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Online 8-week cognitive therapy for problem gamblers: The moderating effects of depression symptoms and perceived financial control

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FULL-LENGTH REPORT

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ABSTRACT

Background and aims: Online interventions for problem gambling are increasingly popular, but not everyone benefits from them. We describe 12 years of real-world data from an online intervention for gambling problems and aim to find out the extent to which depression, alcohol use, and sense of financial control influence the effectiveness of the program. *Methods:* We analyzed treatment effectiveness and moderators in the Finnish "Peli Poikki" program (2007–2018)—an 8-week cognitive behavioral therapy and follow-up program for problem gambling. Participants were Finnish-speaking adults over 18 years of age (N = 2011, 66.9% males). We measured the self-reported level of problem gambling, depression, alcohol use, and sense of financial control across four treatment phases (baseline, post-treatment, 6-month follow-up, and 12-month follow-up), as well as the presence of gambling debt, psychological and physiological health, years suffered from gambling problems, and demographic variables. *Results:* Participation grew across years with retention rates of 55%, 30%, and 19% for post-treatment and the two follow-ups, respectively. The average problem gambling scores declined significantly following treatment and remained low throughout the follow-ups. However, this decline (the beneficial treatment effect) was reversed after the follow-ups for those with high depression scores and those who felt they had no control over their finances. *Discussion and Conclusions:* The Peli Poikki program is a well-functioning online intervention but less effective in the long term for participants with persisting symptoms of depression or without a sense of financial control. More attention is needed to screen and direct people with comorbidities to the appropriate services.

KEYWORDS

online intervention, remote intervention, cognitive behavioral therapy, problem gambling, gambling, mental health

INTRODUCTION

For some, gambling is a harmless leisure-time activity. For others, it is a continuing problem characterized by losing control, chasing losses, experiencing conflicts in social life (American Psychiatric Association, 2013; World Health Organization, 2019), and often facing debts. The prevalence rates in the past year for problem gambling range from 0.12 to 5.8% worldwide and from 0.12 to 3.4% in Europe (Calado & Griffiths, 2016). In Finland, the rates for problem and at-risk gambling are 3.0 and 10.7%, respectively (Salonen, Hagfors, Lind, &

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Kontto, 2020). Problem gambling causes a variety of harms to the gamblers, to the people close to them, and to society (Langham et al., 2015; Salonen, Hellman, Latvala, & Castrén, 2018, 2020), but only a small proportion of those who need help seek it (Suurvali, Hodgins, Toneatto, & Cunningham, 2008; Suurvali, Cordingley, Hodgins, & Cunningham, 2009). Barriers to seeking help include limited access to treatment, insufficient knowledge about treatment contents, and willingness to tackle the problem alone (Suurvali et al., 2009).

In recent years, various Internet- and telephone-supported remote interventions have been developed (van der Maas et al., 2019), and they have lowered treatment access barriers and enabled flexible and anonymous treatment engagement (Cooper, 2004). Remote interventions are demonstrably very effective and economical in improving both gambling problems and comorbid conditions (Abbott et al., 2018; Canale et al., 2016; Castrén et al., 2013; Cunningham et al., 2019; Erevik et al., 2020; Hodgins, Cunningham, Murray, & Hagopian, 2019; Myrseth, Brunborg, Eidem, & Pallesen, 2013; Yakovenko & Hodgins, 2016) even when compared with traditional programs (Goslar et al., 2017; Pallesen, Mitsem, Kvale, Johnsen, & Molde, 2005). However, as noted in a recent meta-analysis on the effectiveness of Internet-based treatments for problem gambling, the factors moderating successful treatment outcomes are not well-understood (Sagoe et al., 2021). Learning more about these factors would help guide individuals to the right type of treatment, tailored to their specific needs to acknowledge the diversity in their conditions.

People with gambling problems have diverse backgrounds. There is a lot of variation in problem gambling presentation and comorbidities. Problem gamblers differ in their level of debt, depression, sense of financial control, and the financial recovery strategies available to them (Heiskanen, 2017; van der Maas, 2016). This heterogeneity needs to be considered when developing and evaluating interventions (Abbott et al., 2018). Emotional and psychological distress (e.g., depression) and financial loss are two main harmful strains for the gambler (Browne et al., 2020; Langham et al., 2015; Salonen et al., 2018) and may significantly affect treatment outcomes. Losing money can fuel gambling through feelings of hopelessness and lowered motivation to quit, which negatively affect recovery (Gavriel-Fried, 2018). Moreover, gambling-related debts increase the likelihood of poor psychosocial functioning, substance abuse, family adversities, and suicidality (Swanton & Gainsbury, 2020).

Here we examine depression, alcohol use, and a sense of financial control as moderators of treatment effectiveness in the context of an 8-week online and phone intervention for gambling disorder. We draw on a rich longitudinal dataset of 2011 individuals participating in the treatment (and follow-ups at 6 and 12 months). Since the latest report on the treatment is over 8 years old (Castrén et al., 2013), our aim is to first provide a more recent and detailed description of this program, and secondly, to investigate whether individual variability in depression, alcohol use, or a sense of financial control influence treatment effectiveness (cf. Singal, Higgins, & Waljee, 2014) in a "real-world" setting. We provide much-needed knowledge on who benefits the most from this type of online treatment and the limitations when designing such interventions.

METHODS

Design

The Peli Poikki (PP) program is an 8-week Internet-based cognitive behavioral therapy using motivational interviewing as an approach, offered to gamblers in Finland and governed by the national helpline Peluuri. The program is easily accessible and has a low threshold for entry, allowing and encouraging individuals from anywhere in Finland to attend. Participants have access to weekly modules and an elective online discussion forum and receive a weekly phone call from a therapist. Participation is free, anonymous,[1] and open to Finnish- or Swedish-speaking persons over 18 years of age. No other exclusion criteria are established due to the program's low threshold. Participants with severe depression symptoms (MADRS $\geq$ 20) are recommended to contact a physician.[2] The participants may have additional therapeutic support for other mental health problems during the PP program, and they may attend mutual support groups. They are, however, advised not to have simultaneous treatment for gambling problems.

Participants completed self-report pre- and post-treatment questionnaires and follow-ups at 6 and 12 months after the treatment. Completing the post-treatment questionnaire indicated that the participant also completed all treatment modules. Compliance with module completion was guaranteed by a mandatory phone conversation with the therapist. The participants could not proceed further in the treatment until they had gone through their completed modules with their therapist. The questionnaires included questions from 9 themes (including demographics, gambling history, life situation, and health), but not all measures are analyzed.[3] Participants answered part of the questions

[1]The participants can provide their name or a pseudonym. To participate, they need a valid e-mail address and a phone number (which can be a prepaid number if they wish to retain full anonymity). The program is not connected to health registers, and it is managed by a non-governmental organization; thus, it is not part of public health or social services. The therapists keep a journal for themselves but are not obliged to do so.

[2]If a person scores at least 20 points on the MADRS self-report, they will be notified of the possibility of depression associated with gambling problems, advised to contact a physician, and/or discuss the matter in more detail with their therapist when the treatment starts. The therapists have also been trained to encounter individuals with suicidal thoughts. Such thoughts are systematically probed and, if needed, people are guided towards appropriate treatment. If the therapists encounter an individual with an apparent acute suicide risk, they will follow specific instructions designed for such purposes.

[3]Variables not included in the main analyses were participants' place of residence, marital, family, and employment status, games the participants typically gambled on or felt they had a problem with, amount of time and money gambled, age at onset of gambling, history of drug use, self-perceived relationship with family members and friends, history of help seeking, and medication.

(screening phase) when applied to the program, and part (baseline phase) upon starting treatment. (The waiting list period ranged from 1 to 3 months). It took 30 min on average to complete one questionnaire. A detailed description of treatment contents is shown in Table S1 (See also Castrén et al., 2013).

Participants and therapists. From 2007 to mid-2018, 2011 individuals (1,334 male, 660 female, 17 unreported) signed up for the PP program.[4] Of the participants, 55.4% completed the program (Tables 1 and 2). The median self-reported income and gambling debt categories were €16,500–€24,999 and €10,000–€19,999, respectively, with 36% of participants having at least a bachelor's degree. Five trained therapists delivered the program. The number of therapists increased from two to five during the studied period. Therapists were typically nurses or social workers with additional training in addiction treatment, e.g., training for motivational interviewing or work experience in substance abuse treatment or in the field of addiction.

Measures

Dependent variable: NODS. The self-report *National Opinion Research Center DSM Screen for Gambling Problems* (NODS; Gerstein et al., 1999) is a 17-item scale where dichotomous items are summed according to specific instructions (Hodgins, 2004; Matheson et al., 2021; maximum score = 10 points). We analyzed NODS as a continuous variable (Figs 1 and 2 highlight the cut-off values.). When responding to NODS items at the baseline and post-treatment phases, participants were asked to reflect on their past 2 months of gambling. At the 6- and 12-month follow-ups, they were asked to reflect on their past 6 months of gambling to match the in-between-period length (as was also done in Carlbring, Degerman, Jonsson, & Andersson, 2012).

Independent variables. The self-administered/self-report version of the *Montgomery-Åsberg Depression Rating Scale* (MADRS; Montgomery & Åsberg, 1979) was used to measure severity of depression. The brief self-report *Alcohol Use Identification Test* (AUDIT-C; Bush et al., 1998) was used to measure risky alcohol consumption. MADRS has 9 items, each with an increasing severity scale from 0 to 6 and an overall score ranging from 0 to 54 points. AUDIT-C has 3 items evaluated on an increasing consumption scale from 0 to 4, with overall scores ranging from 0 to 12 points. We analyzed MADRS and AUDIT-C as continuous variables. *Sense of financial control* was measured as a categorical variable with three levels: "Do you consider your financial situation as (1) Good, (2) Bad but in control, (3) Bad and not in control." *Presence of gambling debt* was a dichotomous measure (0 = no gambling debt, 1 = gambling debt). *Physical health* and *Psychological health* were evaluated by single Likert items asking, "What is your current physical/psychological health situation?" (1 = Very poor, 5 = Very good). *Years with gambling problems* was measured by the question "How many years have you suffered from gambling problems?" and analyzed as a continuous variable.

In terms of demographic variables, *Education* (six levels ranging from 1 = Primary education to 6 = Master's degree or higher) and *Income* (seven levels ranging from 1 = 6,500–€9,999 to 7 = over €50,000) were measured as ordered/ordinal variables but analyzed as continuous Likert-type predictors. Finally, *Age* was measured as a continuous variable and *Gender* as dichotomous (0 = male, 1 = female).

Statistical analyses. Data were analyzed within the R platform for statistical computing (v. 4.0.5; R Core Team, 2013), using linear mixed modeling (LMM) with the lme4 package (Bates, Mächler, Bolker, & Walker, 2015). NODS was log-transformed (log[NODS+1]) to reduce distribution skew. The predictors were Treatment (4 levels: baseline, post-treatment, 6-month follow-up, 12-month follow-up), Sense of financial control (SFC), MADRS scores, AUDIT-C scores, Presence of gambling debt, Years with gambling problems, Physical health, Psychological health, Age, Education, Gender, and Income. Age, Education, Gender, Income, and Years with gambling problems were measured only at baseline; other variables were repeatedly measured. We modeled the interactions between Treatment and SFC, Treatment and MADRS, and Treatment and AUDIT-C. MADRS and AUDIT-C were standardized within the treatment phase to normalize their distributions. This enabled us to inspect whether the treatment effect differed based on the levels of SFC, MADRS, and AUDIT-C. Participant IDs were used as a random intercept effect.

Table 1. Number of participants and retention rates across years and treatment phases

Year	Number of individuals (retention rate %)			
	Baseline	Post-treatment	6-month follow-up	12-month follow-up
2007	86	45 (52.3)	17 (19.7)	11 (12.7)
2008	53	29 (54.7)	6 (11.3)	4 (7.5)
2009	72	34 (47.2)	16 (22.2)	15 (20.8)
2010	162	88 (54.3)	47 (29)	36 (22.2)
2011	182	105 (57.6)	76 (41.7)	60 (32.9)
2012	206	116 (56.3)	74 (35.9)	44 (21.3)
2013	201	106 (52.7)	61 (30.3)	44 (21.8)
2014	222	135 (60.8)	77 (34.6)	55 (24.7)
2015	204	121 (59.3)	82 (40.1)	49 (24)
2016	220	132 (60)	67 (30.4)	39 (17.7)
2017	268	137 (51.1)	62 (23.1)	25 (9.3)
2018	135	67 (49.6)	20 (14.8)	2 (1.4)
Total	2,011	1,115 (55.4)	605 (30)	384 (19.1)

Note. The 8-week treatment program occurred between baseline and post-treatment. The retention rates (in brackets) are the proportion of individuals measured at a given point to individuals measured at baseline. Changes were made to the treatment program in mid-2018, and participants in the new program are not included here.

[4]Minor changes were made to the program in 2018, which prevent combining the new data (from mid-2018 onwards) with the currently reported data (2007 to mid-2018).

Table 2. Mean NODS scores and standard errors across years and treatment phases, and treatment effectiveness. Summary statistics for age, gender, education, income, and self-reported years with gambling problems (measured at baseline).

Year	Mean NODS scores (SE)				TE (%)	Mean age (SD)	Males (%)	Median education	Median income (k€/year)	Mean years with gambling problems (SD)
	Baseline	Post-treatment	6-month follow-up	12-month follow-up						
2007	6.17 (0.30)	2.04 (0.34)	1.23 (0.39)	1.00 (0.63)	95.1	33.6 (10.4)	73.9	Upp. sec.	16.5–24.9	9.15 (6.3)
2008	4.75 (0.39)	1.51 (0.32)	1.00 (0.68)	1.75 (1.43)	92.3	34.3 (11.1)	66.3	Upp. sec.	25.0–34.9	9.09 (7.18)
2009	6.57 (0.33)	1.67 (0.39)	1.87 (0.66)	2.53 (0.89)	87.5	35.6 (12.5)	61.7	Upp. sec.	16.5–24.9	9.03 (7.88)
2010	6.55 (0.21)	1.54 (0.22)	2.08 (0.37)	1.72 (0.38)	92.4	35.0 (12.3)	76.5	Upp. sec.	16.5–24.9	8.50 (7.04)
2011	6.16 (0.19)	1.75 (0.18)	2.02 (0.29)	2.50 (0.38)	91.0	35.7 (12.5)	65.7	Upp. sec.	25.0–34.9	8.82 (7.46)
2012	6.36 (0.16)	1.61 (0.15)	1.77 (0.26)	2.25 (0.42)	93.9	34.2 (11.3)	64.1	Upp. sec.	25.0–34.9	7.59 (6.23)
2013	5.98 (0.18)	1.79 (0.18)	2.14 (0.34)	2.34 (0.44)	89.6	35.4 (11.9)	62.3	Upp. sec.	16.5–24.9	8.36 (7.30)
2014	5.38 (0.18)	1.40 (0.15)	1.84 (0.30)	1.78 (0.39)	88.9	35.5 (11.1)	71.1	Upp. sec.	25.0–34.9	8.23 (6.97)
2015	5.39 (0.19)	1.60 (0.17)	2.30 (0.32)	1.91 (0.42)	84.7	35.3 (11.0)	70.1	Upp. sec.	25.0–34.9	7.53 (6.86)
2016	5.65 (0.19)	1.98 (0.20)	1.73 (0.31)	2.23 (0.48)	92.0	34.0 (9.69)	69.4	Upp. sec.	16.5–24.9	7.46 (6.42)
2017	5.67 (0.16)	1.78 (0.17)	1.80 (0.31)	1.76 (0.58)	94.8	33.6 (10.5)	61.8	Upp. sec.	25.0–34.9	7.50 (6.97)
2018	5.68 (0.25)	2.22 (0.32)	1.45 (0.51)	5.00* (1.0)	95.3	33.2 (8.53)	57.4	Upp. sec.	25.0–34.9	7.92 (6.86)
Total	5.85 (0.01)	1.73 (0.06)	1.92 (0.10)	2.09 (0.15)	91.3	34.6 (11.1)	66.9	Upp. sec.	16.5–24.9	8.07 (6.93)

Note. TE = Treatment effectiveness is calculated as the percentage of individuals whose NODS scores were higher at baseline than at any other treatment phase. The 8-week treatment program occurred between baseline and post-treatment. *There were only two observations in the year 2018 at the 12-month follow-up. Upp. sec. = Upper secondary education.

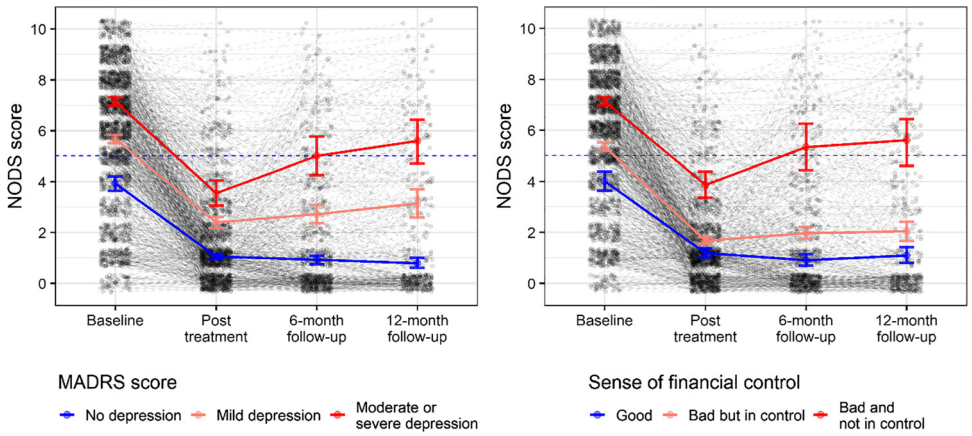

Fig. 1. Left: NODS scores across treatment phases separately for individuals with raw MADRS scores indicating no depression (<6.3 points), mild depression (6.3–18 points), and moderate or severe depression (>18 points; for comparable cut-off points, see Müller-Thomsen et al., 2005; McDowell, 2006). *Right*: NODS scores across treatment phases separately for levels of self-reported sense of financial control. The dashed blue cut-off line (=5) for NODS scores indicates probable disordered gambling. Error bars are 95% confidence intervals. The 8-week treatment program took place between baseline and post-treatment. Random jitter is added to data points for visual clarity

Effect-size estimates were obtained using the method by Nakagawa and Schielzeth (2013), which provides marginal and conditional r^2-values for LMMs. For significance estimates, we used the lmerTest package (Kuznetsova, Brockhoff, & Christensen, 2017), which applies Satterthwaite's method for approximating the degrees of freedom and calculating *P*-values for LMMs. To allow comparison between our findings and those of a recent meta-analysis on online treatments for problem gambling (Sagoe et al., 2021), we also calculated paired samples Cohen's *d* values (with Hedge's correction) of the treatment effect for (1) baseline vs. post-treatment, (2) baseline vs. 6-month follow-up, and (3) baseline vs. 12-month follow-up. Testing multiple interactions without a priori hypotheses inflates researcher degrees of freedom. Thus, to guard against false positives in statistical testing, we strictly interpret $P < 0.001$ as "significant" and $P > 0.001$ as "non-significant".

Finally, we performed post-hoc pairwise comparisons for (1) post-treatment vs. 6-month follow-up, (2) post-treatment vs. 12-month follow-up, and (3) 6-month follow-up vs. 12-month follow-up, using the Tukey's range test. These comparisons were calculated both with and without conditioning the tests on MADRS scores (+/- 2 SDs around the mean). The results of these analyses are detailed in the supporting information document.

All LMM models satisfied the assumptions of linearity. Q-Q plots indicated that the model residuals and random

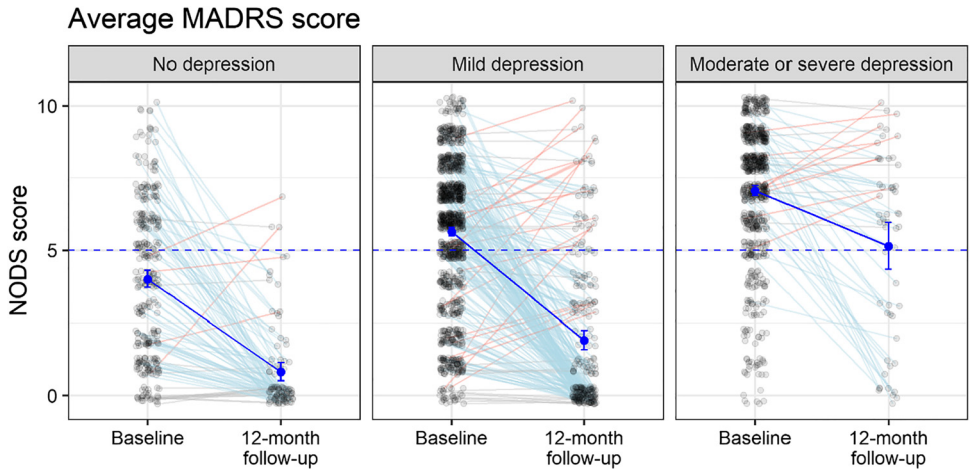

Fig. 2. NODS scores from baseline to the 12-month follow-up, presented separately for individuals with average raw MADRS scores (averaged participant-wise over treatment phases) indicating no depression (<6.3 points), mild depression (6.3–18 points), and moderate or severe depression (>18 points). The dashed blue cut-off line (=5) for NODS scores indicates probable disordered gambling. Each line represents an individual, and cyan lines represent individuals whose NODS scores were higher at baseline than at the 12-month follow-up. In other words, cyan lines represent individuals who still benefited from the treatment after 12 months. Missing lines indicate individuals who dropped out prior to the final 12-month follow-up. Thick blue lines and error bars depict treatment phase-wise means and 95% confidence intervals. Random jitter is added to data points for visual clarity

effects were close to normally distributed and homoscedastic. We nonetheless reran all analyses using robust linear mixed modeling (Koller, 2016) and Bayesian linear mixed modeling (Chung, Rabe-Hesketh, Dorie, Gelman, & Liu, 2013), but the results were essentially the same.

There were a few missing values (4.8%) *not* related to data attrition across our measured variables. Given our large sample size, participants with non-attrition missing data were excluded from the statistical analyses. On the psychometric scales, only ~1% of the responses to the MADRS and AUDIT-C questions were missing, allowing us to calculate participant-wise scale means despite the missing values. The missing values were also ignored when calculating NODS scores. However, the results remained essentially unchanged even after omitting all participants with any missing values.

Ethics

The study procedures were carried out in accordance with the Declaration of Helsinki. The study was approved by the Ethics committee of the Finnish Institute for Health and Welfare. All subjects gave their informed consent for analyzing their data. Before applying to the program, they were informed in writing about how their information will be used, their right to see their data and have it removed, and that the information they provide may be used for scientific research.

RESULTS

Descriptive statistics

Participation in the PP program grew steadily through the years and had stable retention rates at around 55, 30, and 19% for post-treatment, 6- and 12- month follow-ups, respectively (Table 1). The treatment was effective on average, with NODS scores [95% CI] dropping from 5.85 [5.83–5.87, baseline] to 1.73 [1.61–1.85, post-treatment], 1.92 [1.72–2.12, 6-month follow-up], and 2.09 [1.8–2.38, 12-month follow-up. See Table 2, which also presents summary statistics for variables measured only at baseline].

Main results

Data were collapsed over the measurement years, as there was no significant effect of the measurement year on NODS scores. (See the supporting information document (Fig. S1) for a yearly visualization). Age, Education, Income, Presence of gambling debt, AUDIT-C scores, Physical health, and the Treatment*AUDIT-C and Treatment*SCF interactions were not significantly associated with NODS scores (all Ps > 0.001). Treatment, SFC, MADRS scores, Gender, Psychological health, and the Treatment*MADRS interaction were significant predictors. (All Fs > 10.9, Ps < 0.001; being male and having lower psychological health were associated with higher NODS scores.) However, the Treatment*MADRS and Treatment*SCF interactions suppressed each other's effects. Omitting either one from the model substantially increased the other's F-value (Treatment*MADRS: $F(3, 3{,}011) = 23.8$, $P < 0.001$; Treatment*SFC: $F(6, 3{,}031) = 6.97$, $P < 0.001$). Thus, while NODS scores declined somewhat uniformly after treatment, the effect did not last as long for individuals with high MADRS scores and for individuals who felt they cannot control their financial situation (Figs 1 and 2).

The model pseudo R^2 values were 0.55 (marginal effect) and 0.68 (conditional effect), indicating strong effects by conventional standards (Table 3). Cohen's d values for paired samples comparisons were 1.34 (baseline vs. post-

Table 3. ANOVA table for the Linear Mixed Model predicting log-transformed NODS scores

Dependent Variable Log-transformed NODS scores Predictor	*F*-value (DFs)	*P*-value
Treatment	*388.8 (3, 3,009)*	*$<2.2*10^{-16}$*
MADRS (standardized)	*221.0 (1, 3,776)*	*$<2.2*10^{-16}$*
AUDIT-C (standardized)	8.0 (1, 3,408)	0.005
Sense of financial control	*43.69 (2, 3,695)*	*$<2.2*10^{-16}$*
Presence of gambling debt	8.1 (1, 3,742)	0.004
Physical health	1.44 (1, 3,559)	0.23
Psychological health	*10.9 (1, 3,775)*	*0.0009*
Years with gambling problems (B)	0.71 (1, 1,861)	0.40
Gender (B)	*15.6 (1, 1,962)*	*$8.11*10^{-5}$*
Income (B)	9.6 (1, 2,062)	0.002
Education (B)	0.27 (1, 1,901)	0.60
Age (B)	0.34 (1, 1,861)	0.55
*Treatment*MADRS*[1]	*14.3 (3, 3,013)*	*$2.97*10^{-9}$*
Treatment*SFC[1]	2.28 (6, 3,039)	0.033
Treatment*AUDIT-C	2.01 (3, 2,848)	0.11
Random effects	*SD*	
Participant ID (intercept)	0.30	
Residual	0.47	
Model fit		
Pseudo-r^2 (fixed effects)	0.55	
Pseudo-r^2 (fixed + random effects)	0.68	

Note. [1] When these interaction terms were not included in the same model (i.e., modeled in separate analyses), the values were $F(3, 3{,}011) = 23.8$, $P = 3.27*10^{-15}$ (Treatment*MADRS) and $F(6, 3{,}031) = 6.97$, $P = 2.22*10^{-7}$ (Treatment*SFC). Results are based on type 3 ANOVA with Satterthwaite's method (Kuznetsova et al., 2017). Effect size estimates were obtained using the method by Nakagawa and Schielzeth (2013). Significant effects ($P < 0.001$) are italicized. (B) = Variable measured only once at baseline (i.e., Level 2 in the linear mixed model).

treatment), 1.12 (baseline vs. 6-month follow-up), and 1.02 (baseline vs. 12-month follow-up). These effect sizes are slightly above or similar to the meta-analysis average effect (reported in Sagoe et al., 2021) at post-treatment (Hedge's $g = 0.729$) and follow-up (Hedge's $g = 1.1$), again suggesting strong effects – though the lack of a control group needs to be considered when interpreting the strength of the effect.

We also calculated a *treatment effect* variable by subtracting individuals' post-treatment NODS scores from their 12-month follow-up NODS scores and regressed it on participant-wise average raw MADRS scores (controlling for demographics). The association was significant ($B = 0.83$, $t = 3.4$, $P = 0.0009$), indicating that higher average MADRS scores were linked to increased NODS scores between post-treatment and the 12-month follow-up (i.e., the treatment appeared to be "wearing off").

Additional analyses. To evaluate data attrition due to symptoms of depression, we created a *times-measured* variable, indexing the number of times participants took part in the follow-up measures, which ranged from 1 (participated only in the baseline measure) to 4 (participated in all phases). We then regressed the times measured on average raw MADRS scores, and the association was negative and highly significant ($B = -0.048$, $t = -17.43$, $P < 0.001$). Reporting symptoms of depression significantly increased the likelihood of dropping out. In general, subjects may drop out early if the treatment does not have the desired effect, causing data attrition due to a bias in perceived treatment effectiveness. LMMs (multilevel models) are able to handle missing responses using maximum likelihood estimation. However, to check robustness, we reran our main analyses by including only those participants who completed the program and the 12-month follow-up measurement, and the results were very similar (See the supporting information document, Fig. S2 and Table S2, for details).

DISCUSSION

We presented results from 12 years of data on the Finnish Peli Poikki online intervention for gambling problems, where participation has grown with the number of therapists since 2007. The retention rate was stable at around 55%, which is considered acceptable and within the typical range (Cunningham et al., 2019; Ronzitti, Soldini, Smith, Clerici, & Bowden-Jones, 2017) but lower than in some studies (e.g., Cunningham et al., 2020). The rates for 6- and 12-month follow-ups were also within the typical range (Cunningham et al., 2019; Hodgins et al., 2019). The treatment was effective on average and the effect lasted through the follow-ups for individuals without depression and with a sense of control over their finances. However, the beneficial treatment effect started "wearing off" for individuals with symptoms of depression or without a sense of financial control. Thus, the treatment components promote a beneficial change in gambling behavior, but whether this change lasts depends on existing symptoms of depression and a sense of financial control.

Problem gambling often co-occurs with substance use and mental health issues (Lorains, Cowlishaw, & Thomas, 2011; Sundqvist & Rosendahl, 2019) and leads to severe financial problems (Swanton & Gainsbury, 2020). An earlier analysis of the PP program also revealed a reduction in depressive symptoms and risky alcohol consumption (Castrén et al., 2013; see also; Carlbring & Smit, 2008; Carlbring et al., 2012; Cunningham et al., 2019). Our results confirmed that remote intervention is effective on average, but not equally for everyone. Comorbid depression and the lack of a sense of control over one's finances need more attention.

Poor mental health is likely in the presence of both gambling and debt problems (Swanton & Gainsbury, 2020). However, mental health problems are not necessarily linked to objective measures such as loan sizes or actual losses but to the self-reported and complex set of *experienced* problems (Bridges & Disney, 2010; Grant, Schreiber, Odlaug, & Kim, 2010). This indicates that gambling-related mental health problems are better explained by a lack of control over one's

finances than by the absolute amount of debt, which is in line with our current results.

Comorbid depression and a lack of financial control may cause such a strain on the participant that treatment requiring online access, homework completion, and phone consultation with a therapist is hard to tackle. The treatment components addressing comorbid issues might also not be efficient enough. Attention is needed when screening participants for similar online treatments: Those with an elevated level of comorbidities (especially depression) need to be identified and referred to further assessment and support services.

Our results on treatment effectiveness are comparable to those found in a recent meta-analysis on online interventions for problem gambling (Sagoe et al., 2021). The meta-analysis found that studies with higher baseline severity of gambling problems had greater treatment effect, possibly because individuals who were worse off at baseline have a higher potential to benefit from the treatment. Compared with randomized controlled trials, the PP program is less rigid due to its low threshold, and the inclusion criteria are also very lenient. No adults are excluded, and thus even participants with severe symptoms of depression were included. These individuals had higher baseline gambling problem severity, but for them, the treatment was not more effective than for those without depressive symptoms. Therefore, the potential for improvement alone is not enough to guarantee treatment effectiveness.

Most studies on online interventions for gambling problems assess multiple outcome variables, including measures of money lost and gambling frequency. While we focused on NODS as the primary outcome variable, we have also provided analyses in the supporting information document focusing on self-reported gambling losses as an additional outcome variable (see Fig. S3 and Table S3). The results of these analyses were in line with the main findings.

Limitations and future studies

The lack of a control group limits our ability to draw firm conclusions. The therapist effect may have influenced treatment outcomes (Petry, Ginley, & Rash, 2017; van der Maas et al., 2019). This was addressed and mitigated by all therapists using the same 8-module manual for treatment,[5] although no integrity measures were used. In the future, careful integrity checking (coding tool; Rodda et al., 2018) should be used. We analyzed all available data from all participants; however, further investigation of dropping out during treatment is currently in process. We also note that self-report measures are inherently limited due to participants' reluctance to reveal private details, exaggeration, or other biases such as social desirability. A mixed-methods approach with both interview and self-report data might have provided a more accurate reflection of the effectiveness of this program. Future work would benefit from a wider range of measures on treatment effect moderators like symptoms of depression. Finally, while the retention rates were within an acceptable range, they were still somewhat high, and in our analyses, we did not control for treatment received outside of the PP program. Thus, the current results need to be interpreted with some caution.

[5]The manual is available only in Finnish for internal use, with more details upon request from the first author.

Conclusions

The PP program is a well-established low-threshold online intervention for individuals with gambling problems in Finland. Participants without comorbidities seem to benefit the most from the intervention, as the beneficial treatment effect appears to wear off for participants with symptoms of depression or without a sense of control over their finances. Low-threshold programs have multiple benefits, but attention is required in the screening phase to direct people with comorbidities to the appropriate services.

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Authors' contribution: JP: Study concept and design, statistical analysis, interpretation of data, visualization, manuscript write-up. MH: Study concept and design, interpretation of data, manuscript write-up. SC: Study concept and design, interpretation of data, manuscript write-up. All authors had full access to all data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

Conflict of interest: Sari Castrén works full time at the Finnish Institute for Health and Welfare and all her research work is funded within the objectives of §52 Appropriation of the Lotteries Act. Castrén also works as a clinical psychologist at Addiktum Clinic Helsinki, Finland as a private practitioner (part time) treating individuals mainly with addiction problems, and at Mehiläinen Medical Center, Forum Helsinki, where she offers treatments to various psychological issues. She is a clinical advisor to the Canadian company Alavida, Vancouver (remote/internet treatment for alcohol disorder). She is also lecturing about behavioral addictions (e.g., national and international conferences) and training and supervising professionals to treat gambling disorder (MI, CBT) as a part of her duty at the Finnish Institute for Health and Welfare and addictions in general privately. She has received fees from Helsinki University, Tampere City, Vocational school Stadi, Lundbeck, and Mehiläinen for her lectures on behavioural addictions and training professionals, and writer's fees from The Finnish Medical society Duodecim and Myllyhoitoyhdistys ry. She received fees from Svenska Spel (Sweden) for evaluating research plans (grants) and Tampere University for preliminary examination of PhD work. She declares no conflict of interest in relation this manuscript.

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APPENDIX: SUPPORTING INFORMATION

Table S1. Contents of the Peli Poikki -program

Module 1 Psycho-education and motivation to treatment	• Basic knowledge about games of chance and types of games in general • Readings that promote participants' awareness of ambivalence of making change, enhance their motivation, and support their goal setting based on Motivational Interviewing (MI). • Homework • Phone call from a therapist using the MI approach (at least 30 min)
Module 2 Recognition of high-risk situations and triggers	• Identification of high-risk gambling situations • Identification of specific triggers of gambling • Readings of gambling-related automatic thoughts • Homework: to identify gambling-related thoughts, feelings, actions and consequences • Discussion on economic burdens, and homework to practice handling one's financial situation • Phone call from a therapist using the MI approach (at least 30 min)
Module 3 Identification of social concequences of gambling AOs/CSOs	• Participants' significant others were identified and interviewed (questionnaire) about the participant's gambling and inquired how gambling affects their lives. • Participants' goal setting • Homework • Phone call from a therapist using the MI approach (at least 30 min)
Modules 4–5 Working on identification of gambling-related erroneous thoughts using a framework of cognitive behavioural therapy (CBT)	• Identification of gambling-related erroneous thoughs and their relation to problem gambling • Practice of acceptance of present situation, setting a focus on the future to support the goals that were set • Homework • Phone call from a therapist using the MI approach (at least 30 min)
Modules 6–7 Practicing CBT with homework	• Practice of identification and new alternative ways to respond to high-risk situations • Practice of managing one's financial situation • Homework • Phone call from a therapist using the MI approach (at least 30 min)
Module 8 Relapse prevention	• Relapse prevention plan completed with the help of a therapist • Assessment of current situation and, if needed, referrals to appropriate services

Note. Each module includes short written exercises. Homework was allocated after each module. Telephone support consisted of enhancement of participants' motivation with a non-judgmental MI-approach. Each week homework and progress were discussed; if homework were not completed, extra time for that was allocated, prior to moving on to the next module.

Treatment effects by year

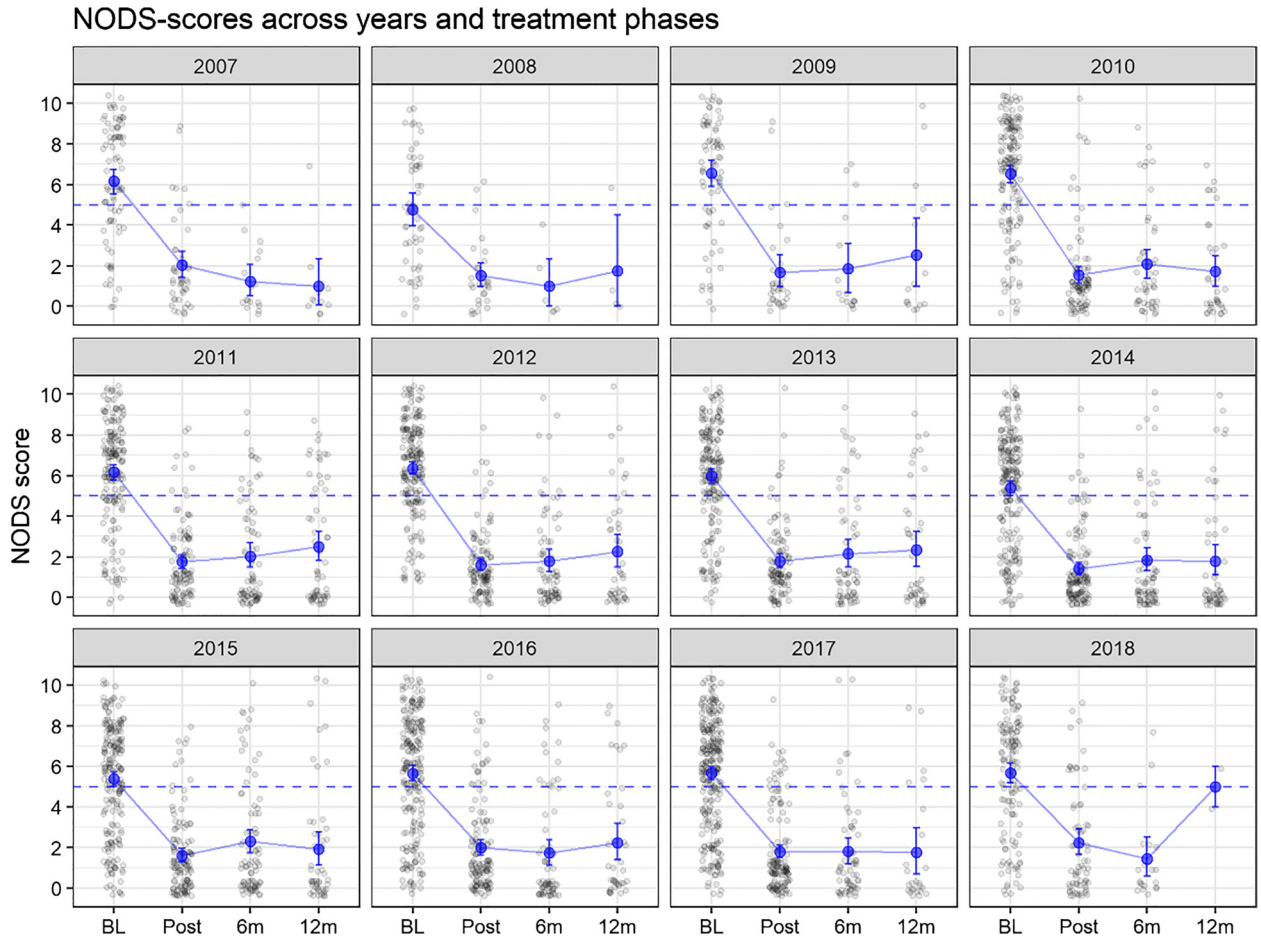

Fig. S1. NODS-scores across treatment phases (BL = Baseline, Post = Post treatment, 6 m = 6-month follow-up, 12 m = 12-month follow-up) separately for the years 2007–2018. The dashed blue cut-off line (=5) for NODS scores indicates probable disordered gambling. Error bars are 95% confidence intervals. The 8-week treatment program took place between Baseline and Post treatment. Random jitter is added to datapoints for visual clarity

Main results for treatment completers only

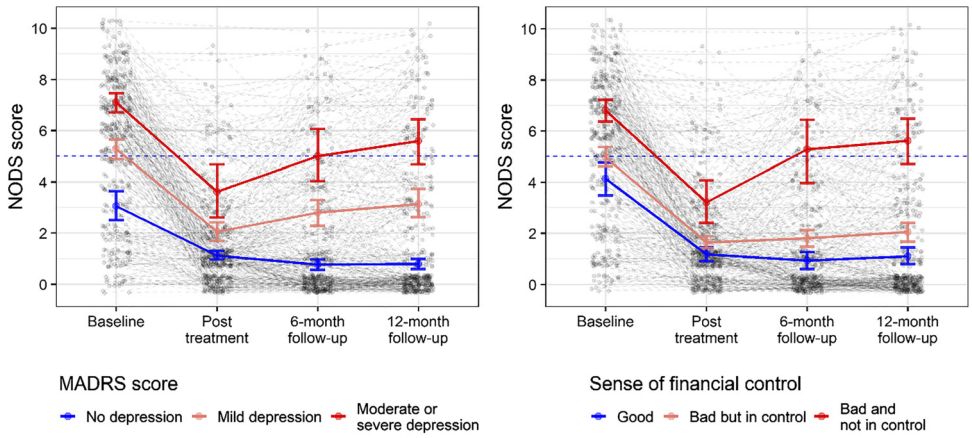

Fig. S2. Left: NODS-scores across treatment phases separately for individuals with raw MADRS-scores indicating no depression (<6.3 points), mild depression (6.3–18 points), and moderate or severe depression (>18 points; for comparable cut-off points, see Müller-Thomsen et al., 2005; McDowell, 2006). *Right*: NODS-scores across treatment phases separately for levels of self-reported sense of financial control. The dashed blue cut-off line (=5) for NODS scores indicates probable disordered gambling. Error bars are 95% confidence intervals. The 8-week treatment program took place between Baseline and Post treatment. Random jitter is added to datapoints for visual clarity. Only individuals who completed the treatment and the 12-month follow-up (N = 384) are included

Table S2. ANOVA-table for the Linear Mixed Model predicting NODS scores for individuals who completed the treatment and the 12-month-up (N = 384)

Dependent Variable NODS scores Predictor	*F*-value (DFs)	*P*-value
Treatment	*148.9 (3, 1,084)*	*$<2.2*10^{-16}$*
MADRS (standardized)	*130.1 (1, 1,296)*	*$<2.2*10^{-16}$*
AUDIT-C (standardized)	0.52 (1, 804)	0.47
Sense of financial control	*13.8 (2, 1,298)*	*$1.1*10^{-6}$*
Presence of gambling debt	1.9 (1, 1,254)	0.16
Physical health	1.04 (1, 1,202)	0.31
Psychological health	4.0 (1, 1,302)	0.045
Years with gambling problems	0.01 (1, 341)	0.94
Gender	9.8 (1, 345)	0.0018
Income	0.003 (1, 357)	0.96
Education	1.18 (1, 346)	0.28
Age	0.18 (1, 356)	0.66
Treatment*MADRS[1]	4.05 (3, 1,061)	0.007
Treatment*SFC	0.92 (6, 1,089)	0.47
Treatment*AUDIT-C	0.73 (3, 1,061)	0.53
Random effects	*SD*	
Participant ID (intercept)	1.18	
Residual	1.69	
Model fit		
Pseudo-r^2 (fixed effects)	0.51	
Pseudo-r^2 (fixed + random effects)	0.67	

Note. Results are based on type 3 ANOVA with Satterthwaite's method (Kuznetsova et al., 2017). Effect size estimates were obtained using the method by Nakagawa and Schielzeth (2013). Significant effects ($P < 0.001$) are italicized. [1]This interaction was not significant by our strict criterion; however, when the two other interactions (Treatment*SFC and Treatment*AUDIT-C) were excluded, the effect of Treatment*MADRS was significant: $F(3, 1{,}060) = 6.02$, $P = 0.0004$. Unlike in the analysis presented in the main text, here NODS was not log-transformed (the distribution was much less skewed than when all individuals were included).

Post hoc comparisons for treatment effect

We performed *post hoc* comparisons on post-baseline treatment phases using the Tukey's range test to guard against familywise (type 1) errors. All pairwise comparisons (1: Post treatment vs. 6-month follow-up, 2: Post treatment vs. 12-month follow-up and 3: 6-month follow-up vs. 12-month follow-up) were nonsignificant (Ps > 0.35); thus, the treatment effect held relatively well on average across follow ups. We then conditioned the same *post hoc* tests on MADRS-scores (holding MADRS-scores 2 SDs above and below the mean value, indicating severe depression and no depression); in this analysis the pairwise comparisons were nonsignificant, given our strict P-value criterion, at MADRS-scores 2 SDs below the mean (all Ps > 0.11), but significant at MADRS-scores 2 SDs above the mean when comparing post treatment with the 12-month follow-up (z-ratio = −4.72, $P < 0.001$). Thus, for individuals with high MADRS scores, NODS scores were significantly higher at the 12-month follow-up than at the post treatment phase (treatment appeared to be wearing off). These results are in line with the main results. Note that these *post hoc* tests were calculated from the LMM presented in the main text, but without log-transforming the DV.

Money spent gambling

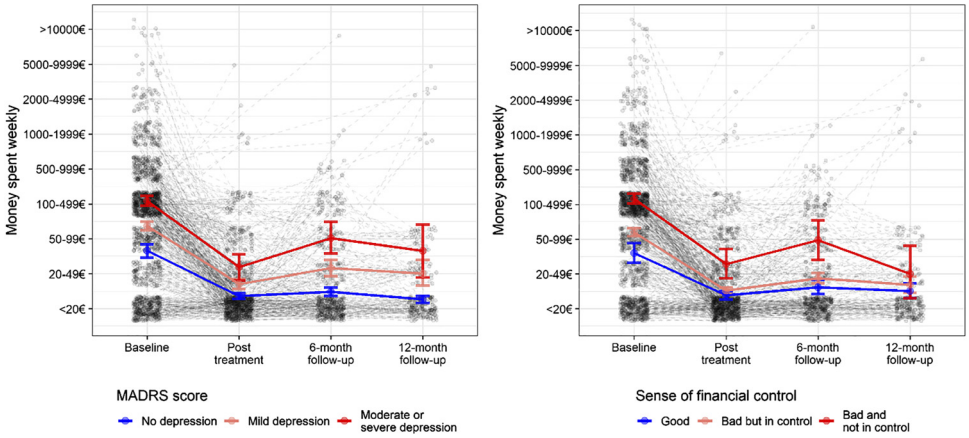

Fig. S3. Left: Self-reported average weekly money spent on gambling during the past month across treatment phases separately for individuals with raw MADRS-scores indicating no depression (<6.3 points), mild depression (6.3–18 points), and moderate or severe depression (>18 points; for comparable cut-off points, see Müller-Thomsen, Arlt, Mann, Maß, & Ganzer, 2005; McDowell, 2006). *Right*: Self-reported average weekly money spent on gambling during the past month across treatment phases separately for levels of self-reported sense of financial control. Error bars are 95% confidence intervals. The 8-week treatment program took place between Baseline and Post treatment. Random jitter is added to datapoints for visual clarity

Table S3. ANOVA-table for the Linear Mixed Model predicting Average weekly money spent on gambling during the past month

Dependent Variable Average weekly money spent on gambling during the past month		
Predictor	*F*-value (DFs)	*P*-value
Treatment	*145.2 (3, 1,774)*	*$<2.2*10^{-16}$*
MADRS (standardized)	*81.78 (1, 2,483)*	*$<2.2*10^{-16}$*
AUDIT-C (standardized)	4.18 (1, 2,157)	0.041
Sense of financial control	*10.6 (2, 2,444)*	*$2.53*10^{-5}$*
Presence of gambling debt	6.05 (1, 2,398)	0.014
Physical health	3.49 (1, 2,266)	0.062
Psychological health	1.54 (1, 2,470)	0.21
Years with gambling problems	0.12 (1, 1,048)	0.73
Gender	1.63 (1, 1,134)	0.20
Income	5.74 (1, 1,244)	0.017
Education	1.46 (1, 1,078)	0.23
Age	6.4 (1, 1,014)	0.012
Treatment*MADRS	3.63 (3, 1,841)	0.01
Treatment*SFC	1.54 (6, 1,812)	0.16
Treatment*AUDIT-C	0.56 (3, 1,698)	0.64
Random effects	*SD*	
Participant ID (intercept)	0.71	
Residual	1.18	
Model fit		
Pseudo-r^2 (fixed effects)	0.37	
Pseudo-r^2 (fixed + random effects)	0.54	

Note. Results are based on type 3 ANOVA with Satterthwaite's method (Kuznetsova et al., 2017). Effect size estimates were obtained using the method by Nakagawa and Schielzeth (2013). Significant effects ($P < 0.001$) are italicized.

We also calculated paired samples Cohen's *d* values (with Hedge's correction) of the treatment effect for 1) Baseline vs. Post treatment, 2) Baseline vs. 6-month follow-up, and 3) Baseline vs. 12-month follow-up. The paired samples Cohen's *d* values were 0.981 (Baseline vs. Post treatment), 0.659 (Baseline vs. 6-month follow-up), and 0.772 (Baseline vs. 12-month follow-up). These effect sizes are above the meta-analysis average effect (reported in Sagoe et al., 2021) at post treatment (Hedge's $g = 0.19$) and follow-up (Hedge's $g = 0.202$), suggesting strong effects.