However, no previous studies have investigated VRET against another technology-delivered intervention for adolescents with PSA (Kahlon et al., 2023).

The current study presents secondary analyses from a randomized controlled trial (Kahlon et al., 2023) and aimed to explore how unidimensional perfectionism (Garner et al., 2006) moderated treatment outcomes in adolescents with PSA who received self-guided internet-delivered interventions and self-guided Virtual Reality Exposure Therapy. The study was exploratory and based on the literature on the association between perfectionism and anxiety disorders in general. The primary aim was to investigate whether interventions targeting PSA also resulted in a change in perfectionism during the intervention period and follow-up period. The second aim was to investigate whether a change in perfectionism during the intervention period, follow-up period and pre-treatment level of perfectionism moderated the clinical efficacy of four self-guided interventions for PSA: 1) VR only (VR + NA), 2) VR followed by online exposure program (VR + online EXP), 3) online psychoeducation followed by online exposure program (online PE + EXP), and 4) waitlist followed by online psychoeducation program (waitlist + online PE). As interventions targeting PSA may also lead to a reduction In other social anxiety symptoms (Hindo & González-Prendes, 2011; Hofmann et al., 2006) other social anxiety symptoms were included in the analysis.

Methods

Design

The study was a four-armed randomized trial with both active and passive control groups (Kahlon et al., 2023). The participants were randomized to four groups. Two experimental groups: 1) VR only (VR + NA), 2) VR followed by online exposure program (VR + online

EXP), one active control group 3) Online psychoeducation followed by online exposure program (online PE + EXP), and one passive control group 4) waitlist followed by online psychoeducation program (waitlist + online PE). The combined intervention was administered successively, with each intervention lasting for three weeks, giving a total of six weeks. The VR + NA group received weekly assessments in the last three weeks.

The study included a block randomization strategy with ten participants in each block generated from random.org. None of the study team members, nor the participants, were blinded during the trial.

All groups received weekly assessments measuring PSA symptoms during the six weeks intervention period. At pre-treatment (week 0), week 3, post-treatment (week 6), and 3 month follow-up (week 12) the assessments also included self-reported symptoms of social anxiety and level of perfectionism. Main outcomes investigating the clinical effects of the VR intervention are presented in Kahlon et al. (2023). The current study presents novel, exploratory, secondary analyses and investigates whether changes in PSA and social anxiety symptoms are predicted by pre-treatment scores and changes in perfectionism from pre to post and post to follow-up.

The study received approval from the Regional Ethical Committee South-East (REK 60,628) and was pre-registered at Clinicaltrials.gov (NCT04396392).

Sample

The sample consisted of 100 adolescents aged 13–16 years ($M = 14.2$, $SD = 0.99$) with a gender distribution consisting of 84% females. The sample was adolescents living in Bergen County, Norway, and surrounding areas. Three recruitment strategies were used: promoting advertisement about the project on social media channels, such as Facebook, Instagram, and Snapchat; informing school health services, including hanging up posters; and oral presentations in the classrooms at schools in the catchment area.

Procedure

The recruitment period started 7 September 2020 and the last participant was enrolled in the study 15 March 2021. Interested adolescents filled out a screening survey on the website UngSpotlight.no. To be included, participants had to report "yes" to the following questions: "Are you afraid of speaking in front of your class?" and "Do you avoid speaking in front of your class if possible?". In addition, participants had to report a score higher than < 55 on the primary outcome measure Public Speaking Anxiety Scale (PSAS; Bartholomay & Houlihan, 2016). The cut-off was set based on the median score from a feasibility study (Kahlon et al., 2019) conducted prior to the randomized controlled trial (Kahlon et al., 2023). Exclusion criteria for the study applying to all groups were: ongoing psychological/pharmacological treatment related to SAD, reading difficulties, and balance and stereoscopic vision impairment affecting the VR experience.

Adolescents who met the inclusion criteria were instructed to leave their contact information on the website. Eligible adolescents were then contacted by telephone within a few days. One member of the study team (SK) conducted phone interviews with adolescents aged 16. If younger than 16 years, the phone interview was conducted with both adolescents and their parents, following the Norwegian ethical guidelines. During

the phone interview, an assessment was made based on both inclusion and exclusion criteria. The study team member (SK) decided the eligibility at the end of the phone interview. If eligible, the adolescents were randomized to one of four groups based on the block randomization list and received access to an informed consent form and a following pre-assessment the same day.

Participants allocated to group 1) VR only or 2) VR + online EXP met with a member from the study team within the next day after completing the necessary requirements, which included signing the informed consent form and filling out the pre-assessment. The requirements for receiving the VR device were set to ensure that they were dedicated to participating as the study only had a limited number of VR devices. During this meeting, they received a VR device they would borrow for the following three weeks. Group 3) the online PE + EXP group received access to online PE intervention automatically after completing informed consent and pre-assessments, while the waitlist + online PE filled out weekly assessments in this period. After three weeks, group 1 received weekly assessments, groups 2 and 3 received the additional online EXP intervention, whereas group 4 was assigned the online PE intervention.

The informed consent form, all assessments and the online interventions took place at the YouWell platform, by logging in through a secure two-factor digital authentication signature. Adolescents aged 16 years were able to log in themselves, while adolescents younger than 16 years would have to log in through their parents throughout the whole intervention and assessment period. To promote adherence, they received automated notifications. When a new assessment was made available the participants received SMS notifications and the parents received email notifications. In addition, if participants had not logged in for four days or had any uncompleted assessments, they received a reminder. They also received a personalized message at post-assessment and follow-up assessment, thanking them for participating in the project and nudging them to complete the assessments to receive a gift card.

Interventions

Virtual Reality (VR)

A VR classroom was developed in collaboration with Attensi AS. The application was designed as a self-guided, automated, and gamified version. The application consisted of two training modes: 1) progress mode and 2) practice mode. The progress mode included 15 predefined tasks, based on four adjustable variables: number of audiences (6 to 16 virtual avatars), duration of task (one to two minutes), audience reaction (uninterested, neutral, or interested), and type of presentation (sitting by their desk and reading from a book or presenting in front of the classroom). Each task started with instructions for the presentation they were about to hold and identifying their catastrophic beliefs for the task. After completing the task, they were instructed to report the degree of anxiety they experienced during the performance, if the catastrophic belief occurred, and what they have learned. One task lasted for a maximum of five minutes. The participants were instructed to complete at least five tasks a week and practice three times a week. They were expected to complete all 15 levels during the intervention period. To reach the next task, the participant had to be rewarded with at least four out of five stars based on their performance such as speaking loudly and looking at the audience. The thresholds were

predefined and set by the study team to ensure that the participants were conducting the exposure tasks as advised and not just looking down during the presentation tasks or speaking in a whispering voice. The practice mode was unlocked when the participant completed the first five tasks. In the practice mode, the participant could adjust the variables and construct their own exposure situation, which would allow for more playful elements.

Online psychoeducation (online PE)

The online PE consisted of three modules, where one module was assigned weekly. The modules focused on providing knowledge and normalizing PSA and how to identify and manage catastrophic beliefs and safety strategies. The intervention included three Bitmoji avatars which followed them through the intervention, Emma, Lucas, and Samira. The avatars were adolescents at junior high school and each avatar had a history of public speaking anxiety in front of their class. The adolescents received text examples on how the avatars experienced their PSA and how they would cope with their anxiety throughout the intervention.

Online exposure (online EXP)

Online EXP was an extension of the online PE program and consisted of three modules, where one module was assigned weekly. The intervention focused on how to plan good exposure tasks and how to practice in vivo exposure. The participants would follow the same Bitmoji avatars as presented in online PE and how they planned their exposure tasks. The participants were encouraged to do three school-related exposure tasks a week during the three-week intervention period. Before each exposure the participants had to fill out a form regarding what type of exposure they were going to do, when they were going to do it, and what they were afraid was going to happen. After completing an exposure task, they had to fill out a new form about what happened during the exposure and what they had learned.

Measures

Public speaking anxiety symptoms

PSAS. Public Speaking Anxiety Scale (PSAS; Bartholomay & Houlihan, 2016) comprises 17 items on a five-point Likert scale from 1 (not at all) to 5 (extremely). A higher sum value of the items indicates higher symptoms of PSA. The scale is originally in English and developed for adults but has been translated and feasibility tested with adolescents. As there are no existing thresholds for this population, the cut-off score < 55 was derived from the median score from the feasibility study (Kahlon et al., 2019). Cronbach alpha at prescreening was 0.76.

Generalized social anxiety symptoms

Social Phobia Scale – 6 (SPS-6; Peters et al., 2012) comprises six items on a four-point Likert scale from 0 (not at all) to 4 (extremely) and assesses social phobia symptoms while being scrutinized by others. Sum value is calculated by adding up the items, with a higher sum value of the items indicating higher social phobia anxiety. Cronbach's alpha at prescreening was 0.90 for SPS-6.

Social Interaction Anxiety Scale – 6 (SIAS-6; Peters et al., 2012) comprises six items on a four-point Likert scale from 0 (not at all) to 4 (extremely) and assesses social interaction anxiety symptoms. Sum value is calculated by adding up the items, with a higher sum value indicating higher symptoms of social interaction anxiety. Cronbach's alpha at pre-screening was 0.84 for SIAS-6

Perfectionism as secondary outcome and moderator

***Eating disorder inventory 2 – perfectionism.*.** The perfectionism subscale EDI-P is a 6-item questionnaire on a scale from 0 (not at all) to 4 (all the time) which assesses how their degree of perfectionism affects different areas of their life (Garner et al., 1983). The scale benefits by being short and can easily be administered to adolescents together with other assessments. Although the scale was originally developed as unidimensional (Garner et al., 1983), EDI-P can be divided into two subscales: self-oriented perfectionism (items 1–3) and socially perceived perfectionism (items 4–6) (Lampard et al., 2012). EDI-P has been widely used in adolescent samples, with good internal consistency (Drieberg et al., 2019; Johnston et al., 2018; Morgan-Lowes et al., 2019).

The first statistical approach was to conduct exploratory factor analysis. However, factor analysis of EDI-P in the current sample did not indicate two factors. In line with the original theory and development behind the EDI-P (Drieberg et al., 2019; Garner et al., 1983; Johnston et al., 2018; Morgan-Lowes et al., 2019) combined with the statistical approach with factor analysis, EDI-P was assessed through a unidimensional measure by using the total sum score. EDI-P was used both for investigating whether the interventions led to a reduction in perfectionism and whether it moderated treatment outcomes. As no existing Norwegian norms exist, no cut-off scores were applied in the current study. Cronbach's alpha for the scale at pre-screening was 0.71 for EDI-P.

Statistical analysis

Descriptive analyses were analyzed using SPSS version 26 (IBM Corp, 2019) and Mplus version 8.7 for other analyses (Muthén & Muthén, 2021). To explore the two study aims, we analyzed level and change in EDI-P (primary aim) and moderation models of levels and changes in the outcome variables PSAS, SIAS, and SPS predicted by level and change in EDI-P together with the treatment group variables (secondary aim). These models were analyzed by latent growth curve (LGC) models (Bollen & Curran, 2006; Wang & Wang, 2012) featuring all included participant, as per the intention to treat principle. Time unit was week, with the intercept level fixed to pre-treatment level. Full Information Maximum Likelihood (FIML) was used for using all information available for estimation under the assumption missing at random (MAR) (Enders, 2010).

Model fit were chi-square, comparative fit (CFI), Tucker-Lewis index (TLI), Standardized Root Mean Square Residual (SRMR), and root mean square error of approximation (RMSEA) with confidence intervals. Thresholds for these are: CFI and the NNFI > 0.95, SRMR < .08, and the RMSEA < 0.08 or preferably 0.05 (close fit) (Bollen & Curran, 2006; Wang & Wang, 2012). The first model for each variable explored linear change over time. However, changes during the treatment and follow-up phase should often be expected to be different, with a stronger reduction in symptoms during treatment than in the next follow-up phase. If this was the case, the trajectories were divided

into two or more parts. Dividing into different periods could also result in different effects of the predictors in the two phases. Unequal time intervals in predictor and outcome variables could give conceptually problematic predictions. We therefore developed models with equal intervals on the predictor and outcomes.

The residual variances (time-specific errors) were fixed to be equal over time to keep the number of the estimated parameters lowest possible but were estimated as unique (heteroscedasticity) if model fit indicated this. If a covariance between intercept and slope (s) was found to be small and not statistically significant, this was fixed to zero. Thus, a model without all covariance is identical to the mixed effect model (linear mixed model) with a diagonal covariance matrix (Hox et al., 2018). In the PSAS model with more measurement over time residual covariance was allowed for estimation in order to represent relationships between variables not accounted for by the growth factors (Bollen & Curran, 2006). The mean change per week for the total period was estimated by summing the means in the change factors.

The primary aim was analyzed with an unconditional LGC model, i.e. a model without any predictors. The secondary aim was first explored by testing the levels and changes in the three outcome measures separately (unconditional LGC) and then regressing the levels of baseline and changes in outcomes on levels of baseline and changes in perfectionism, in addition to group differences in multivariate LGC models. Due to the randomization, we fixed the estimated baseline level in outcome to be equal for the treatment group variables. The waitlist + online PE group was set to the reference group when estimating the change factors. In these secondary aim models, the three-week measurement was removed from EDI-P to estimate the moderated treatment effect in identical intervals in the outcomes. Baseline interaction terms between treatment conditions and pre-treatment EDI-P were used as predictors to explore whether perfectionism moderated the effects of the different interventions. This strategy did not include any sensitivity- or post-hoc analyses. As the study presents a complex set secondary analyses, with no applicable parameter estimates available from past research, no a prior power calculations were performed.

Results

Participants and consort

A total of 100 adolescents were included in the study and allocated to the four groups (Kahlon et al., 2023). Observed means and standard deviations for primary and secondary outcome measures at all measure points across the four groups are presented in Table 1.

Model fit results

Model fit results for levels and changes in the variables showed poor fit for several of the linear models. The PSAS model was therefore represented with two pieces, 0–6 weeks, and 6–18 weeks, and showed good fit with observed data fit (See Supplementary Table S1). This model was estimated without covariance between the intercept and the slopes. A similar two-piecewise model describing level and change in SIAS showed a fair fit. The two-piece

Table 1. Observed means and standard deviations for PSAS, SIAS, SPS and EDI-P.

		Waitlist + Online PE			VR only			Online PE + EXP			VR + online EXP		
		N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
PSAS	Pre	20	65.00	6.24	20	65.00	8.25	39	67.51	7.12	20	63.90	7.26
	Post	15	60.27	9.76	16	55.00	10.39	26	61.04	11.03	16	55.44	11.07
	Follow-up	11	56.09	12.54	16	52.50	11.08	18	61.17	10.95	12	53.50	12.30
SIAS	Pre	20	11.40	5.60	20	10.60	5.44	39	10.56	5.22	20	10.45	5.85
	Post	15	10.27	6.60	16	8.88	6.25	26	9.73	6.19	16	9.31	5.99
	Follow-up	11	9.00	6.31	16	7.94	5.09	18	10.06	5.88	12	11.58	4.62
SPS	Pre	20	11.40	6.35	20	9.85	5.24	39	12.54	7.26	20	11.45	6.82
	Post	15	9.60	7.16	16	6.50	5.70	26	9.73	7.02	16	8.31	6.03
	Follow-up	11	9.55	7.26	16	5.44	4.60	18	9.94	6.55	12	9.92	5.33
EDI-P	Pre	20	6.90	3.91	20	7.05	4.24	39	7.31	3.53	20	6.55	4.61
	Post	15	7.20	3.99	16	6.75	4.25	26	6.77	3.12	15	6.67	3.92
	Follow-up	11	7.18	3.71	16	6.63	4.92	18	6.61	3.93	12	6.58	3.82

Note: PSAS = Public Speaking Anxiety Scale, SIAS = Social Interaction Anxiety Scale, SPS = Social Phobia Scale, EDI-P = Eating Disorder Inventory—Perfectionism, SD = Standard deviation, EXP = Exposure, PE = Psychoeducation.

SPS model showed mediocre fit measures regarding RMSEA, but good values on the other indices.

Regarding the predictor variable EDI-P, the two-piece growth model did not fit the data well, yet the linear model did. The linear model of EDI-P did not show any changes over time at mean (−0.01, $p = .693$) and individual levels (SD = 0.07, $p = .434$). However, inspection of individual data showed this variable to vary over time. In the three intervals (slopes) model, all but one covariance was fixed to zero in a model with a model that fitted data well.

Changes over time in EDI-P, PSAS, SIAS, and SPS

There were no changes in EDI-P over time at group level (0–3 weeks: $M = -0.05$, $p = .699$; 3–6 weeks: $M = -0.07$, $p = .568$; 6–18 weeks: $M = 0.02$, $p = .594$). However, statistically significant individual differences in changes over time were found (0–3 weeks: SD = 0.93, $p = .002$; 3–6 weeks: SD = 0.74, $p = .028$; 6–18 weeks: SD = 0.16, $p = .029$). The two-piece growth model showed a statistically significant total change over time from pre-treatment to follow-up on all anxiety measures (see Table 2).

Changes in PSAS predicted by changes and pre-treatment scores of EDI-P and intervention groups

From pre-treatment to post, there was no significant effect of change in EDI-P associated with change in PSAS. From post to follow-up, there was a significant positive association between change in EDI-P and PSAS, indicating that a one-point reduction on EDI-P measurement was associated with 0.85 points reduction on the PSAS measurement. There were no significant interaction effects between the reference group and EDI-P levels at pre-treatment, nor for the three intervention groups (Table 3).

Table 2. Results from two-piece growth curve level and change models for the three outcome variables PSAS, SIAS and SPSS. Change is estimated per week.

	Pre			Change Pre—Post[a]				Change Post—FU[b]				Total change[c]	
	M	*SD*	*p*	*M*	*P*	*SD*	P^I	*M*	*P*	*SD*	P^I	*M*	*P*
PSAS	65.43	6.76	<.001	**−1.14**	**<.001**	1.15	<.001	**−0.21**	**.009**	0.44	.005	**−24.23**	**<.001**
SIAS	10.76	4.82	<.001	−0.17	.084	0.70	.001	−0.05	.200	0.18	.183	**−4.10**	**.008**
SPS	11.59	6.21	<.001	**−0.48**	**<.001**	0.65	.009	−0.01	.824	0.24	.094	**−8.91**	**<.001**

Note: FU = Follow-up, PSAS = Public Speaking Anxiety Scale, SIAS = Social Interaction Anxiety Scale, SPS = Social Phobia Scale, *M* = Mean, SD = Standard deviation, *p* = significance at group level, p^I = significance at individual level.
[a]Change Pre—Post equivalent to change 0–6 weeks
[b]Change Post—Follow-up equivalent to change 6–18 weeks
[c]Total change for the total study period from pre to follow up was estimated based on change per week in each interval multiplied with 18 weeks.

Table 3. Changes in PSAS, SPS-6, and SIAS-6 in the intervals Pre – Post and Post – Follow-up predicted by treatment groups and changes in EDI-P, in addition to the interaction terms between pre-treatment levels in EDI-P and treatment groups.

	Change Pre—Post		Change Post—Follow-up	
	b	*p*	*b*	*p*
PSAS				
Waitlist + Online PE[a]	−0.50	.139	**−0.53**	**.002**
VR only	**−1.60**	**.026**	0.25	.448
Online PE+EXP	0.04	.950	0.34	.345
VR + Online EXP	−0.91	.177	0.05	.901
EDI-P change[b]	0.49	.205	**0.85**	**.013**
EDI-P Pre*VR only	0.13	.109	0.02	.675
EDI-P Pre*Online PE+EXP	−0.09	.203	0.02	.706
EDI-P Pre*VR+Online EXP	−0.02	.814	0.04	.372
SIAS-6				
Waitlist + Online PE[a]	−0.11	.532	**−0.16**	**.043**
VR only	−0.58	.146	0.14	.363
Online PE+EXP	0.64	.078	**−0.34**	**.041**
VR + Online EXP	0.53	.179	−0.04	.833
EDI-P change[b]	0.26	.200	**0.46**	**.002**
EDI-P Pre*VR only	0.07	.154	−0.01	.743
EDI-P Pre*Online PE+EXP	−0.07	.067	**0.05**	**.006**
EDI-P Pre*VR+Online EXP	**−0.11**	**.009**	**0.05**	**.014**
SPS-6				
Waitlist + Online PE[a]	−0.29	.117	−0.15	.108
VR only	**−0.86**	**.035**	0.32	.080
Online PE+EXP	**0.85**	**.023**	−0.29	.142
VR + Online EXP	0.38	.344	−0.04	.871
EDI-P change[b]	0.26	.209	**0.57**	**.002**
EDI-P Pre*VR only	**0.10**	**.034**	−0.02	.306
EDI-P Pre*Online PE+EXP	**−0.14**	**.000**	**0.06**	**.008**
EDI-P Pre*VR+Online EXP	**−0.11**	**.014**	0.04	.105

Note: FU: Follow-up, PE = Psychoeducation, EXP = Exposure, PSAS = Public Speaking Anxiety Scale, SIAS − 6 = Social Interaction Anxiety Scale − 6, SPS = Social Phobia Scale − 6, EDI—P = Eating Disorder Inventory—Perfectionism, *b* = unstandardized regression coefficient.
[a]The reference group with intercept value.
[b]Changes in EDI-P predicting the outcome changes within the Pre—Post and Post—Follow-up intervals.

Changes in SIAS predicted by changes and pre-treatment scores of EDI-P and intervention groups

From pre-treatment to post, there were no significant effects of change in EDI-P associated with change in SIAS. From post to follow-up, there was a significant positive association between change in EDI-P and SIAS, indicating that a one-point reduction on EDI-P was associated with 0.46-point reduction on the SIAS measurement (Table 3).

Estimated pre-treatment levels in SIAS were related to pre-treatment levels in EDI-P ($r = .30$, $p = .005$), which shows that higher pre-treatment levels in EDI-P were related to higher pre-treatment levels in SIAS. From pre-treatment to post there was a significant interaction effect, indicating a stronger reduction in SIAS symptoms when EDI-P pre-treatment levels were high compared to low for those receiving VR + online EXP. Thus, a one-point higher pre-treatment score on EDI-P was associated with 0.11 points stronger reduction on SIAS. From post to follow-up, significant interaction effects indicated a weaker reduction in SIAS symptoms when EDI-P pre-treatment levels were high compared to low in the Online PE + EXP and VR + online EXP groups. Thus, a one-point higher pre-treatment score on EDI-P was associated with 0.05 points weaker reduction in SIAS for both intervention groups (Table 3).

Changes in SPS-6 predicted by changes and pre-treatment scores of EDI-P and intervention groups

From pre-treatment to post, the change score of EDI-P did not predict change in SPS. From post to follow-up, there was a significant positive association between change in EDI-P and SPS, indicating that adolescents with reduction in EDI-P scores had a stronger reduction in SPS from post to follow-up (Table 3).

Estimated pre-treatment levels in SPS were related to pre-treatment levels in EDI-P ($r = .41$, $p < .001$), which shows that higher pre-treatment levels in EDI-P were associated with higher pre-treatment levels in SPS. There was a significant interaction effect from pre-treatment to post, indicating a weaker reduction when EDI-P pre-treatment levels were high compared to low in the VR-only group. More specifically, a one-point higher pre-treatment score on EDI-P was associated with 0.10 points weaker reduction in SPS. The results also indicated a stronger decrease in SPS symptoms when EDI-P pre-treatment levels were high compared to low in the intervention groups Online PE + EXP and VR + Online EXP. Thus, a one-point higher pre-treatment score on EDI-P was associated with, respectively, 0.14- and 0.11-points stronger reduction in SPS. From post to follow-up, a weaker reduction was found when EDI-P pre-treatment levels were high compared to low in the Online PE + EXP group, showing that a one-point higher pre-treatment score on EDI-P was associated with 0.06 points weaker reduction in SPS in this group (Table 3).

Discussion

The study is the first to report results on perfectionism as a predictor from a randomized controlled study on self-guided interventions targeting adolescents aged 13–16 with public speaking anxiety (PSA) (Kahlon et al., 2023). The primary aim of the current

study was to explore whether there was a change in perfectionism during an intervention targeting PSA in adolescents. The second aim was to explore whether levels and changes in perfectionism moderated the clinical effects of PSA and social anxiety symptoms. The aim of the study was exploratory due to the limited evidence from interventions targeting the association between perfectionism and highly prevalent public-speaking anxiety (PSA). As most research on perfectionism as a predictor is conducted on children or late adolescence to adulthood with an anxiety disorder, the study provides early evidence on young adolescents with PSA.

The study found that self-guided interventions targeting PSA did not lead to an overall reduction in perfectionism, however, there were individual differences in changes in perfectionism during the intervention and the follow-up period. A reduction in perfectionism in the follow-up period was associated with a higher reduction in all outcome measures compared to those without any reduction in perfectionism. Pre-treatment levels of perfectionism were not associated with change in PSA symptoms during the intervention period, nor the follow-up period. However, high pre-treatment level of perfectionism was associated with a poorer outcome on social phobia symptoms and social interaction anxiety symptoms in the follow-up period for the online exposure groups.

Overall, the results showed that adolescents did not have any significant changes in perfectionism across all groups. This is in line with the literature which states that in order to treat perfectionism it should be targeted directly (Shafran et al., 2018). CBT for clinical perfectionism has for instance shown to be efficacious at reducing symptoms on perfectionism, as well as anxiety, depression, and eating disorders (Shafran et al., 2023) with evidence also from an adolescent population (Fairweather-Schmidt & Wade, 2015; Nehmy & Wade, 2015; Osenk et al., 2023; Shu et al., 2019).

A decrease in perfectionism was associated with an additional decrease in all outcome measures. A consistent finding was that the positive association between the decrease in perfectionism and the outcome measures was identified during the follow-up period, but no similar association was identified in the intervention period. In the FRIENDS study, the older children aged 10–11 years also reported delayed treatment gains whereas the younger children aged 9–10 years reported a reduction in perfectionism immediately after the intervention (Essau et al., 2012). This may reflect that the cognitive component of PSA plays a more central role in adolescence and practice in real life is necessary in order to achieve treatment gains (Essau et al., 2012).

A high pre-treatment level of perfectionism was associated with a higher pre-treatment level of generalized social anxiety symptoms. Setting high standards is one of the main components of generalized social anxiety symptoms and perfectionism, and individuals with these traits tend to critically evaluate themselves and show excessive concern about making mistakes (Frost et al., 1990, 1995). Thus, the high standards they set for themselves might induce their anxiety level as they won't be able to live up to those standards (Juster et al., 1996).

The VR-only group had a poorer outcome in social phobia symptoms during the intervention period if pre-treatment levels of perfectionism were high compared to those with low pre-treatment levels of perfectionism. Whereas for the groups who received the online exposure program, a high pre-treatment level of perfectionism was associated with a stronger reduction in social phobia symptoms during the intervention period

compared to those with low pre-treatment levels of perfectionism. However, the decrease seemed to be only temporary as those who received the online exposure program had a poorer outcome in social phobia symptoms during the follow-up period compared to those with low pre-treatment levels of perfectionism. Moreover, the group receiving online psychoeducation + online exposure program with high pre-treatment levels of perfectionism also had a poorer outcome in social interaction anxiety symptoms during the follow-up period compared to those with low pre-treatment levels of perfectionism. This may indicate that perfectionism may hinder successful long-term treatment improvement (Egan et al., 2016). However, it is worth noting that the primary study examined adverse effects, and none of the participants reported any instances of clinically significant deterioration (Kahlon et al., 2023).

Research suggests that interventions that do not target perfectionism directly have lower clinical effects than interventions that have an explicit focus on perfectionism (Flett & Hewitt, 2014). Findings from the study show that high levels of perfectionism may lead to a poorer treatment outcome. In order to gain a higher treatment improvement, CBT interventions for PSA should therefore introduce tailored interventions with an explicit focus on perfectionism when the perfectionism scores are at high levels (Ashbaugh et al., 2007).

Limitations

There are some limitations that need to be addressed in the study. A larger proportion of the study included females which may have affected the generalizability of the study. COVID-19 pandemic restrictions were in effect during the recruitment period. This may have affected the clinical effects of the interventions, as the adolescents did not have the same opportunities for real-life exposure. The groups receiving VR followed by online exposure program (VR + online EXP) and online psychoeducation followed by online exposure program (online PE + EXP) had a longer intervention period compared to the other two groups, which may be an extraneous variable that affect the interpretation of the findings. The difference in treatment duration (three versus six weeks), may cause an effect in itself regardless of the content of the intervention. Another limitation is that the study did not include a no-treatment control group. Moreover, the original study was underpowered due to COVID-19 pandemic which led to a revised study design including a lower sample size due to a limited time frame. The original study was powered primarily for the first three weeks of the intervention and not for the two phases combined, and therefore, null results should be interpreted with caution. It is also worth noting that the sample in the current study was within the subclinical range on perfectionism compared to Swedish (Garner et al., 1983) and Danish (Clausen et al., 2011) patient- and control groups, which may further affect the interpretation of the findings. The fact that this study included a subclinical sample could represent a limitation as there may be a floor effect. In addition, one needs to be cautious about the generalizability to clinical samples with more symptoms and comorbidity. Although the EDI-P scale was originally developed as unidimensional (Garner et al., 1983), studies have investigated EDI-P as a multidimensional structure comprising self-oriented and socially prescribed perfectionism (Lampard et al., 2012; Sherry et al., 2004). Exploratory factor

analysis in our sample did not indicate two factors of EDI-P, which is why the total score of EDI-P was chosen. This may have been the result of including a small sample size within the subclinical range and power issues. However, the scale benefits by being short and less time-consuming, which is the reason this scale was chosen for this study. Other mechanisms may be involved and explain some of the variance found in PSA and perfectionism, such as anticipatory and postmortem anxiety, however, these were not investigated in the current study. Due to these limitations, the results should be interpreted with caution, and seen as explorative and not strict confirmatory.

Clinical implications

The results suggest that high pre-treatment levels of perfectionism may lead to a non-effective treatment, resulting in no improvement on generalized social anxiety symptoms. Clinicians should therefore assess the degree of perfectionism before during PSA interventions and consequently capture and target perfectionism in order to optimize the treatment.

Future studies

There is limited evidence on the role of perfectionism in young adolescents with PSA and more research is needed with larger sample sizes. Research suggests that different dimensions of perfectionism are associated with anxiety in different ways (Damian et al., 2021; Einstein et al., 2000). Future studies should therefore investigate the role of the different dimensions of perfectionism and how the dimensions predict treatment outcomes with a higher sample size per group, preferably using a multidimensional measure of perfectionism. For example, socially prescribed perfectionism has an especially strong association with anxiety symptoms due to external pressure from parents related to academic excel (Einstein et al., 2000). It is therefore important to investigate the role of parent involvement in future studies targeting PSA.

Conclusion

The current study and its aims were exploratory as there are limited studies on how perfectionism moderates the clinical efficacy in adolescents receiving a PSA intervention. However, the study may indicate that perfectionism moderates PSA and high levels of perfectionism should be targeted directly during PSA interventions. The findings indicate that future studies should continue investigating the association between perfectionism and PSA in this target group.

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Availability of data and material

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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