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The efficacy of multi-component positive psychological interventions:  
A systematic review and meta-analysis of randomized controlled trials

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### Abstract

Recently, we see a sharp increase in the number of multi-component positive psychology interventions (MPPIs). The aim of the current study is to examine the efficacy of MPPIs, through a systematic review and meta-analysis. We included 50 randomized controlled trials (RCTs) that were published in 51 articles between 1998 and August 2018. We found standardized mean differences of Hedges'  $g = 0.34$  for subjective well-being, Hedges'  $g = 0.39$  for psychological well-being, indicating small to moderate effects, and Hedges'  $g = 0.29$  for depression, and Hedges'  $g = 0.35$  for anxiety and stress, indicating small effects. Removing outliers led to a considerable decrease in effect sizes for subjective well-being and depression, a slight decrease for psychological well-being, and a strong increase in the effect size for stress. Removing low quality studies led to a considerable decrease in the effect sizes for subjective well-being, psychological well-being, and depression, and a slight decrease for anxiety, but a strong increase for stress. Moderator analyses only showed a significant effect for study quality, showing larger effect sizes for low quality studies compared to studies of moderate and high quality. In addition, a larger effect size for anxiety was found in studies from non-Western countries compared to studies from Western countries. In sum, this systematic review and meta-analysis found evidence for the efficacy of MPPIs in improving mental health. We conclude that MPPIs have a small effect on subjective well-being and depression, and a small to moderate effect on psychological well-being. In addition, they may have a small to moderate effect on anxiety and a moderate effect on stress, but definite conclusions of the effects of MPPIs on these outcomes cannot be made due to the limited number of studies. Further well-conducted research among diverse populations is necessary to strengthen claims on the efficacy of MPPIs.

## Introduction

The positive psychology movement intended to redirect the course of psychological research: away from a focus on pathology, diseases and deficits, and towards the study of human strengths, flourishing and the optimal functioning of individuals, groups, and institutions (Gable & Haidt, 2005; Seligman & Csikszentmihalyi, 2000; Sheldon & King, 2001). Since its inauguration in 1998, the movement has made a considerable impact on the scientific community, with an exponential growth of publications (Donaldson et al., 2014; Hart & Sasso, 2011; Hendriks et al., 2018c; Kim, Doiron, Warren, & Donaldson, 2018; Rusk & Waters, 2013). Positive psychology builds on the ideas of humanistic psychology, but employs state-of-the-art-research methods to ensure scientific rigor (Froh, 2004; Sheldon & Kasser, 2001). Studies that investigate the efficacy of so-called positive psychology interventions (PPIs), are a cornerstone of psychological inquiry.

There has been much discussion on the definition of PPIs. A broad definition was introduced by Sin and Lyubomirsky (2009), who defined PPIs as all interventions that aim at increasing positive feelings, behaviors, and cognitions. Narrower definitions were suggested by Bolier et al. (2013), who added that these interventions ‘should have been explicitly developed in line with the theoretical tradition of positive psychology’ (Bolier et al., 2013) and Parks and Biswas-Diener (2013), who suggested that an intervention can only be regarded as a PPI if sufficient empirical evidence exists suggesting significant effects for the intervention (Parks & Biswas-Diener, 2013). Schueller and Parks (2014) argued that in addition to the (positive) aim of an intervention, the pathways through which the interventions operate is a second essential component when deciding if an intervention can be considered as a PPI. Building on these suggestions, we define positive psychology interventions as interventions aiming at increasing positive feelings, behaviors, and cognitions, while also using theoretically and empirically based pathways or strategies to increase well-being.

To date, two meta-analyses have been published that examined the overall efficacy of PPIs. The first meta-analysis included 51 controlled studies and found large effects for enhanced well-being ( $r = 0.29$ ,  $d \cong 0.61$ ) and depressive symptoms ( $r = 0.31$ ,  $d \cong 0.65$ ) (Sin & Lyubomirsky, 2009). The second meta-analysis included 39 RCTs (Bolier et al., 2013) and reported small effect sizes ( $d = 0.34$ ) for subjective well-being, psychological well-being ( $d = 0.20$ ), and depression ( $d = 0.20$ ). Bolier et al. (2013) argued that the effect sizes in the meta-analysis by Sin and Lyubomirsky might be overestimated, due to the application of less stricter inclusion criteria, for example by including non-randomized controlled trials and studies in the field of mindfulness and life review therapy.

### **Multi-Component Positive Psychology Interventions (MPPIs)**

A differentiation can be made between single component intervention studies and multi-component intervention studies. Single component intervention studies usually consist of one or more positive psychology activities targeting one component of well-being. For example, studies on the effects of gratitude interventions (DeSteno et al., 2015; Digdon & Koble, 2011; Isik & Erguner-Tekinalp, 2017; Lau & Cheng, 2011), engaging in acts of kindness (Alden & Trew, 2013; Buchanan & Bardi, 2010; O'Connell et al., 2016), and strengths-based interventions (Proyer et al., 2015; Toback et al., 2016). MPPIs may be considered as interventions that contain a variety of evidence-based individual exercises and targeting two or more theoretically relevant hedonic and eudaimonic well-being components, that are conducted within an integral program. Examples of theoretical components are the components of the PERMA-model (i.e. positive emotions, engagement, relationships, meaning, and accomplishment) by Seligman (2011), and the components of the Synergetic Change Model (i.e. emotions, goals and habits, virtues and relationships, comprehension and coping, attention and awareness), which was developed by Rusk, Vella-Broderick and Waters (2018).

## **Present Study**

Over the years, there is a growing body of research on the efficacy of MPPIs. The primary aim of this meta-analysis is to examine the efficacy of MPPIs on well-being and distress in both the general public and in clinical populations. MPPIs contain a wide variety of positive activities that target different domains of mental well-being. Consequently, we expect that MPPIs have larger effects than have been found in prior meta-analyses of mainly single component interventions, both at post-treatment and at follow-up measurements. The secondary aims were to identify moderators that may influence the relation between the intervention and the outcomes, determine the quality of the studies, and examine potential publication bias.

## **Method**

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines for systematic reviews and meta-analyses (Moher et al., 2010) and the recommendations of the Cochrane Back Review group (Higgins et al., 2011) were followed in the planning and the implementation of the meta-analysis.

## **Search Strategy**

A systematic literature search was conducted in the following three databases: PubMed, PsycINFO and Scopus, from 1998 to August 2018. The last run was conducted on the 31st of July 2018. The search was conducted by the first and third author. The databases were searched with the following terms: positive psychology, well-being, happiness, happy, flourishing, life satisfaction, satisfaction with, optimism, gratitude, strengths, forgiveness, compassion and random. The search strings were adapted to the according database (see the Appendix 1). Additionally, reference lists of four meta-analyses (Bolier et al., 2013; Chakhssi, Kraiss, Sommers-Spijkerman, & Bohlmeijer, 2018; Dickens, 2017; Sin & Lyubomirsky, 2009) and six review articles on PPIs (Casellas-Grau et al., 2014; Macaskill, 2016; Rashid,

2015; Sutipan et al., 2016; Walsh et al., 2016; Woodworth et al., 2016) were checked. Several experts in the field of positive psychology also suggested additional studies.

### **Selection of Studies**

After removal of duplicates, titles and abstracts were screened by two reviewers (first and second author). Full texts of potentially relevant articles were assessed. Studies were included based on the following criteria: i) studies were RCTs; ii) studies were administered to adults in clinical and non-clinical populations; iii) interventions were comprised of at least two positive activities and two modules that were explicitly based on strategies aiming at hedonic and eudaimonic well-being components and conducted within an integral program; iv) studies were published in peer reviewed journals; v) studies used outcome measures to examine the effects on subjective and psychological well-being, depression, anxiety, and stress. Excluded were: i) cluster randomized controlled trials; ii) interventions that were primarily focused on one component such as mindfulness-based therapies, Acceptance and Commitment therapy, loving kindness meditation, forgiveness therapy, compassion focused therapy, hope therapy, and self-management; iii) studies that did not provide sufficient data to calculate post-treatment effect sizes per condition and the corresponding author was unable to provide the necessary data upon request; iv) studies that were published in book chapters, dissertations, and studies in grey literature; v) articles that were not published in English.

### **Data Extraction**

The first author performed the data extraction, which was then verified by the second author. Any disagreements were resolved by consensus and through consultation with the last author. The following data was gathered: authors, year of publication, country of origin, condition of participants (clinical or non-clinical), intervention type (PPI or PPI plus other intervention type), delivery form (group-based, individual therapy or self-help), description of control group (active or non-active), number of sessions, duration of session period, follow-up

assessment, number of participants per condition at post-test level, mean age and standard deviation of participants, percentage of female participants, retention rate at post-test level per condition, type of outcome and used questionnaires. Self-help refers to interventions through self-help books or instructions by email, and web-based self-help applications. Individual therapy refers to an intervention that was delivered by therapists during face-to-face sessions. Following Gosling et al. (2010), we classified North America, Western Europe, Israel, Australia, and New Zealand as Western-countries, other countries were classified as non-Western. For the meta-analyses, we extracted means and standard deviations at post-test. In case of insufficient data or unclear reporting, we contacted the authors through e-mail. In total, fifteen authors were contacted, of which eight provided sufficient additional data to be able to include the study in our analysis.

### **Quality Assessment**

The first and third author independently assessed the quality of each study using the Cochrane Collaboration's tool for assessing risk of bias in RCTs (Higgins et al., 2011) with six criteria: (i) sequence generation: was there a detailed description of method that was used to generate the allocation sequences (e.g. referring to random numbers, using a computer with random number generator, coin tossing, drawing of lots); (ii) allocation concealment: could the processes of enrolling of participants not be foreseen by participants or investigators, for example through the use of numbered, opaque, sealed envelopes or central allocation (web-based applications); (iii) were outcome measures blinded, administered by an independent person or via online assessment; (iv) was there a description of the withdrawals/drop-outs; (v) was a power analysis carried out or was the group size per condition larger than 50; (vi) was an intention-to-treat analysis conducted, or were there zero drop-outs. One point was appointed for each criterion met. The quality of a study was assessed as 'high' when a minimum of five criteria were met, 'moderate' when three to four criteria were met, and 'low'

when less than three criteria were met. Consensus between the two reviewers was reached through discussion.

### **Statistical Analyses**

Data analyses were performed with the program Comprehensive Meta-Analysis (CMA, version 3.3.070). We used the means, standard deviations, and sample sizes for each study, to calculate the effect size using dichotomous outcomes. For each comparison between a PPI and a control group, Hedges'  $g$  effect sizes were calculated to assess the between-group differences at post-test. These effect sizes were calculated by subtracting the average score of the PPI group from the average score of the comparison group (both at post-test) and dividing the result by the pooled standard deviations obtained from the two groups. We used Hedges'  $g$  because this effect size measure is more accurate than Cohen's  $d$  when study sample sizes of the studies are small (Cuijpers, 2016), which is the case in more than half of the studies we included. Similarly to Cohen's  $d$ , Hedges'  $g$  effect sizes of 0 to 0.32 can be considered as small, effect sizes of 0.33 to 0.55 as moderate, and effect sizes of 0.56 to 1.2 as large (Lipsey & Wilson, 1993). In the calculation of effect sizes for depression, stress, and anxiety we used the scores on instruments that explicitly measured these outcomes. For subjective and psychological well-being, we also used scores from instruments related to these constructs of well-being. See Appendix 1 for detailed information on the used instruments per outcome. If more than one measure was used for a particular outcome in one study, the pooled effect size was calculated. Thus, each study provided only one effect size for all outcomes. When available, we computed between-group effect sizes (Hedges'  $g$ ) for follow-up differences. Follow-up effects were calculated if there was a minimum of five studies per outcome.

Due to the diverse populations, we expected considerable heterogeneity. Therefore, we performed the meta-analysis using a random effects model, with a 95% confidence interval and using a two-tailed test. Separate meta-analyses were performed for subjective well-being,



psychological well-being, depression, anxiety, and stress. Forest plots of post between-group effect sizes were produced for each outcome variable, both with and without outliers. We considered a study as an outlier when its 95% confidence interval (CI) was outside the 95% CI of the overall mean effect size (on either side). We tested for statistical heterogeneity between studies using the  $I^2$  statistics, a measure of how much variance between studies can be attributed to differences between studies, beyond the expected chance (Higgins & Green, 2011). We used the  $I^2$  statistic to estimate the percentage of heterogeneity across the studies not attributable to random sample error alone. A value of 0% indicated no heterogeneity. Values of 25%, 50%, and 75% reflected low, moderate, and high degrees of heterogeneity, respectively (Higgins & Thompson, 2002). Significant heterogeneity was indicated by a significant Q-statistic ( $p < 0.05$ ), meaning that one or more variables were present that moderated the observed effect size.

Exploratory subgroup analyses were conducted to examine the moderating effects of the following variables: (i) population types: clinical and non-clinical; (ii) intervention: MPPI and MPPI combined with another therapy form; (iii) delivery mode: group intervention, individual therapy, and self-help; (iv) control group: active and non-active controls; (v) number of sessions: eight or less, more than eight; (vi) duration of program: eight weeks or less, more than eight weeks; (vii) quality rating: low quality (score of 0, 1, 2), moderate quality (score of 3, 4), high quality (score of 5, 6); (viii) region: Western or non-Western.

We assessed publication bias in the following ways. First, we created a funnel plot by plotting the overall mean effect size against study size. Absence of publication bias is present when there is a symmetric distribution of studies around the effect size, while a higher concentration of studies on one side of the effect size than on the other indicates publication bias (Sterne et al., 2008). Second, we calculated a fail-safe N, a formal test of funnel plot asymmetry, for each analysis. This fail-safe N indicates the number of unpublished non-

significant studies that would be required to lower the overall effect size below significance (Egger et al. 1997; Orwin, 1983). Findings were considered robust if the fail-safe  $N \geq 5k + 10$ , where  $k$  is the number of studies (Rosenberg, 2005). Third, we used the trim- and-fill method (Duval & Tweedie, 2000). This procedure imputes the effect sizes of missing studies and produces an adjusted effect size accounting for the missing studies.

## Results

### Study Selection

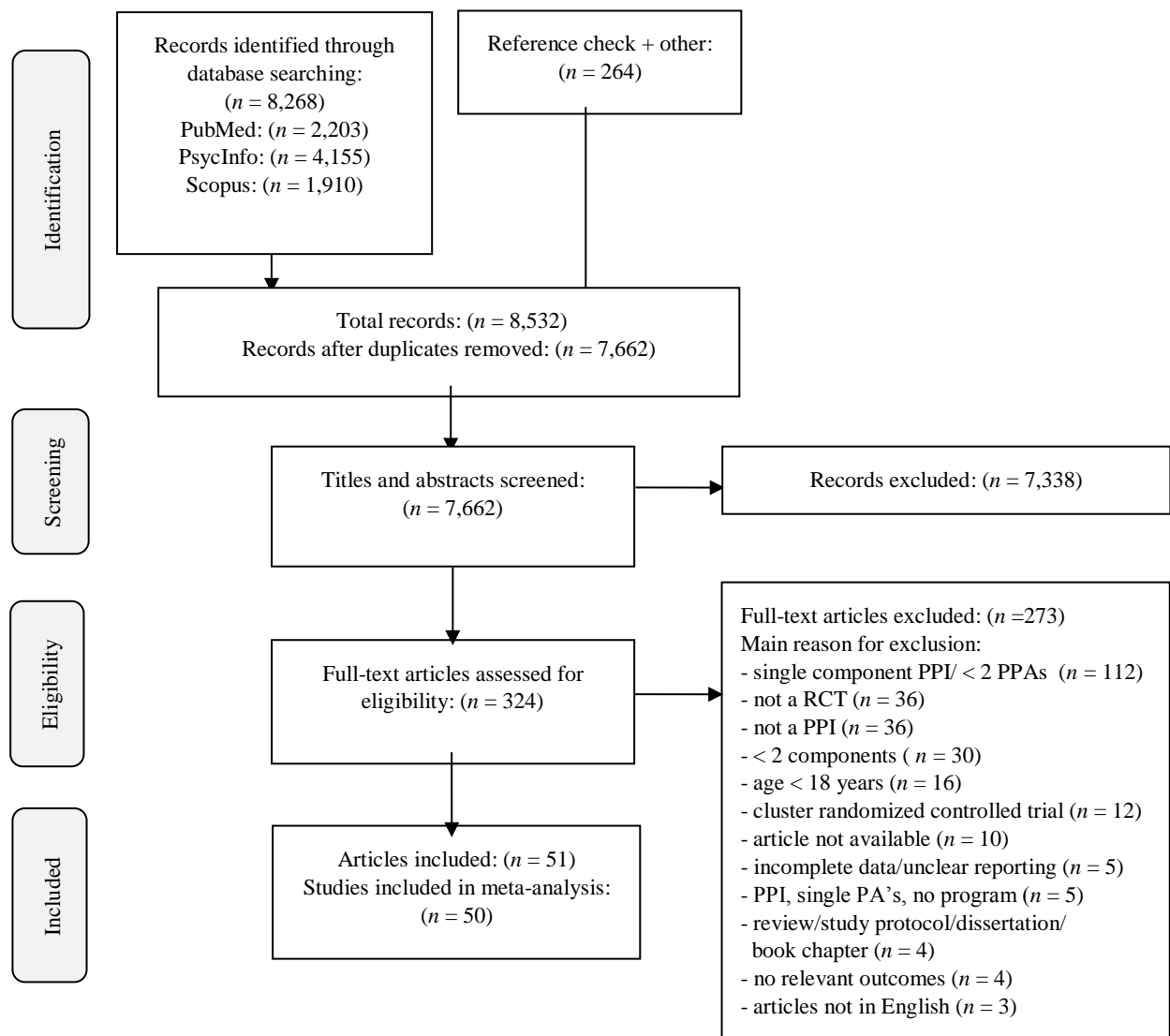
In total we found 8,532 records: 2,203 from PubMed, 4,155 from PsycINFO, 1,9610 from Scopus, 260 from searching reference lists and four studies were suggested by third parties. After removal of duplicates, 7,662 records remained for screening. Of these, we discarded 7,338 articles based on screening title and abstract that did not meet the inclusion criteria. We then assessed 324 full-text articles. Finally, 51 articles with a total of 50 studies met the inclusion criteria and were included in the meta-analysis. Results from one study was published in two articles (Asl et al., 2016; Asl et al., 2014), and two articles reported outcomes of two studies (Ivtzan et al., 2017; Seligman et al., 2006). Figure 1 displays the selection process in a flow diagram.

### Study Characteristics

The studies included a total of 6,141 participants at post measurement level. Sample sizes of the MPPI condition ranged from 8 to 450, with a median of 35. Twenty-four studies (48%) were conducted among clinical populations and 26 among non-clinical populations (52%). Delivery modes were group-based ( $n = 28$ , 43%), through self-help books/instructions by e-mail ( $n = 19$ , 41%) or online/web-based self-help applications ( $n = 16$ , 84%), and individual therapy ( $n = 3$ , 6%). Twenty-three control conditions (46%) were active control groups (placebo,  $n = 8$ , 16%; cognitive behavioral therapy,  $n = 6$ , 12%; treatment as usual,  $n = 6$ , 12%; mindfulness meditation,  $n = 2$ , 4% and dialectical behavioral therapy,  $n = 1$ , 2%).

Twenty-seven control conditions (54%) were non-active control groups (wait-list,  $n = 18$ , 36%; no intervention,  $n = 9$ , 18%). The number of sessions varied between 1 and 28, with an average of 8.6 sessions ( $SD = 5.73$ ). The duration of the MPPI varied between 1 day and 22 weeks, with an average of 8.1 weeks ( $SD = 3.88$ ). Two studies did not report the duration period. Twenty-two (44%) studies reported follow-up effects. The mean age of the participants in the intervention groups ( $n = 42$ ) was 39.7 years ( $SD = 13.07$ ). The average retention rate was 74% for the MPPI groups ( $n = 48$ ), and 79% for the control groups ( $n = 48$ ). The average percentage of female participants in the intervention groups was 67% ( $n = 44$ ). It should be noted that not all studies reported the exact age, retention rate or number of female participants. The main characteristics of the studies are presented in Table 1.

**Figure 1.** Results of literature search and selection process.



**Table 1. Main study characteristics of included studies of the meta-analyses of multicomponent positive psychology interventions**

First author, year, country	Condition of participants	Intervention type	Delivery	Control group	Sessions, duration	Follow Up	N post	Mean age/SD	% female*	Retention PPI Controls	Outcome measures
Antoine, 2017, France	Healthy adults	PPI	Self-help	NI	6, 6w	-	Ne = 45 Nc = 94	37.0	69.5 **	76% 63%	Dep: BDI, Anx: STAI
Asgharipoor, 2012, Iran	Patients with major depression	PPI	Group	CBT	6, 12w	-	Ne = 9 Nc = 9	26.4 (5.9)	72%	100% 100%	SWB: OHI; PWB: SWS pwb subscale Dep: BDI; Stress: SUDS
Asl, 2014, 2016, Iran	Infertile women	PPI	Group	Waitlist	6, 6w	-	Ne = 18 Nc = 18	30.5 (5.7)	100%	83% 89%	SWB: OHI Dep: BDI
Bolier, 2013, the Netherlands	Mildly depressed adults	PPI	Self-help: online,	Waitlist	6, 9w	4m	Ne = 143 Nc = 141	43.5 (11.7)	80%	66% 84%	SWB: MHC-SF ewb subscale, PWB: MHC-SF pwb subscale, Dep: CES-D, Anx: HADS-A
Cantarella, 2017, Italy	Elderly	PPI	Group	Placebo	6, 8 w	-	Ne = 16 Nc = 16	69.4 (6.6)	-	100%	SWB: WHO-QoL Brief, PWB: Ben-SSC
Carr, 2016, Ireland	Patients with major depression	PPI	Group	TAU	20, 20w	3m	Ne = 28 Nc=29	41.0	66%	70% 73%	Dep: BDI
Celano, 2017, USA	Patients with major depression	PPI	Self-help	CBT	6, 6w	6w	Ne = 29 Nc = 29	44.0 (10.0)	69%	97% 94%	SWB: PANAS Dep: QIDS-SR
Cerezo, 2015, Spain	Women with breast cancer	PPI	Group	Waitlist	14, 14w	-	Ne = 87 Nc = 88	50.0 (9.6)	100%	86% 83.0%	SWB: SWLS
Chaves, 2017, Spain	Women with major depression	PPI	Group	CBT	10, 10w	-	Ne = 34 Nc = 39	51.6 (10.4)	100%	72% 80%	SWB: SWLS; PWB: PWBS Dep: BDI; Anx: BAI
Cheung, 2016, USA	Women with breast cancer	PPI	Group	CBT	5, 5 w	1m	Ne = 14 Nc = 13	53.4 (11.2)	100%	71% 85%	SWB: DES Dep: CES-D
Cohn, 2014, USA	Adults with type 2 diabetes	PPI	Self-help: online	Placebo	8, 9w	-	Ne = 25 Nc = 17	54 (median)	51%	79%	SWB: PANAS Dep: CES-D; Stress: PSS
Cullen, 2015, UK	Adults with acquired brain injury (ABI)	PPI	Individual	TAU	8, 8w	11w	Ne = 10 Nc = 10	57 (median)	37%	71% 71%	SWB: AHI Dep, Anx, Stress: DASS-21
Dowlatabadi, 2016, Iran	Women with breast cancer	PPI	Group	NI	10, 10w	-	Ne=17 Nc=17	36.6 (5.5)	100%	76% 81%	SWB: OHI Dep: BDI
Drodz, 2014-a, Norway	Healthy adults	PPI	Self-help: online	Waitlist	13, 4w	5m	Ne = 108 Nc = 88	30.6 (8.4)	75%	96% 94%	SWB: PANAS
Drodz, 2014-b, Norway	HIV patients with depressive symptoms	PPI	Self-help: online	Waitlist	14, 5w	-	Ne = 36 Nc = 31	48.2 (9.3)	7.5%	72% 94%	SWB: SWS Dep: CES-D
Dyrbye, 2016, USA	Healthy adults	PPI	Self-help: online	NI	10, 10w		Ne = 145 Nc = 145	-	32%	94% 98%	SWB: Slas PWB: EWS, GJS/PJSC, WES
Feicht, 2013, Germany	Healthy adults	PPI	Self-help: online	Waitlist	21, 7w	4w	Ne = 72 Nc = 57	37.2 (9.0)	69%	94% 100%	SWB: VAS; PWB: FS Stress: SWSS

Gelfin, 2018, Israel	Healthy adults	PPI	Self-help: online	Waitlist	6, 6w	4w	Ne = 25 Nc = 29	36.0 (10.5) (all)	74% (all)	51% 71%	SWB: SHI, PPI, SWLS
Guo, 2016, China	Undergraduate students	PPI	Group	NI	8, 8	3m	Ne=34 Nc=42	20.4 (1.2)	95%	81% 98%	PWB: GSE Dep: BDI
Hausmann, 2017, USA	Adults with osteoarthritis	PPI	Self-help	Placebo	6, 6w	3m	Ne = 19 Nc = 19	69.2 (11.3)	19%	91% 91%	SWB: PANAS, SWLS
Hendriks, 2018, Suriname	Healthy Adults	PPI	Group	Waitlist	7, 7w	-	Ne = 80 Nc = 78	36.3 (9.6)	60%	91% 91%	SWB: MHC-SF- ewb subscale; PWB: MHC SF – pwb subscale, Dep, Anx, Stress: DASS-21
Huffman, 2011, USA	Patients with Acute Cardiovascular disease	PPI	Group	Relaxation	8, 8w	-	Ne = 9 Nc1 = 7 Nc2 = 7	-	-	90% 70% 70%	SWB: SHS Dep: CES-D Anx: HADS-A
Hwang, 2016, China	Student with depressive symptoms	PPI	Group	MM	12, 6w	-	Ne=8 Nc=8	22.7 (2.3)	67%	73% 73% 80%	SWB: SPANE PWB: FS
Ivtzan, 2016, UK	Healthy adults	PPI + MM	Self-help: online	Waitlist	8, 8w	1m	Ne = 53 Nc = 115	40.7 (11.3) 31.5 (13,5)	78% 57%	24% 53%	SWB: PHI; PWB: GSE, PWBS, MLQP, COS, APM Dep: BDI; Stress: PSS
Ivtzan, 2017, UK study 1	Healthy adults		Self-help	Waitlist	8, 8w		Ne = 22 Nc = 21	39.8 (15.2)	78%	39% 38%	SWB: PANAS-pa PWB: MLQ-P, SCS
Ivtzan, 2017, HK study 2	Healthy adults	PPI + MM	Self-help	Waitlist	8, 8w		Ne = 19 Nc = 17	24.3 (8.5)	39%	35% 31%	SWB: PANAS-pa PWB: MLQ-P, SCS
Joutsenniemi, 2014, Finland	Healthy adults	PPI	Self-help: e-mail based	Placebo	28, 13w	-	Ne = 417 Nc = 433	42.0	83%	40% 37% 42%	PWB: HFS Dep: BDI
Kahler, 2015, USA	Healthy adults, smoker	PPI	Group	TAU	6, 8w	26w	Ne = 35 Nc = 31	46.0 (13.4)	50%	94% 87%	SWB: CES D-pa Dep: CES-D
Khayatan, 2014, Iran	Women with Multiple Sclerosis	PPI	Group	NI	6,6w	-	Ne = 15 Nc = 15	31.1 (6.4)	100%	100% 100%	Dep: BDI
Koydemir, 2015, Turkey	University students	PPI	Self-help: online	Waitlist	5, 8w	-	Ne = 44 Nc = 36	18.7 (1.0)	48%	-	SWB: SHS PWB: WHOQOL ph/sr
Lü, 2013, China	Individuals with low trait positive affect	PPI	Group	NI	8, 8w	-	Ne = 16 Nc = 18	20.0 (4.3)	-	100% 100%	SWB: PANAS
Luthans, 2008, USA	Healthy adults	PPI + CBT	Self-help	Placebo	2, 2w	-	Ne = 187 Nc = 177	32.2	-	-	PWB: PCQ
Luthans, 2010, USA	Healthy adults	PPI + CBT	Group	CBT	1,1d	-	Ne = 153 Nc = 89	21.1	42%	-	PWB: PCQ
Mohammadi, 2018, Iran	Patients with heart disease	PPI	Group	Placebo	8, 8w	-	Nc = 31 Ne = 30	52.5 (5.4)	23%	97% 93%	SWB: OHI Dep: HADS-D, Anx: HADS-A
Moskowitz, 2017, USA	Adults with HIV	PPI	Individual	Placebo	6, 5m	5m	Ne= 74 Nc = 76	36.0 (9.9)	7.0%	73% 80%	SWB: DES Dep: CES-D

Müller, 2016, USA	Patients, various (muscular) diseases	PPI	Self-help	Placebo	4, 4-8w	2.5 m	Ne = 39 Nc = 38	59.4 (11.8)	70%	77% 85%	SWB: PANAS Dep: HADS-D
Myers, 2017, 2018, USA	Healthy adults	PPI	Self-help: online	TAU	7, 1m	1m	Ne = 90 Nc = 128	41.9 (11.8)	77%	69% 67%	PWB: I COPPE Scale
Neumeijer, 2018, Germany	Healthy adults	PPI	Group	Waitlist	7		Ne= 90 Nc = 128	41..2 (12.3)	67%	63% 89%	SWB: SHS, SAS
Nikrahan, 2016, Iran	Cardiac patients	PPI	Group	Waitlist	6, 6 w	8w	Ne = 32 Nc = 12	56.6 (8.7)	43%	78% 87%	SWB: OHI Dep: BDI
Page, 2013, Australia	Healthy adults	PPI	Group	NI	6,6w	6m	Ne = 18 Nc = 13	39.7 (10.0)	73%	58% 43%	SWB: SWLS, PANAS PWB: SPWB
Peters, 2017, the Netherlands	Patients with chronic pain	PPI	Self-help: online	CBT	8, 8w	6m	Ne = 85 Nc = 80	48.5 (12.0)	85%	73% 69% 80%	SWB: BMIS + other Dep: HADS-D Anx: HADS-A
Proyer, 2016, Switzerland	Healthy adults	PPI	Group	Waitlist	5, 12	1m	Ne = 50 Nc= 50	45.7 (12.8)	69%	33%	SWB: AHI PWB: OTH
Roepke, 2015, USA	Adults with depression symptoms	PPI + CBT	Self-help: phone based	Waitlist	1m	6w	Ne = 93 Nc = 93	40.1 (12.4)	70%	22% 19% 42%	SWB: SWLS Dep: CES-D Anx: GADS
Rogerson, 2016, USA	Healthy adults	PPI + CBT	Group	Waitlist	5, 5w	-	Ne = 14 Nc = 14	-	-	93% 100%	PWB: RAW
Sanjuan, 2016, Spain	Cardiac patients	PPI	Group	TAU	24, 8w	-	Ne = 57 Nc = 51	54.4 (9.1)	17%	88% 84%	SWB: PANAS Dep: SCL-90-R
Schotanus-Dijkstra, 2016, the Netherlands	Adults with low or moderate well-being	PPI	Self-help: e-mail support	Waitlist	8, 9w	6m	Ne = 137 Nc = 138	47.8 (10.9)	86%	89% 95%	SWB -MHC-SF- ewb subscale; PWB: MHC-SF, pwb subscale, Dep: HADS-D Anx: HADS-A Dep: CES-D
Schueller, 2012, USA	Self-help-seeking participants	PPI	Self-help: online	NI	6, 6w	-	Ne=151 Nc=204	-	-	47% 57%	Dep: CES-D
Seligman, 2006, USA, study 1	Students, mild depressive symptoms	PPI	Group	NI	6, 6w	3m	Ne = 19 Nc = 21	-	42%	-	SWB: SWLS Dep: BDI
Seligman, 2006, USA, study 2	Adults with major depressive disorder	PPI	Individual	TAU	14, 12w	-	Ne = 11 Nc1 = 9	-	69%	87% 60% 71%	SWB: SWLS PWB: PPTI Dep: HRSD
Uliaszek, 2016, Canada	University students	PPI + DBT	Group	DBT	12, 12w	-	Ne = 15 Nc = 22	22.2 (5.0),	78%	56% 85%	PWB: PPTI/; Dep/Anx: SCL-90-R D/A; Stress: DTS

**Abbreviations**

Anx = anxiety; CBT = Cognitive Behavioral Therapy; DBT = Dialectical Behavior Therapy; Dep = depression; MM = Mindfulness meditation; PPI = Positive psychology intervention; PWB = Psychological well-being; SWB = Subjective well-being. Abbreviations of questionnaires are listed in Appendix 3.

\* % of females at post-test, intervention and control groups, \*\* at baseline

### **Study Measures**

Outcomes that were classified as subjective well-being included happiness, emotional and subjective well-being, satisfaction with life, positive affect, quality of life, and well-being. Outcomes that were classified as psychological well-being included flourishing, authentic living, personal growth, meaning, autonomy, (work) engagement, psychological capital, environmental well-being, positive relations, purpose in life, and self-acceptance. All studies included at least one measure of a particular outcome.

In total, we found 39 studies that measured subjective well-being, 24 studies measured psychological well-being, 31 studies measured depression, 11 studies measured anxiety, and eight studies measured stress. An overview of the questionnaires that were used to measure the outcomes is shown in Appendix 3. Five studies included two measures for subjective well-being, which were pooled by the authors of the current meta-analysis (Cheung et al., 2017; Gelfin, Zohar, & Lev-Ari, 2018; Hausmann et al., 2017; Hendriks et al., 2018a; Mohammadi et al., 2018). Six studies (Chaves, Lopez-Gomez, Hervas, & Vazquez, 2017; Dyrbye et al., 2016; Ivtzan et al., 2016; Mohammadi et al., 2018; Myers et al., 2017; Rogerson, Meir, Crowley-McHattan, McEwen, & Pastoors, 2016) included two or more measures for psychological well-being that were pooled.

### **Quality Assessment**

The quality score of the studies ranged from one to six, the mean score was 3.22 (SD = 1.77). Thirteen studies were rated as high-quality studies (26%), with four studies (8%) meeting all the six quality criteria. Twenty-one studies (42%) were of moderate quality and 16 studies (32%) were rated as low-quality studies. Twenty-eight studies (56%) reported adequately how randomization took place. In 24 studies (48%), the allocation of the participants was concealed. In 29 studies (58%), the blinding of outcome assessment was described. An adequate description of drop-outs was provided in 37 studies (74%). Twenty-

two studies (44%) had a population size larger than 50 per allocated arm or the population size was based on a power calculation. Twenty-one studies (42%) analyzed outcomes on the basis of an intention-to-treat analysis or had zero drop-outs. The outcome of the quality assessment is shown in Table 2.

**Table 2.** Quality assessment of RCTs

Studies	SG	AC	BOA	DW	PA	ITT	Total	Quality
<i>Bolier, 2013</i>	1	1	0	1	1	1	5	High
<i>Celano, 2016</i>	1	1	1	1	0	1	5	High
<i>Drozd, 2014a</i>	1	1	1	1	1	1	6	High
<i>Dyrbye, 2016</i>	1	1	1	1	1	0	5	High
<i>Feicht, 2013</i>	1	1	1	1	1	0	5	High
<i>Hendriks, 2018</i>	1	1	1	1	1	1	6	High
<i>Ivtzan, 2016</i>	1	1	1	1	1	0	5	High
<i>Joutsenniemi, 2014</i>	1	1	1	1	1	1	6	High
<i>Kahler, 2015</i>	1	1	1	1	0	1	5	High
<i>Moskowitz, 2017</i>	1	0	1	1	1	1	5	High
<i>Myers, 2018</i>	1	1	1	0	1	1	5	High
<i>Roepke, 2015</i>	1	1	1	1	1	1	6	High
<i>Schotanus-Dijkstra, 2016</i>	1	0	1	1	1	1	5	High
<i>Carr, 2016</i>	0	0	1	1	0	1	3	Moderate
<i>Cerezo, 2014</i>	1	0	0	1	1	0	3	Moderate
<i>Chaves, 2016</i>	0	1	1	1	0	1	4	Moderate
<i>Cheung, 2018</i>	1	1	1	1	0	0	4	Moderate
<i>Cohn, 2014</i>	1	1	1	1	0	0	4	Moderate
<i>Cullen, 2015</i>	1	1	1	1	0	0	4	Moderate
<i>Drozd, 2014b</i>	0	1	0	1	0	1	3	Moderate
<i>Hausmann, 2017</i>	1	1	0	1	0	1	4	Moderate
<i>Ivtzan, 2017 study 1</i>	1	1	0	0	1	1	4	Moderate
<i>Ivtzan, 2017, study 2</i>	1	1	0	0	1	1	4	Moderate
<i>Luthans, 2008</i>	1	1	1	0	1	0	4	Moderate
<i>Mohammadi, 2018</i>	1	0	1	0	1	1	4	Moderate
<i>Müller, 2016</i>	1	0	1	1	0	0	3	Moderate
<i>Nikrahan, 2016</i>	1	0	1	1	0	0	3	Moderate
<i>Page, 2013</i>	0	1	0	1	1	1	4	Moderate
<i>Peters, 2017</i>	1	0	1	1	1	0	4	Moderate
<i>Proyer, 2016</i>	1	0	1	1	1	0	4	Moderate
<i>Rogerson, 2016</i>	1	0	1	1	0	0	3	Moderate
<i>Sanjuan, 2016</i>	1	0	1	1	0	0	3	Moderate
<i>Schueller, 2012</i>	0	1	1	1	1	0	4	Moderate
<i>Uliaszek, 2016</i>	0	0	1	1	0	1	3	Moderate
<i>Antoine, 2017</i>	0	0	0	1	1	0	2	Low
<i>Asgharipoor, 2012</i>	0	0	0	0	0	0	0	Low
<i>Asl, 2014/2016</i>	0	0	0	1	0	0	1	Low
<i>Canterella, 2017</i>	0	0	0	1	0	1	2	Low
<i>Dowlatabadi, 2016</i>	0	0	0	0	0	0	0	Low
<i>Gelfin, 2018</i>	0	0	0	0	0	0	0	Low
<i>Guo, 2016</i>	0	0	0	1	0	0	1	Low
<i>Huffman, 2011</i>	0	1	0	0	0	0	1	Low
<i>Hwang, 2016</i>	1	0	0	1	0	0	2	Low
<i>Khayatan, 2014</i>	0	0	0	0	0	0	0	Low
<i>Koydemir, 2015</i>	0	1	1	0	0	0	2	Low
<i>Lü, 2013</i>	0	0	0	1	0	0	1	Low
<i>Luthans, 2010</i>	0	0	0	0	1	0	1	Low



<i>Neumeijer, 2018</i>	0	0	0	1	1	0	2	Low
<i>Seligman, 2006 study 1</i>	0	0	0	0	0	0	0	Low
<i>Seligman, 2006 study 2</i>	0	0	1	1	0	0	2	Low

**Abbreviations:**

SG = Sequence generation; AC = Allocation concealment; BOA = Blinding of main outcome assessments;  
 DW = Description of withdrawals/ drop-outs; PA = Power analysis or N > 50; ITT = Intention-to-treat analysis/ 0 drop-outs

**Post-Treatment Effects of MPPI's**

We calculated post-treatment for the following outcomes: subjective well-being, psychological well-being, depression, anxiety, and stress. This was done for all studies, studies excluding outliers, and we also calculated the effects sizes for all outcomes excluding low quality studies. Follow-up effects including outliers were calculated for all outcomes except for stress. Follow-up effects excluding outliers was only calculated for subjective well-being and depression, due to the limited number of studies reporting follow-up effects on these outcomes. The main results are presented in Table 3.

**Table 3. Between – group effects**

Outcome measures	# studies	Hedge's g	95% CI	Z	Heterogeneity		Fail-safe N
					Q value	I <sup>2</sup>	
<i>All studies post-treatment</i>							
Subjective well-being	39	0.34	(0.18 - 0.50)	4.15***	191,28***	80.24	755
Psychological well-being	24	0.39	(0.23 - 0.55)	4.88***	102.44***	77.55	459
Depression	31	0.29	(0.14 - 0.45)	3.76***	131.35***	77.16	346
Anxiety	11	0.35	(0.23 - 0.48)	5.77***	12.19ns	17.94	92
Stress	8	0.35	(0.03 - 0.66)	2.16*	20.19**	65.32	24
<i>Studies post-treatment, excl. outliers</i>							
Subjective well-being	31	0.24	(0.15 - 0.33)	5.23***	40.16ns	25.29	-
Psychological well-being	18	0.35	(0.22 - 0.48)	5.31***	29,61**	42.59	-
Depression	28	0.21	(0.07 - 0.29)	3.10**	60.63***	55.47	-
Stress	7	0.49	(0.28 - 0.69)	4.66***	7.85ns	23.53	-
<i>Studies post-treatment, excl. low quality studies</i>							
Subjective well-being	26	0.26	(0.07 - 0.44)	2.76**	139.63***	82.10	-
Psychological well-being	17	0.31	(0.15 - 0.47)	3.78***	65.99***	75.75	-
Depression	21	0.14	(0.03 - 0.26)	2.43*	42.53**	52.97	-
Anxiety	9	0.33	(0.19 - 0.46)	4.79***	10,75ns	25,57	-
Stress	7	0.49	(0.28 - 0.69)	4.66***	7,85ns	23,53	-
<i>Follow-up effects</i>							
Subjective well-being	17	0.27	(0.07 - 0.48)	2.61**	56.80***	71.83	-
Psychological well-being	5	0.32	(0.01 - 0.63)	1.99*	19.91***	79.91	-
Depression	15	0.45	(0.15 - 0.76)	2.91**	88.29***	84.14	-
Anxiety	5	0.09	(-0.44 - 0.62)	0.33ns	36.23***	88.95	-

*Follow-up effects  
excl. outliers*

Subjective well-being	14	0.24	(0.15 - 0.37)	2.48*	33.26***	60.91	-
Depression	14	0.31	(0.07 - 0.54)	2.57*	43.88***	70.38	-

\*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$ ; ns: non-significant

Notes: for anxiety there were no outliers. Follow-up effects for stress and follow-up effects exclusive outliers for psychological well-being, anxiety, and stress were not calculated because there were less than 5 studies per category.

**Effects on Subjective Well-Being.** For subjective well-being, a significant small to moderate effect was observed ( $g = 0.34$ , 95% CI: 0.18 to 0.50,  $p < 0.001$ ) at post-treatment based on 39 comparisons. The effect sizes of the studies ranged from -0.86 to 2.26. Heterogeneity analysis revealed a significant and high level of heterogeneity ( $I^2 = 80.24$ ,  $Q = 192.27$ ,  $p < 0.001$ ). Removing eight outliers reduced both the effect size ( $g = 0.24$ , 95% CI: 0.15 to 0.33,  $p < 0.001$ ) and the heterogeneity, which was small ( $I^2 = 25.29$ ,  $Q = 40.16$ ,  $p < 0.001$ ). When low-quality studies were excluded, the effect size remained small ( $g = 0.26$ , 95% CI: 0.07 – 0.44,  $p < 0.01$ ) with a high level of heterogeneity ( $I^2 = 82.10$ ,  $Q = 139.63$ ,  $p < 0.001$ ). The forest plot in Figure 2 displays the post-treatment effects, including outliers.

**Effects on Psychological Well-Being.** For psychological well-being, a significant moderate effect was observed ( $g = 0.39$ , 95% CI: 0.23 to 0.55,  $p < 0.001$ ) at post-treatment based on 24 comparisons. Effect sizes ranged from to -0.44 to 1.58. Heterogeneity was significant and high ( $I^2 = 77.55$ ,  $Q = 102.44$ ,  $p < 0.001$ ) Removing six outliers reduced the effect size ( $g = 0.35$ , 95% CI: 0.22 to 0.48,  $p < 0.001$ ). After omitting outliers, heterogeneity was reduced to moderate ( $I^2 = 42.59$ ,  $Q = 29.61$ ,  $p < 0.05$ ). When studies of low quality were excluded, the effect size was reduced ( $g = 0.31$ , 95% CI: 0.15 to 0.47,  $p < 0.05$ ), with a significant moderate to high level of heterogeneity ( $I^2 = 75.75$ ,  $Q = 65.99$ ,  $p < 0.001$ ). The forest plot in Figure 3 displays the post-treatment effects

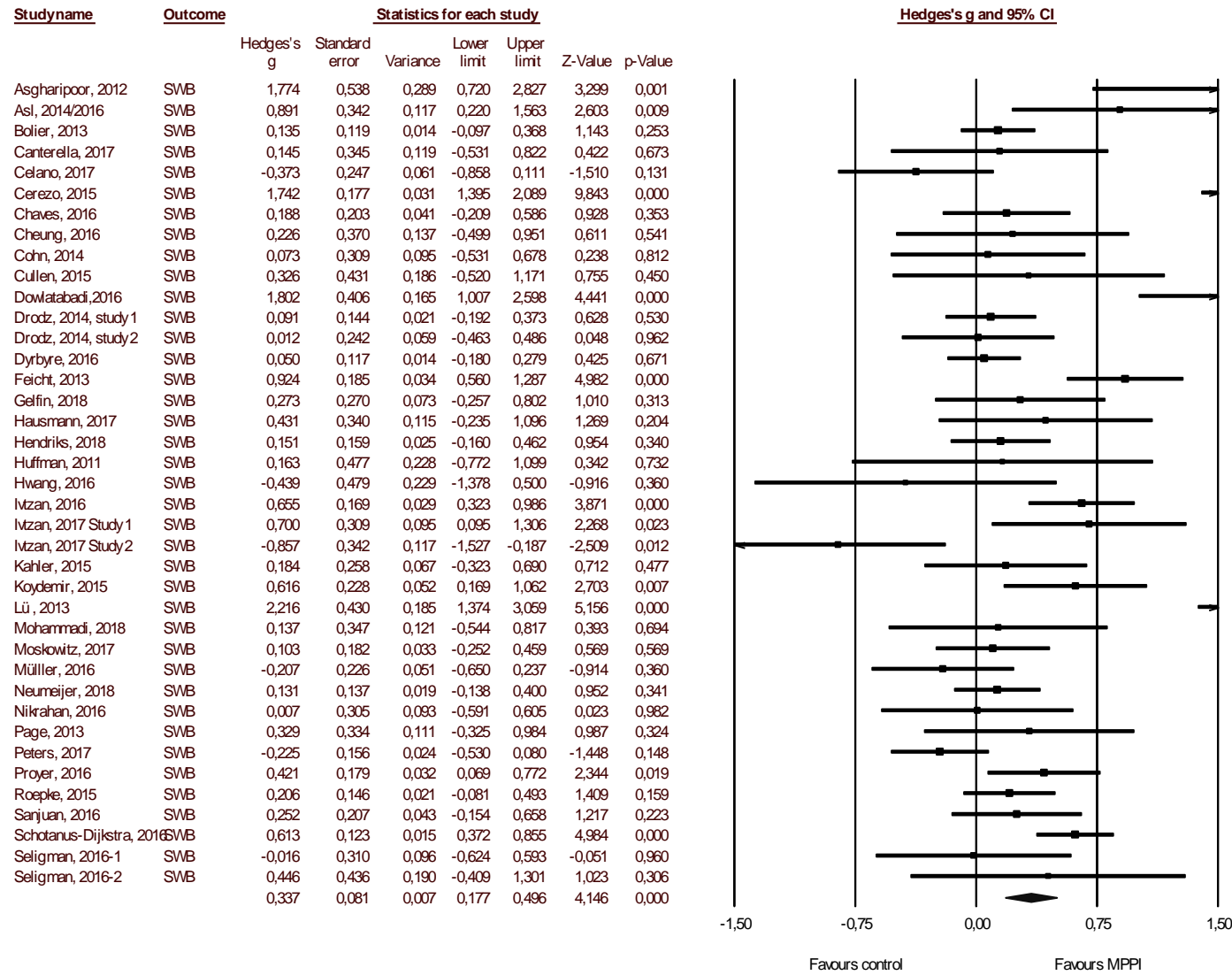


Figure 2. Post-test effects of MPPIs on subjective well-being (SWB), including outliers

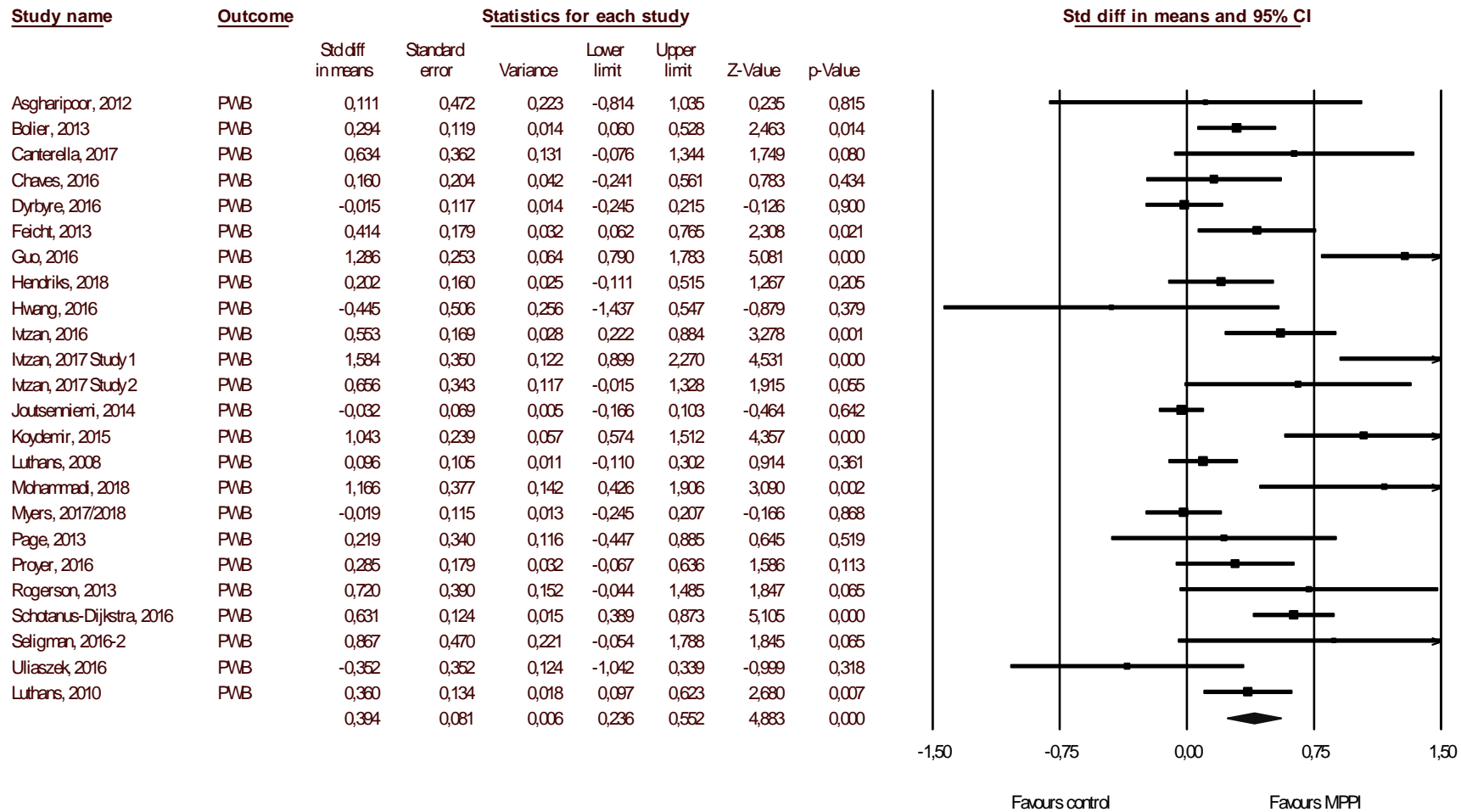


Figure 3. Post-test effects of MPPIs on psychological well-being (PWB), including outliers.

**Effects on Depression.** For depression (25 comparisons), a significant small effect was observed ( $g = 0.32$ , 95% CI: 0.13 to 0.51,  $p < 0.001$ ) at post-treatment. Effect sizes of studies ranged from -1.50 to 3.05. Heterogeneity was significant and high ( $I^2 = 80.55$ ,  $Q = 123.40$ ,  $p < 0.001$ ). Removing one outlier (Guo et al., 2016) reduced the effect size ( $g = 0.21$ , 95% CI: 0.07 to 0.36,  $p = 0.004$ ) and heterogeneity was moderate ( $I^2 = 65.16$ ,  $Q = 66.01$ ,  $p = 0.000$ ). When studies with a low quality were excluded, the effect size was no longer significant. The post-treatment effects are displayed in a forest plot in Figure 4.

**Effects on Anxiety.** For anxiety, a significant small to moderate effect was observed ( $g = 0.35$ , 95% CI: 0.23 to 0.48,  $p < 0.001$ ) at post-treatment based on 11 comparisons. Effect sizes of studies ranged from -0.70 to 1.16, and there were no outliers. The level of heterogeneity was not significant. When two low quality studies were excluded, the effect size was slightly reduced ( $g = 0.33$ , 95% CI: 0.19 to 0.46,  $p < 0.001$ ) and the heterogeneity remained insignificant. The forest plot in Figure 5 displays the post-treatment effects.

**Effects on Stress.** For stress, a significant small to moderate effect was observed ( $g = 0.35$ , 95% CI: 0.03 to 0.66,  $p < 0.05$ ) at post-treatment, based on 8 comparisons. Effect sizes of studies ranged from -2.25 to 1.89. Heterogeneity was low ( $I^2 = 20.19$ ,  $Q = 65.32$ ,  $p < 0.01$ ). When one outlier was removed, the effect size increased ( $g = 0.49$ , 95% CI: 0.28 - 0.69,  $p < 0.001$ ). Heterogeneity was no longer significant. When one low quality study was excluded, the effect size remained moderate ( $g = 0.48$ , 95% CI: 0.28 to 0.69,  $p < 0.001$ ) and the heterogeneity remained insignificant. The forest plot in Figure 6 displays the post-treatment effects.

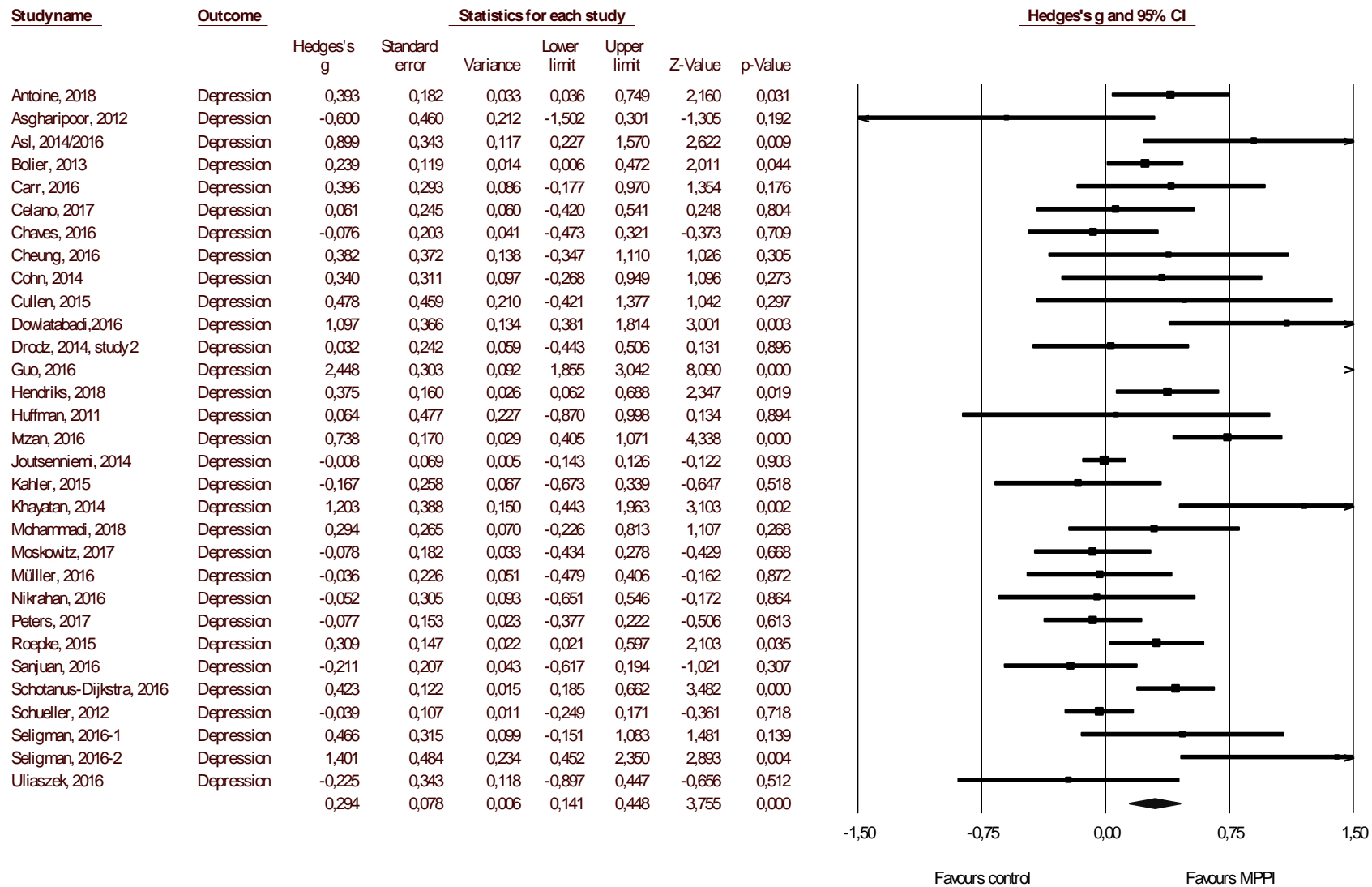


Figure 4. Post-test effects of MPPIs on depression, including outliers.

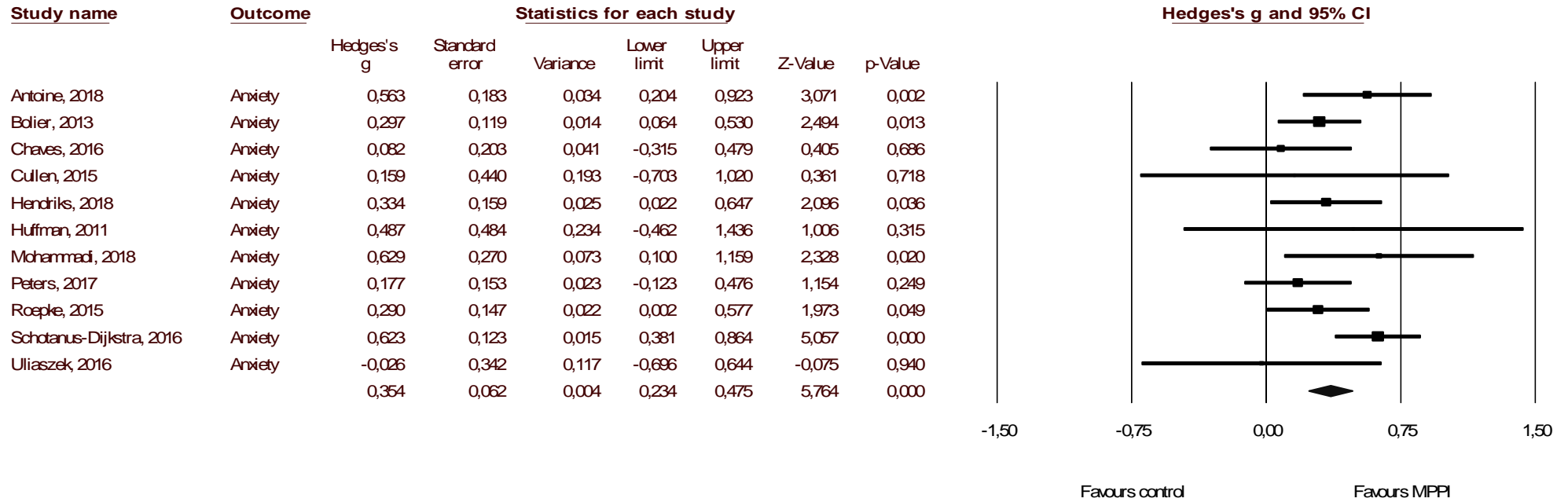


Figure 5. Post-test effects of MPPIs on anxiety, including outliers.

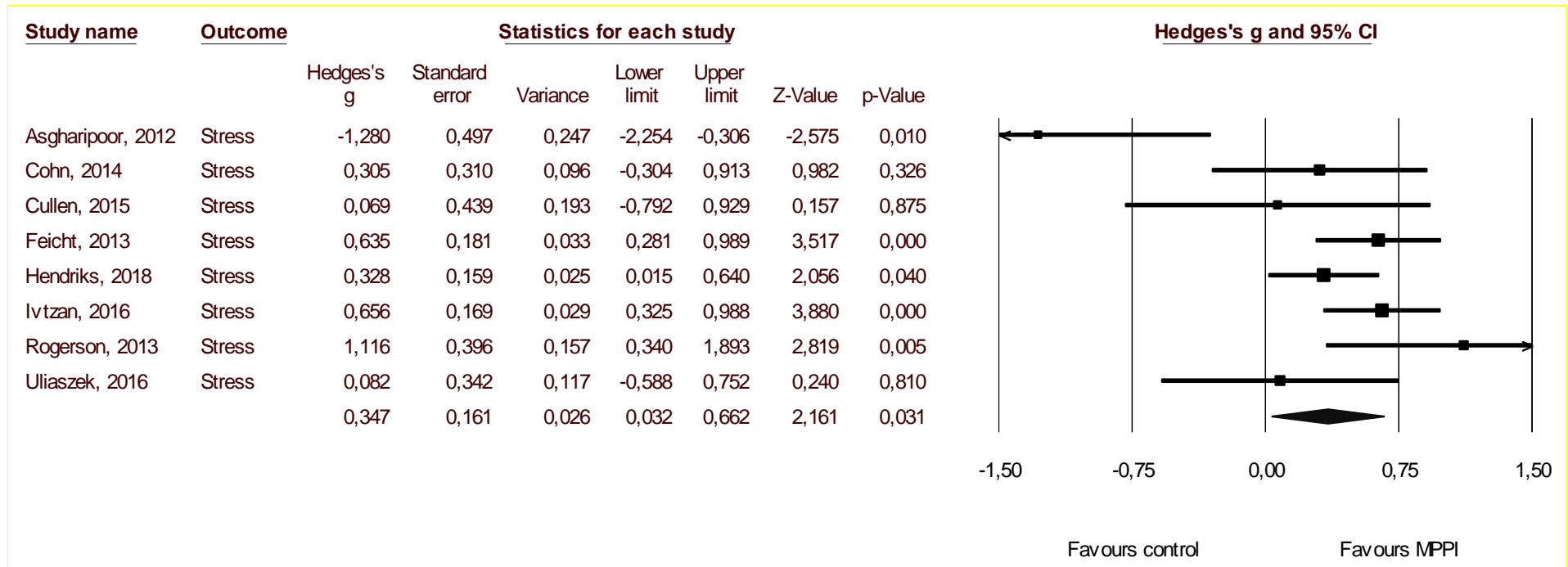


Figure 6. Post-test effects of MPPIs on stress, including outliers.



### Subgroup Analyses

We did not find any significant results for subjective well-being and psychological well-being. For depression, significant higher effect sizes were found for low quality studies compared to studies with a high quality. Studies of low quality ( $n = 10$ ) had a large effect size ( $g = 0.75$ , 95% CI: 0.47 to 1.04,  $p < 0.001$ ), whereas studies of high quality ( $n = 9$ ) had a small effect size ( $g = 0.22$ , 95% CI: 0.00 to 0.45,  $p < 0.01$ ).

In addition, the region of origin of the studies also had a significant moderating effect on this outcome: studies from non-Western countries ( $n = 8$ ) had a large effect size ( $g = 0.72$ , 95% CI: 0.41 to 1.03,  $p < 0.001$ ), whereas studies from Western countries ( $n = 23$ ) had a small effect size ( $g = 0.27$ , 95% CI: 0.01 to 0.33,  $p < 0.05$ ). All outcomes of the subgroup analyses are shown in Appendix 3.

### Publication Bias

The possibility of publication bias was determined for subjective well-being, psychological well-being, and depression because of the small number of studies included for anxiety and stress. We found some indications of publication bias, but the results were not conclusive. The funnel plots for subjective well-being, psychological well-being, and depression were somewhat asymmetrical, with a few more studies showing a positive outcome. However, the fail-safe numbers were higher for subjective well-being (755), psychological well-being (459), and depression (346) than required (205, 130, and 155 respectively). Contrary to the funnel plots, Egger's regression intercept was significant for psychological well-being (2.23,  $t = 2.96$ ,  $df = 22$ ,  $p < 0.01$ ) and depression (1.50,  $t = 2.06$ ,  $df = 29$ ,  $p < 0.05$ ), but not significant for subjective well-being (0.72,  $t = 0.79$ ,  $df = 37$ ,  $p = 0.43$ ). Finally, when possible missing studies were imputed using the Duval and Tweedie's trim-and-fill method, the adjusted effect sizes increased for subjective well-being ( $g = 0.45$ , 95% CI: 0.34 to 0.67), but decreased for psychological well-being ( $g = 0.24$ , 95% CI: 0.23 to 0.55).

and depression ( $g = 0.20$ , 95% CI: 0.17 to 0.48). In sum, potential missing publications may have influenced the results of the meta-analyses.

### **Follow-Up Effects**

Follow-up periods ranged from one month to twelve months. Analysis showed a significant small effect ( $g = 0.27$ , 95% CI: 0.07 to 0.48,  $p < 0.01$ ) for subjective well-being at follow-up measurement (17 comparisons). After removal of three outliers, the effect size decreased ( $g = 0.24$ , 95% CI: 0.05 to 0.43,  $p < 0.05$ ). The effects for depression at follow-up measurement (15 comparisons) were moderate ( $g = 0.45$ , 95% CI: 0.15 to 0.76,  $p < 0.01$ ), but this effect-size dropped to small after removing one outlier ( $g = 0.31$ , 95% CI: 0.07 to 0.54,  $p < 0.01$ ). The follow-up effect size for psychological well-being was also small ( $g = 0.32$ , 95% CI: 0.00 to 0.70,  $p < 0.05$ ). We did not calculate follow-up effect sizes for psychological well-being, anxiety, and stress due to the small number of studies reporting follow-up effects (5, 5, and 3 respectively).

## **Discussion**

### **Main Findings**

The aim of this study was to examine the efficacy of multi-component positive psychology interventions (MPPIs) across randomized controlled trials. Following a systematic literature search, we included 51 articles describing 50 studies on the effects of MPPIs in our meta-analysis. We conclude that over the past six years, there has been a sharp increase in the number of RCTs involving MPPIs. In comparison, a meta-analysis of PPIs by Bolier et al. (2013) that featured studies from 1998 to November 2012, included 34 single component PPIs and merely five MPPIs. Analyses of all studies suggest that MPPIs have small to moderate effect sizes for subjective well-being ( $g = 0.34$ ), psychological well-being ( $g = 0.39$ ), anxiety ( $g = 0.35$ ), and stress ( $g = 0.35$ ), and a small effect size for depression ( $g = 0.29$ ). After removing outliers, the effect sizes decreased for subjective well-being ( $g = 0.24$ ),

psychological well-being ( $g = 0.35$ ), and depression ( $g = 0.21$ ), but increased for stress ( $g = 0.49$ ). There were no outliers for anxiety. Removing low quality studies led to similar conclusions compared to the analyses without the low quality studies, in part because the outliers were often of low quality. Follow-up results showed small effects for subjective well-being ( $g = 0.27$ ), and psychological well-being ( $g = 0.32$ ). The effect size for depression increased to moderate ( $g = 0.45$ ), while the effect size for anxiety sharply dropped ( $g = 0.09$ ). Follow-up effects for stress were not calculated due to the limited amount of studies that included follow-up assessments.

Our findings on subjective well-being, psychological well-being, and depression are in line with two previous meta-analyses of RCT's on the effect of PPIs. Bolier et al. (2013) reported small effects on these outcomes, and a recent meta-analysis by Chakhssi et al. (2018) in clinical samples with psychiatric or somatic disorders, also reported small effects on well-being and depression. According to the Synergistic Change Model (Rusk et al., 2017) lasting positive change as a result of a PPI, is most likely to occur when interventions are targeted at multiple domains of positive functioning. The model suggests that targeting multiple domains decreases the risk of relapse and increases the likelihood of spill-over effects and synergy between the various activities. We expected to find higher effect sizes for all outcomes well-being and depression, since MPPIs target multi-domains of positive functioning. Although larger effect sizes on subjective well-being, psychological well-being, and depression were not found, compared to the studies of Bolier et al. (2013) and Chakhssi et al. (2018), the effect sizes were still of small to moderate magnitude. Our meta-analysis is the first that found promising results for PPIs on anxiety, and stress in particular. Still, the total number of studies that reported on these outcomes was limited, so caution is warranted when drawing conclusions on the effects of MPPIs on anxiety and stress.

Explorative subgroup analyses revealed mainly no significant results, indicating that we could not identify study or intervention characteristics that led to more or less effectivity of MPPIs. We only found that two moderators may have influenced the outcomes on depression. Low quality studies had a significant higher effect size than moderate or high quality studies. Our finding that studies of lower quality have a higher effect size on depression is in line with the findings of the meta-analysis of Bolier et al. (2013). However, they reported a higher effect size for low quality studies compared to studies from moderate quality, rather than studies of high quality. In addition, Bolier and colleagues also reported significant higher effects for low quality studies compared to moderate quality studies on subjective well-being and psychological well-being, whereas we did not. The meta-analysis by Chakhssi et al. (2018) reported a significant moderating effect of study quality only for well-being, and not for depression. Differences can be explained by the fact that all meta-analyses used different criteria to measure quality. Bolier and colleagues assessed the study quality on five criteria, of which two criteria differed from the criteria that were used in our study, whereas Chakhssi and colleagues used six criteria, of which five were the same as the criteria we used.

In addition, we found that the region of origin of the studies had a significant moderating effect on depression: studies from non-Western countries reported higher effect sizes than studies from Western countries. Differences in effect sizes between Western and non-Western countries are possibly confounded by study quality, because six of the ten low-quality studies on depression were from non-Western countries. The findings in relation to the lower quality of studies from non-Western countries and possible large effect sizes are in line with a meta-analysis that we recently conducted on the efficacy of PPIs from non-Western countries (Hendriks et al., 2018c). This study, that included 28 RCTs, showed that PPIs from non-Western countries have moderate effect sizes on well-being, and large effects on

depression and anxiety. Quality analysis, using the same six criteria that were used in this current study, revealed a mean quality score of 1.79 (SD = 1.7), indicating a low quality. The quality analysis of the current meta-analysis showed that non-Western studies had a mean rating score of 1.89 (SD = 1.8), compared to a mean rating score of 3.62 (SD = 1.5) for Western countries. This difference was significant ( $p < 0.05$ ). Lower quality may contribute to higher effect sizes. An important aspect is sample size. Prior studies have shown that trials with small sample sizes tend to overestimate effect sizes (Slavin & Smith, 2009; Zhang et al., 2013). Our analyses showed that the intervention groups in the studies from non-Western countries had much smaller sample sizes (mean = 27), than the groups in the studies from Western countries (mean = 71).

### **Strengths and Limitations**

One of the strengths of this meta-analysis is its methodological rigor. It was conducted according to The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines for systematic reviews and meta-analyses (Moher et al., 2010, Moher, Liberati, Teztlaff, & Altman, 2009) and the recommendations of the Cochrane Back Review group (Higgins et al., 2011). Another strength is the differentiation of the intervention by region. In general, PPI studies from non-Western countries tend to report larger effect-size than studies from Western countries. Our moderator analysis showed the moderating effect is significant for depression. This finding may contribute to a better understanding of the moderating effect of the region on the efficacy of PPIs, or at least to a broader examination on the possible reasons why there are differences. We recommend that other researchers further examine the relationship between the ethnic/cultural background of the participants and the outcomes of interventions.

We believe there are several limitations related to the findings of this study. First, there is a relatively small number of studies on anxiety ( $n = 11$ ) and stress ( $n = 8$ ). In order to

draw firmer conclusions on the effects of MPPIs on these outcomes, more RCTs are needed. Second, there is also a limited number of studies for all subgroups. For example, while for psychological well-being there were 18 studies conducted among non-clinical populations, we only found six studies among clinical populations that measured the effects of the MPPIs. With such a small sample of studies, definite conclusions on the effects of MPPI on psychological well-being among the clinical population cannot be drawn. With a limited number of studies and, on average, a high level of heterogeneity, the impact of excluding a single study could also have a high impact. This was illustrated in our findings for stress: based on eight studies we found an effect size of  $g = 0.35$  (a small to moderate effect).

However, after removing one outlier (of low quality) the effect size for stress increased to  $g = 0.49$  (moderate effect). The third limitation applies to the quality of the studies, or better said: the lack thereof. Only 26% of the studies could be classified as high-quality studies ( $n = 13$ ), 42% of the studies ( $n = 21$ ) were classified as moderate, and 32% of the studies were classified as low-quality studies ( $n = 16$ ). The main reasons for the lack of quality are the omission of randomization procedures (52% of the studies), the failure to state whether or not allocation of the participants was concealed (52%), and the failure to state whether or not the outcome assessment was blinded (42%). Furthermore, 29 studies (58%) conducted completers-only analyses, as opposed to intention-to-treat analyses, thereby increasing the risk of selection bias (Yelland et al., 2015). Another aspect is that the majority of the studies is weakly powered: 28 of the 50 studies (56%) had a population less than 50 participants per condition. Twenty-two studies (44%) even had less than 30 participants in the intervention group. Studies with low power have a weak predictive value, have a low probability of finding an effect or exaggerate the magnitude of the effect when an effect is discovered (Button et al., 2013, Slavin & Smith, 2009).

### **Conclusion and Implications**

Despite the limitations, we conclude that MPPIs have a small effect on subjective well-being and depression, and a small to moderate effect on psychological well-being, and possibly anxiety and stress. However, the limitations also warrant some implications for future research. Firstly, there is a need for a more rigorous methodological approach in studies in the field of positive psychology, which should lead to higher quality studies. This recommendation is a reoccurring one, which have been stated in some previous PPI meta-analyses as well (Bolier et al., 2013; Weiss, Westerhof, & Bohlmeijer, 2016). Considering the explicit call for more rigorous research methods to study well-being which is often heard in positive psychology (Diener, 2009; Froh, 2004; Linley & Joseph, 2004; Linley et al., 2006), we recommend that future studies should at least be based on a power-analysis to avoid the risk that clinical trials fail to detect meaningful differences (Adams-Huet & Ahn, 2009), or include a minimum of 50 participants per condition.

We also highly recommend that future studies pay more attention to methodological reporting and follow protocols guidelines such as the CONSORT (Moher et al., 2010) or the Standard Protocol Items: Recommendations for Interventional Trials (SPIRIT) guidelines (Chan et al., 2013). In light of the growing number of RCTs from non-Western countries, this recommendation particular applies to studies from such countries, since nine of the eleven non-Western studies we included had a low study quality rating. Secondly, due to the high heterogeneity of the studies it was not possible to determine the optimal conditions under which studies could maximize their efficacy, for example the most effective intervention period or number of sessions. In conclusion, our findings show for the first time the overall efficacy of MPPIs and the subgroup analyses contribute to a better understanding of the effectiveness of MPPIs. Future studies among of higher quality and more diverse populations could enrich the field of positive psychology and mental health and contribute to more insight into the optimal conditions to design the most effective positive psychology interventions.

**Competing Interests**

The authors declare that they have no competing interests.

**Authors' Contributions**

The meta-analyses and data-analyses were conducted by TH, who also wrote the manuscript.

The literature search was conducted by TH and MS, the risk of bias analysis was conducted by TH and AH. JdJ was an advisor in the project. EB was the editor of the article. All authors contributed to the writing of the manuscript and approved the final manuscript.



### References

\*Studies preceded by an asterisk were included in the systematic review and meta-analysis.

Adams-Huet, B., & Ahn, C. (2009). Bridging Clinical Investigators and Statisticians. *Journal of Investigative medicine*, 57(8), 818-824.

Alden, L. E., & Trew, J. L. (2013). If it makes you happy: Engaging in kind acts increases positive affect in socially anxious individuals. *Emotion*, 13(1), 64-75.

\*Antoine, P., Dauvier, B., Andreotti, E., & Congard, A. (2018). Individual differences in the effects of a positive psychology intervention: Applied psychology. *Personality and Individual Differences*, 122, 140-147.

\*Asgharipoor, N., Farid. A. A., Arshadi, H., & Sahebi. A. (2012). A comparative study on the effectiveness of positive psychotherapy and group cognitive-behavioral therapy for the patients suffering from major depressive disorder. *Iranian Journal of Psychiatry and Behavioral Sciences*, 6(2), 33-41.

\*Asl, S. T. S., Sadeghi, K., Bakhtiari, M., Ahmadi, S. M., Anamagh, A. N., & Khayatan, T. (2016). Effect of group positive psychotherapy on improvement of life satisfaction and the quality of life in infertile woman. *International Journal of Fertility and Sterility*, 10(1), 105-112.

\*Asl, S. T. S., Sadeghi, K., Bakhtiari, M., Khazaie, H., Rezaei, & Ahmadi, S. M. (2014). (2014). The effectiveness of group positive psychotherapy on improving the depression and increasing the happiness of the infertile women: clinical trial. *European Journal of Experimental Biology*, 4(3), 269-275.

\*Bolier, L., Haverman, M., Kramer, J., Westerhof, G. J., Riper, H., Walburg, J. A., . . . Bohlmeijer, E. T. (2013). An Internet-based intervention to promote mental fitness for mildly depressed adults: randomized controlled trial. *Journal of Medical Internet Research*, 15(9).

- Bolier, L., Haverman, M., Westerhof, G. J., Riper, H., Smit, F., & Bohlmeijer, E. T. (2013). Positive psychology interventions: a meta-analysis of randomized controlled studies. *BMC Public Health, 13*, 119.
- Buchanan, K. E., & Bardi, A. (2010). Acts of kindness and acts of novelty affect life satisfaction. *Journal of Social Psychology, 150*, 235–237.
- Button, K. S., Ioannidis, J. P., Mokrysz, C., Nosek, B. A., Flint, J., Robinson, E. S., & Munafò, M. R. (2013). Power failure: why small sample size undermines the reliability of neuroscience. *Nature Reviews Neuroscience, 14*(5), 365-376.
- \*Cantarella, A., Borella, E., Marigo, C., & De Beni, R. (2017). Benefits of well-being training in healthy older adults. *Applied Psychology: Health and Well-Being, 9*(3), 261-284.
- \*Carr, A., & Finnegan, L. (2015). The Say 'Yes' to Life (SYTL) program: A positive psychology group intervention for depression. *Journal of Contemporary Psychotherapy 45*(2): 109-118.
- Casellas-Grau, A., Font, A. & Vives, J. (2014). Positive psychology interventions in breast cancer. A systematic review. *Psychooncology, 23*, 9–19.
- \*Celano, C., Beale, E., Mastromauro, C., Stewart, J., Millstein, R., Auerbach, R., & Huffman, J. (2016). Psychological interventions to reduce suicidality in high-risk patients with major depression: a randomized controlled trial. *Psychological Medicine, 1-12*.
- \*Cerezo, M. V., Ortiz-Tallo, M., Cardenal, V., & De La Torre-Luque, A. (2014). Positive psychology group intervention for breast cancer patients: a randomised trial. *Psychological Reports, 115*(1), 44-64.
- Chakhssi, F., Kraiss, J. T., Sommers-Spijkerman, M., & Bohlmeijer, E. T. (2018). The effect of positive psychology interventions on well-being in clinical populations: A systematic review and meta-analysis. *BMC Psychiatry, 18*(1), 211.

- Chan, A. W., Tetzlaff, J. M., Gøtzsche, P. C., Altman, D. G., Mann, H., Berlin, J. A., ... & Krleža-Jerić, K. (2013). SPIRIT 2013 explanation and elaboration: guidance for protocols of clinical trials. *BMJ*, *346*, e7586.
- \*Chaves, C., Lopez-Gomez, I., Hervas, G., & Vazquez, C. (2017). A comparative study on the efficacy of a positive psychology intervention and a cognitive behavioral therapy for clinical depression. *Cognitive Therapy and Research*, *41*(3), 417-433.
- \*Cheung, E. O., Cohn, M. A., Dunn, L. B., Melisko, M. E., Morgan, S., Penedo, F. J., . . . Moskowitz, J. T. (2017). A randomized pilot trial of a positive affect skill intervention (lessons in linking affect and coping) for women with metastatic breast cancer. *Psycho-Oncology*, *26*(12), 2101-2108.
- \*Cohn, M. A., Pietrucha, M. E., Saslow, L. R., Hult, J. R., & Moskowitz, J. T. (2014). An online positive affect skills intervention reduces depression in adults with type 2 diabetes. *The Journal of Positive Psychology*, *9*(6), 523-534.
- Cuijpers, P. (2016). *Meta-analyses in mental health research. A practical guide*. Amsterdam: Vrije Universiteit Amsterdam.
- \*Cullen, B., Pownall, J., Cummings, J., Baylan, S., Broomfield, N., Haig, C., & Evans, J. J. (2016). Positive PsychoTherapy in ABI Rehab (PoPsTAR): a pilot randomised controlled trial. *Neuropsychological rehabilitation*, *28*(1), 17-33.
- DeSteno, D., Li, Y., Dickens, L., & Lerner, J. S. (2015). Gratitude: A tool for reducing economic impatience. *Psychological Science*, *25*(6), 1262–1267.
- Dickens, L. R. (2017). Using gratitude to promote positive change: A series of meta-analyses investigating the effectiveness of gratitude interventions. *Basic and Applied Social Psychology*, *39*(4), 193-208.
- Diener, E. (2009). *The science of well-being: The collected works of Ed Diener* (Vol. 37): Springer Science & Business Media.

- Digdon, N., & Koble, A. (2011). Effects of constructive worry, imagery distraction, and gratitude interventions on sleep quality: A pilot trial. *Applied Psychology: Health and Well-Being*, 3(2), 193-206.
- Donaldson, S. I., Dollwet, M., & Rao, M. A. (2015). Happiness, excellence, and optimal human functioning revisited: Examining the peer-reviewed literature linked to positive psychology. *The Journal of Positive Psychology*, 10(3), 185-195.
- \*Dowlatabadi, M. M., Ahmadi, S. M., Sorbi, M. H., Beiki, O., Razavi, T. K., & Bidaki, R. (2016). The effectiveness of group positive psychotherapy on depression and happiness in breast cancer patients: A randomized controlled trial. *Electronic Physician*, 8(3), 2175.
- \*Drozd, F., Mork, L., Nielsen, B., Raeder, S., & Bjørkli, C. A. (2014). Better Days—A randomized controlled trial of an internet-based positive psychology intervention. *The Journal of Positive Psychology*, 9(5), 377-388.
- \*Drozd, F., Skeie, L. G., Kraft, P., & Kvale, D. (2014). A web-based intervention trial for depressive symptoms and subjective well-being in patients with chronic HIV infection. *AIDS care*, 26(9), 1080-1089.
- Duval, S., & Tweedie, R. (2000). Trim and fill: a simple funnel-plot-based method of testing and adjusting for publication bias in meta-analysis. *Biometrics*, 56(2), 455-463.
- \*Dyrbye, L. N., West, C. P., Richards, M. L., Ross, H. J., Satele, D., & Shanafelt, T. D. (2016). A randomized, controlled study of an online intervention to promote job satisfaction and well-being among physicians. *Burnout Research*, 3(3), 69-75.
- Egger, M., Smith, G. D., Schneider, M., & Minder, C. (1997). Bias in meta-analysis detected by a simple, graphical test. *BMJ*, 315(7109), 629-634.
- \*Feicht, T., Wittmann, M., Jose, G., Mock, A., Hirschhausen, E. von, & Esch, T. (2013). Evaluation of a seven-week web-based happiness training to improve psychological

- well-being, reduce stress, and enhance mindfulness and flourishing: A randomized controlled occupational health study. *Evidence-Based Complementary and Alternative Medicine*, Article ID 676953.
- Froh, J. J. (2004). The history of positive psychology: Truth be told. *NYS psychologist*, *16*(3), 18-20.
- Gable, S. L., & Haidt, J. (2005). What (and Why) Is Positive Psychology? *Review of General Psychology*, *9*(2), 103–110.
- \*Gelfin, M., Zohar, A. H., & Lev-Ari, L. (2018). Personality Change and Therapeutic Gain: Randomized Controlled Trial of a Positive Psychology Intervention. *International Journal of Psychology and Psychological Therapy*, *18*(2), 193-205.
- Gosling, S. D., Sandy, C. J., John, O. P., & Potter, J. (2010). Wired but not WEIRD: The promise of the Internet in reaching more diverse samples. *Behavioral and Brain Sciences*, *33*(2-3), 94-95.
- \*Guo, Y.-F., Zhang, X., Plummer, V., Lam, L., Cross, W., & Zhang, J. P. (2016). Positive psychotherapy for depression and self-efficacy in undergraduate nursing students: A randomized, controlled trial. *International Journal of Mental Health Nursing*, *26*(4), 375-383
- Hart, K. E., & Sasso, T. (2011). Mapping the contours of contemporary positive psychology. *Canadian Psychology*, *52*(2), 2–92.
- \*Hausmann, L. R., Youk, A., Kwoh, C. K., Ibrahim, S. A., Hannon, M. J., Weiner, D. K., . . . Parks, A. (2017). Testing a positive psychological intervention for osteoarthritis. *Pain Medicine*, *18*(10), 1908-1920.
- Hendriks, T. (2018a). Positive psychology interventions in a multi-ethnic and cross-cultural context. Doctoral dissertation. University of Amsterdam, Amsterdam, The

Netherlands. Retrieved from

<http://www.uva.nl/en/profile/h/e/t.hendriks2/t.hendriks2.html>

Hendriks, T., Schotanus-Dijkstra, M., Hassankhan, A., Graafsma, T., Bohlmeijer, E. T., & de Jong, J. (2018b). The efficacy of non-Western positive psychology interventions: a meta-analysis and systematic review. *International Journal of Wellbeing*, 8(1), 71-98.

Hendriks, T., Warren, M. A., Schotanus-Dijkstra, M., Hassankhan, A., Graafsma, T., Bohlmeijer, E. T., & de Jong, J. (2018c). How WEIRD are positive psychology interventions? A bibliometric analysis of randomized controlled trials on the science of well-being. *The Journal of Positive Psychology*, 1-13.

Higgins, J., & Thompson, S. G. (2002). Quantifying heterogeneity in a meta-analysis. *Statistics in Medicine*, 21(11), 1539-1558.

Higgins, J. P., & Green, S. (2011). *Cochrane handbook for systematic reviews of interventions* (Vol. 4): John Wiley & Sons.

Higgins, J. P. T., Altman, D. G., Gøtzsche P. C., Jüni, P., Moher, D., Oxman, A. D., Savovic, J., Schulz, K. F., Weeks, L., & Sterne, J. A. C. (2011). The Cochrane Collaboration's tool for assessing risk of bias in randomized trials. *BMJ*, 343, d5928.

\*Huffman, J. C., Mastromauro, C. A., Boehm, J. K., Seabrook, R., Fricchione, G. L., Denninger, J. W., & Lyubomirsky, S. (2011). Development of a positive psychology intervention for patients with acute cardiovascular disease. *Heart International*, 6(e13), 47-54.

\*Hwang, K., Kwon, A., & Hong, C. (2016). A preliminary study of new positive psychology interventions: Neurofeedback-aided meditation therapy and modified positive psychotherapy. *Current Psychology*, 36(3), 683-695.

- Isik, S., & Erguner-Tekinalp, B. (2017). The effects of gratitude journaling on Turkish first year college students' college adjustment, life satisfaction and positive affect. *International Journal for the Advancement of Counselling, 39*(2), 164-175.
- \* Ivtzan, I., Young, T., Martman, J., Jeffrey, A., Lomas, T., Hart, R., & Eiroa-Orosa, F. J. (2016). Integrating mindfulness into positive psychology: A randomised controlled trial of an online positive mindfulness program. *Mindfulness, 7*(6), 1396-1407.
- \* Ivtzan, I., Young, T., Lee, H. C., Lomas, T., Daukantaitė, D., & Kjell, O. N. (2018). Mindfulness based flourishing program: A cross-cultural study of Hong Kong Chinese and British participants. *Journal of Happiness Studies, 19*(8), 2205-2223.
- \*Joutsenniemi, K., Kaattari, C., Härkänen, T., Pankakoski, M., Langinvainio, H., Lönnqvist, J., Mattila, A.S., & Mustonen, P. (2014). E-mail-based exercises in happiness, physical activity and readings: A randomized trial on 3274 Finns. *Journal of Psychiatry, 17*(6), 1000140.
- \*Kahler, C. W., Spillane, N. S., Day, A. M., Cioe, P. A., Parks, A., Leventhal, A. M., & Brown, R. A. (2015). Positive Psychotherapy for smoking cessation: A pilot randomized controlled trial. *Nicotine & Tobacco Research, 13*85–1392.
- \*Khayatan, T., Azkhosh, M., Bahmani, B., Azimian, M., & Dolatshahi, B. (2014). Group positive psychotherapy and depression of females affected by multiple sclerosis. *Iranian Rehabilitation Journal, 12*(22), 49-53.
- Kim, H., Doiron, K. M., Warren, M. A., & Donaldson, S. I. (2018). The international landscape of positive psychology research: A systematic review. *International Journal of Wellbeing, 8*(1), 50-70.
- \*Koydemir, S., & Sun-Selisik, Z. (2016). Well-being on campus: Testing the effectiveness of an online strengths-based intervention for first year college students. *British Journal of Guidance & Counselling, 44*(4), 434-446.

- \*Koydemir, S., & Sun-Selisik, Z. (2016). Well-being on campus: Testing the effectiveness of an online strengths-based intervention for first year college students. *British Journal of Guidance & Counselling, 44*(4), 434-446.
- Lau, R. W., & Cheng, S. T. (2011). Gratitude lessens death anxiety. *European Journal of Ageing, 8*(3), 169-175.
- Linley, P. A., & Joseph, S. (2004). Applied positive psychology: a new perspective for professional practice. In P. A. Linley, & Joseph, S. (Ed.), *Positive psychology in practise* (pp. 3-14). New Jersey: John Wiley & Sons, Inc.
- Linley, P. A., Joseph, S., Harrington, S., & Wood, A. M. (2006). Positive psychology: Past, present, and (possible) future. *The Journal of Positive Psychology, 1*(1), 3–16.
- Lipsey, M. W., & Wilson, D. B. (1993). The efficacy of psychological, educational, and behavioral treatment: Confirmation from meta-analysis. *American Psychologist, 48*, 1181-1209.
- \*Lü, W., Whang, Z., & Liu, Y. (2013). A pilot study on changes of cardiac vagal tone in individuals with low trait positive affect: The effect of positive psychotherapy. *International Journal of Psychophysiology, 88*, 213–217.
- \*Luthans, F., Avey, J. B., & Patera, J. L. (2008). Experimental analysis of a web-based training intervention to develop positive psychological capital. *Academy of Management Learning & Education, 7*(2), 209-221.
- \*Luthans, F., Avey, J. B., Avolio, B. J., & Peterson, S. J. (2010). The development and resulting performance impact of positive psychological capital. *Human Resource Development Quarterly, 21*, 41–67.
- Macaskill, A. (2016). Review of positive psychology applications in clinical medical populations. *Healthcare, 4*(66).



- \*Mohammadi, N., Aghayousefi, A., Nikrahan, G. R., Adams, C. N., Alipour, A., Sadeghi, M., . . . Huffman, J. C. (2018). A randomized trial of an optimism training intervention in patients with heart disease. *General Hospital Psychiatry, 51*, 46-53.
- Moher, D., Hopewell, S., Schulz, K. F., Montori, V., Gøtzsche, P. C., Devereaux, P. J., Elbourne, D. E., Egger, M., & Altman, D. (2010). CONSORT 2010 Explanation and Elaboration: updated guidelines for reporting parallel group randomized trials. *BMJ, 340*, c869.
- \*Moskowitz, J. T., Carrico, A. W., Duncan, L. G., Cohn, M. A., Cheung, E. O., Batchelder, A., . . . Folkman, S. (2017). Randomized controlled trial of a positive affect intervention for people newly diagnosed with HIV. *Journal of Consulting and Clinical Psychology, 85*(5), 409.
- \*Müller, R., Gertz, K. J., Molton, I. R., Terrill, A. L., Bombardier, C. H., Ehde, D. M., & Jensen, M. P. (2016). Effects of a tailored positive psychology intervention on well-being and pain in individuals with chronic pain and a physical disability: A feasibility trial. *The Clinical Journal of Pain, 32*(1), 32-44.
- \*Myers, N. D., Prilleltensky, I., Prilleltensky, O., McMahon, A., Dietz, S., & Rubenstein, C. L. (2017). Efficacy of the fun for wellness online intervention to promote multidimensional well-being: A randomized controlled trial. *Prevention Science, 18*(8), 984-994.
- Myers, N. D., Dietz, S., Prilleltensky, I., Prilleltensky, O., McMahon, A., Rubenstein, C. L., & Lee, S. (2018). Efficacy of the fun for wellness online intervention to promote well-being actions: A secondary data analysis. *Games for Health Journal, 7*(4), 225-239.
- \*Neumeier, L. M., Brook, L., Ditchburn, G., & Sckopke, P. (2017). Delivering your daily dose of well-being to the workplace: a randomized controlled trial of an online well-

- being programme for employees. *European Journal of Work and Organizational Psychology*, 26(4), 555-573.
- \*Nikrahan, G. R., Laferton, J. A., Asgari, K., Kalantari, M., Abedi, M. R., Etesampour, A., & Huffman, J. C. (2016). Effects of positive psychology interventions on risk biomarkers in coronary patients: A randomized, wait-list controlled pilot trial. *Psychosomatics: Journal of Consultation and Liaison Psychiatry*, 57(4), 359-368.
- O'Connell, B. H., O'Shea, D., & Gallagher, S. (2016). Enhancing social relationships through positive psychology activities: a randomised controlled trial. *The Journal of Positive Psychology*, 11(2).
- Orwin, R. G. (1983). A fail-safe N for effect size in meta-analysis. *Journal of Educational Statistics*, 8(2), 157-159.
- \*Page, K. M., & Vella-Brodrick, D. A. (2013). The working for wellness program: RCT of an employee well-being intervention. *Journal of Happiness Studies*, 14(3), 1007-1031.
- Parks, A. C., & Biswas-Diener, R. (2013). Positive interventions: Past, present and future. In T.B. Kashdan & J. V. Ciarrochi (Eds.), *Mindfulness, acceptance, and positive psychology: The seven foundations of well-being*. Oakland, CA: New Harbinger Publications
- \*Peters, M. L., Smeets, E., Feijge, M., van Breukelen, G., Andersson, G., Buhrman, M., & Linton, S. J. (2017). Happy Despite Pain: A Randomized Controlled Trial of an 8-week Internet-delivered Positive Psychology Intervention for Enhancing Well-being in Patients with Chronic Pain. *The Clinical Journal of Pain*.
- Proyer, R. T., Gander, F., Wellenzohn, S., & Ruch, W. (2015). Strengths-based positive psychology interventions: a randomized placebo-controlled online trial on long-term effects for a signature strengths- vs. a lesser strengths-intervention. *Frontiers in Psychology*, 6, 456.

- \*Proyer, R. T., Gander, F., Wellenzohn, S., & Ruch, W. (2016). Addressing the role of personality, ability, and positive and negative affect in positive psychology interventions: Findings from a randomized intervention based on the Authentic Happiness Theory and extensions. *The Journal of Positive Psychology, 11*(6), 609-621.
- Rashid, T. (2015). Positive psychotherapy: A strength-based approach. *The Journal of Positive Psychology, 10*(1), 25-40.
- \*Roepke, A. M., Jaffeem, S. R., Riffle, O. M., McGonigal, J., Broome, R., & Maxwell, B. (2015). Randomized controlled trial of SuperBetter, a smartphone-based/internet-based self-help tool to reduce depressive symptoms. *Games for Health Journal: Research, Development, and Clinical Applications, 4*(3), 235-246.
- \*Rogerson, S., Meir, R., Crowley-McHattan, Z., McEwen, K., & Pastoors, R. (2016). A randomized controlled pilot trial investigating the impact of a workplace resilience program during a time of significant organizational change. *Journal of Occupational and Environmental Medicine, 58*(4), 329-334.
- Rosenberg, M. S. (2005). The file-drawer problem revisited: a general weighted method for calculating fail-safe numbers in meta-analysis. *Evolution, 59*(2), 464-468.
- Rusk, R. D., Vella-Brodrick, D. A., & Waters, L. (2018). A complex dynamic systems approach to lasting positive change: The Synergistic Change Model. *The Journal of Positive Psychology, 13*(4), 406-418.
- Rusk, R. D., & Waters, L. E. (2013). Tracing the size, reach, impact, and breadth of positive psychology. *The Journal of Positive Psychology, 8*(3), 207-221.
- \*Sanjuan, P., Montalbetti, T., Perez-Garcia, A. M., Bermudez, J., Arranz, H., & Castro, A. (2016). A randomised trial of a positive intervention to promote well-being in cardiac patients. *Applied Psychology: Health and Well-Being, 8*(1), 64-84.

- \*Schotanus-Dijkstra, M., Drossaert, C. H., Pieterse, M. E., Boon, B., Walburg, J. A., & Bohlmeijer, E. T. (2017). An early intervention to promote well-being and flourishing and reduce anxiety and depression: A randomized controlled trial. *Internet Interventions, 9*, 15-24.
- \*Schueller, M. S., & Parks, A. C. (2012). Disseminating self-help: positive psychology exercises in an online trial. *Journal of Medical Internet Research, 14*(e63.).
- Schueller, S. M., & Parks, A. C. (2014). The science of self-help. *European Psychologist, 19*(2), 145-155.
- \*Seligman, M. E. P., Rashid, T., & Parks, A. C. (2006). Positive psychotherapy. *American Psychologist, 61*(8), 774-788.
- Seligman, M. E. P., Steen, T. A., Park, N., & Peterson, C. (2005). Positive psychology progress: empirical validation of interventions. *American Psychologist, 60*(5), 410.
- Seligman, M. E. P., & Csikszentmihalyi, M. (2000). Positive psychology: an introduction. *American Psychologist, 55*, 5-14.
- Sheldon, K. M., & Kasser, T. (2001). Goals, congruence, and positive well-being: New empirical support for humanistic theories. *Journal of Humanistic Psychology, 41*(1), 30-50.
- Sheldon, K. M., & King, L. (2001). Why Positive Psychology is necessary. *American Psychologist, 56*(3), 216-217.
- Sin, N. L., & Lyubomirsky, S. (2009). Enhancing well-being and alleviating depressive symptoms with positive psychology interventions: A practice-friendly meta-analysis. *Journal of Clinical Psychology, 65*, 467-487.
- Slavin, R., & Smith, D. (2009). The relationship between sample sizes and effect sizes in systematic reviews in education. *Educational Evaluation and Policy Analysis, 31*(4), 500-506.

- Sterne, J. A., Egger, M., & Moher, D. (2008). Addressing reporting biases. In J.P.T. Higgins & S. Green (Eds.), *Cochrane handbook for systematic reviews of interventions: Cochrane book series*, 297-333.
- Sutipan, P., Intarakamhang, U., & Macaskill, A. (2016). The impact of positive psychological interventions on well-being in healthy elderly people. *Journal of Happiness Studies*, 1-23.
- Toback, R. L., Graham-Bermann, S. A., & Patel, P. D. (2016). Outcomes of a character strengths-based intervention on self-esteem and self-efficacy of psychiatrically hospitalized Youths. *Psychiatric Service*, 67, 574-577.
- \*Uliaszek, A. A., Rashid, T., Williams, G. E., & Gulamani, T. (2016). Group therapy for university students: A randomized control trial of dialectical behavior therapy and positive psychotherapy. *Behaviour Research and Therapy*, 77, 78-85.
- Walsh, S., Cassidy, M., & Priebe, S. (2017). The application of positive psychotherapy in mental health care: A systematic review. *Journal of Clinical Psychology*, 73(6), 638-651.
- Weiss, L. A., Westerhof, G. J., & Bohlmeijer, E. T. (2016). Can we increase psychological well-being? The effects of interventions on psychological well-being: A meta-analysis of randomized controlled trials. *PloS one*, 11(6), e0158092.
- Woodworth, R. J., O'Brien-Malone, A., Diamond, M. R., & Schuz, B. (2016). Happy Days: Positive Psychology interventions effects on affect in an N-of-1 trial. *International Journal of Clinical and Health Psychology*, 16(1), 21-29.
- Yelland, L. N., Sullivan, T. R., Voysey, M., Lee, K. J., Cook, J. A., & Forbes, A. B. (2015). Applying the intention-to-treat principle in practice: Guidance on handling randomisation errors. *Clinical Trials*, 12(4), 418-423.

Zhang, Z., Xu, X., & Ni, H. (2013). Small studies may overestimate the effect sizes in critical care meta-analyses: a meta-epidemiological study. *Critical Care*, 17(1), R2.

### Appendix 1. Strings of the search strategy

**PUBMED:** ((well-being[Title/Abstract] OR happiness[Title/Abstract] OR happy[Title/Abstract] OR flourishing[Title/Abstract] OR "life satisfaction"[Title/Abstract] OR "satisfaction with life"[Title/Abstract] OR optimism[Title/Abstract] OR gratitude[Title/Abstract] OR strengths[Title/Abstract] OR forgiveness[Title/Abstract] OR compassion[Title/Abstract] OR "positive psych\*" [Title/Abstract])) AND "random"\*[Title/Abstract]

**PSYCINFO:** well-being or happiness or happy or flourishing or "life satisfaction" or "satisfaction with life" or optimism or gratitude or strengths or forgiveness or compassion or "positive psych\*").ti. and ("well-being" or happiness or happy or flourishing or "life satisfaction" or "satisfaction with life" or optimism or gratitude or strengths or forgiveness or compassion or "positive psych\*"). ab. and random\*.af

**SCOPUS:** #1 well-being or happiness or happy or flourishing or "life satisfaction" or "satisfaction with life" or optimism or gratitude or strengths or forgiveness or compassion or "positive psych\*"

#2 AND ABS(well-being or happiness or happy or flourishing or "life satisfaction" or "satisfaction with life" or optimism or gratitude or strengths or forgiveness or compassion or "positive psych\*")AND TITLE-ABS-KEY(random\*) AND DOCTYPE(ar) AND PUBYEAR > 1997 AND ( LIMIT-TO ( SUBJAREA,"MEDI" ) OR LIMIT-TO ( SUBJAREA,"HEAL" ) OR LIMIT-TO ( SUBJAREA,"PSYC" ) OR LIMIT-TO ( SUBJAREA,"SOC" ) OR LIMIT-TO ( SUBJAREA,"NURS" ) OR LIMIT-TO ( SUBJAREA,"BUSI" ) OR LIMIT-TO ( SUBJAREA,"MULT" ) ) AND ( LIMIT-TO ( LANGUAGE,"English" ) ) AND ( LIMIT-TO ( AFFILCOUNTRY,"United States" ) ) AND ( LIMIT-TO ( EXACTKEYWORD,"Human" ) OR LIMIT-TO ( EXACTKEYWORD,"Article" ) OR LIMIT-TO ( EXACTKEYWORD,"Humans" ) OR LIMIT-TO ( EXACTKEYWORD,"Controlled Study" ) OR LIMIT-TO ( EXACTKEYWORD,"Male" ) OR LIMIT-TO ( EXACTKEYWORD,"Female" ) OR LIMIT-TO ( EXACTKEYWORD,"Adult" ) OR LIMIT-TO ( EXACTKEYWORD,"Randomized Controlled Trial" ) OR LIMIT-TO ( EXACTKEYWORD,"Controlled Clinical Trial" ) OR LIMIT-TO ( EXACTKEYWORD,"Middle Aged" ) OR LIMIT-TO ( EXACTKEYWORD,"Aged" ) OR LIMIT-TO ( EXACTKEYWORD,"Clinical Trial" ) OR LIMIT-TO ( EXACTKEYWORD,"Physiology" ) OR LIMIT-TO ( EXACTKEYWORD,"Priority Journal" ) OR LIMIT-TO ( EXACTKEYWORD,"Major Clinical Study" ) OR LIMIT-TO ( EXACTKEYWORD,"Young Adult" ) OR LIMIT-TO ( EXACTKEYWORD,"Treatment Outcome" ) OR LIMIT-TO ( EXACTKEYWORD,"Methodology" ) OR LIMIT-TO ( EXACTKEYWORD,"Quality Of Life" ) OR LIMIT-TO ( EXACTKEYWORD,"Clinical Article" ) OR LIMIT-TO (

*EXACTKEYWORD,"Procedures" ) OR LIMIT-TO ( EXACTKEYWORD,"Questionnaire" ) OR LIMIT-TO ( EXACTKEYWORD,"Human Experiment" ) OR LIMIT-TO ( EXACTKEYWORD,"Normal Human" ) OR LIMIT-TO ( EXACTKEYWORD,"Wellbeing" ) OR LIMIT-TO ( EXACTKEYWORD,"Double Blind Procedure" ) OR LIMIT-TO ( EXACTKEYWORD,"Randomization" ) OR LIMIT-TO ( EXACTKEYWORD,"Depression" ) OR LIMIT-TO ( EXACTKEYWORD,"Outcome Assessment" ) OR LIMIT-TO ( EXACTKEYWORD,"Random Allocation" ) OR LIMIT-TO ( EXACTKEYWORD,"Follow Up" ) OR LIMIT-TO ( EXACTKEYWORD,"Questionnaires" ) OR LIMIT-TO ( EXACTKEYWORD,"Exercise Therapy" ) OR LIMIT-TO ( EXACTKEYWORD,"Time" ) OR LIMIT-TO ( EXACTKEYWORD,"Animals" ) OR LIMIT-TO ( EXACTKEYWORD,"Double-Blind Method" ) OR LIMIT-TO ( EXACTKEYWORD,"Well-being" ) OR LIMIT-TO ( EXACTKEYWORD,"Psychology" ) OR LIMIT-TO ( EXACTKEYWORD,"Psychological Aspect" ) OR LIMIT-TO ( EXACTKEYWORD,"Stress, Mechanical" ) OR LIMIT-TO ( EXACTKEYWORD,"Training" ) OR LIMIT-TO ( EXACTKEYWORD,"Physical Activity" ) OR LIMIT-TO ( EXACTKEYWORD,"Strength" ) OR LIMIT-TO ( EXACTKEYWORD,"Mental Health" ) OR LIMIT-TO ( EXACTKEYWORD,"Placebo" ) OR LIMIT-TO ( EXACTKEYWORD,"Health Status" ) OR LIMIT-TO ( EXACTKEYWORD,"Happiness" ) OR LIMIT-TO ( EXACTKEYWORD,"Personal Satisfaction" ) OR LIMIT-TO ( EXACTKEYWORD,"Self Concept" ) OR LIMIT-TO ( EXACTKEYWORD,"Life Satisfaction" ) OR LIMIT-TO ( EXACTKEYWORD,"Follow-Up Studies" ) OR LIMIT-TO ( EXACTKEYWORD,"Anxiety" ) OR LIMIT-TO ( EXACTKEYWORD,"Satisfaction" ) OR LIMIT-TO ( EXACTKEYWORD,"Psychological Well Being" ) OR LIMIT-TO ( EXACTKEYWORD,"Self Report" ) OR LIMIT-TO ( EXACTKEYWORD,"Instrumentation" ) OR LIMIT-TO ( EXACTKEYWORD,"Emotion" ) OR LIMIT-TO ( EXACTKEYWORD,"Adaptation, Psychological" ) OR LIMIT-TO ( EXACTKEYWORD,"United States" ) OR LIMIT-TO ( EXACTKEYWORD,"Fatigue" ) OR LIMIT-TO ( EXACTKEYWORD,"Social Support" ) OR LIMIT-TO ( EXACTKEYWORD,"Affect" ) OR LIMIT-TO ( EXACTKEYWORD,"Pilot Study" )*



## Appendix 2. Abbreviations of questionnaires

**Subjective well-being:** AHI: Authentic Happiness Index\*; BMIS: Brief Mood Introspection Scale (BMIS); CES-D pa: Center for Epidemiological Studies Depression Scale, positive affect subscale; MHC-SF-ewb subscale: Mental Health Continuum –Short Form - emotional well-being subscale; OHI: Oxford Happiness Index; PANAS: Positive and Negative Affect Schedule; PHI: Pemberton Happiness Index; SHS: Subjective Happiness Scale; SIAs: Standardized linear analog scale; SPANE: Scale of Positive and Negative Experience; SWLS: Satisfaction With Life Scale; SWS: Subjective Well-being Scale; VAS: Visual Analog Scale-Happiness

**Psychological well-being:** APM: Appreciation inventory scale: present moment; COS: Compassion for Others scale; FS: Flourishing Scale; GSE: Generalised self-efficacy scale; HFS: Happiness Flourishing Scale; MHC-SF pwb: Mental Health Continuum Short Form - psychological well-being subscale; MLQP: Meaning in Life Questionnaire – presence subscale; OTH: Orientations to Happiness Questionnaire; PCQ: PsyCap Questionnaire; PPTI: Positive Psychotherapy Inventory; PIL: Purpose In Life Test; PWBS: Psychological Well-Being Scales; RAW: Resilience at Work; SWS: Subjective Well-being Scale pwb subscale

**Depression:** BDI: Beck Depression Index; CES-D: Center for Epidemiological Studies - Depression scale; DASS-21: Depression Anxiety Stress Scale; HADS-D: Hospital Anxiety and Depression Scale, depression; HRSD: Hamilton Rating Scale for Depression; QIDS-SR: 16-item Quick Inventory of Depressive Symptomatology; SCL-90R: Symptom Checklist-90 Revised

**Anxiety:** BAI: Beck Anxiety Inventory; DASS-21: Depression Anxiety Stress Scales; HADS-A: Hospital Anxiety and Depression Scale, anxiety; SCL-90R: Symptom Checklist-90 Revised; STAI: State-Trait Anxiety Inventory

**Stress:** DASS-21: Depression Anxiety Stress Scale; DTS: Distress Tolerance Scale; PSS-Perceived Stress Scale; SUDS: Subjective Units of Distress scale; SWSS: Stress Warning Signals Scale

\* In a prior meta-analysis by Bolier et al. (2013) the AHI was classified as an instrument to measure psychological well-being since it also focuses on aspects of PWB, such as engagement, or meaning (Seligman, Steen, Park, & Peterson, 2005).

**Appendix 3. Outcomes of moderator analyses**

Outcome	Criteria	Value	N	Hedge's g	(95% CI)	I <sup>2</sup>	Z
<b>Subjective well-being</b>	Population	<i>Clinical</i>	21	0.33	(0.10 - 0.56) ns	82.41	2.83
		<i>Non-clinical</i>	18	0.34	(0.11 - 0.57) ns	78.35	2.94
	Intervention	<i>PPI</i>	34	0.37	(0.20 - 0.55) ns	80.22	4.01
		<i>PPI + other</i>	5	0.11	(-0.33 - 0.55) ns	83.82	0.48
	Delivery	<i>Group</i>	19	0.50	(0.26 - 0.74) ns	83.91	4.11
		<i>Individual</i>	3	0.26	(-0.37 - 0.88) ns	0.00	0.81
		<i>Self-help</i>	17	0.12	(-0.03 - 0.43) ns	76.79	1.67
	Control	<i>Active</i>		0.38	(0.12 - 0.63) ns	84.47	2.84
		<i>Non-active</i>	22	0.31	(0.11 - 0.52) ns	75.62	3.01
	Sessions	<i>≤ 8 sessions</i>	9	0.54	(0.21 - 0.87) ns	91.77	3.21
		<i>&gt; 8 sessions</i>	30	0.28	(0.09 - 0.46) ns	67.03	2.95
	Duration	<i>≤ 8 weeks</i>	26	0.48	(0.21 - 0.75) ns	89.43	3.47
		<i>&gt; 8 weeks</i>	13	0.26	(0.06 - 0.46) ns	67.33	2.51
	Quality	<i>High</i>	11	0.30	(-0.03 - 0.54) ns	75.13	1.78
		<i>Moderate</i>	15	0.25	(-0.01 - 0.52) ns	76.32	3.51
		<i>Low</i>	13	0.55	(0.25 - 0.86) ns	85.88	1.67
	Region	<i>Western</i>	30	0.25	(0.07 - 0.43) ns	82.53	3.81
		<i>Non-Western</i>	9	0.70	(0.34 - 1.07) ns	79.46	2.75
<b>Psychological well-being</b>	Population	<i>Clinical</i>	6	0.35	(-0.02 - 0.71) ns	47.48	1.88
		<i>Non-clinical</i>	18	0.40	(0.22 - 0.58) ns	81.56	4.40
	Intervention	<i>PPI</i>	18	0.34	(0.15 - 0.52) ns	78.09	3.58
		<i>PPI + other</i>	6	0.55	(0.23 - 0.87) ns	76.49	3.39
	Delivery	<i>Group</i>	12	0.38	(0.14 - 0.62) ns	61.56	3.06
		<i>Individual</i>	1	0.83	(-0.25 - 1.91) ns	0.000	1.51
		<i>Self-help</i>	11	0.38	(0.17 - 0.59) ns	85.19	3.55
	Control	<i>Active</i>	11	0.18	(-0.04 - 0.40) ns	58.11	1.62
		<i>Non-active</i>	13	0.53	(0.34 - 0.72) ns	76.84	5.54
	Sessions	<i>≤ 8 sessions</i>	7	0.08	(-0.19 - 0.35) ns	46.20	0.61
		<i>&gt; 8 sessions</i>	17	0.50	(0.33 - 0.71) ns	75.49	5.75
	Duration	<i>≤ 8 weeks</i>	9	0.20	(-0.05 - 0.45) ns	73.70	1.60
		<i>&gt; 8 weeks</i>	15	0.50	(0.31 - 0.72) ns	77.55	5.00
	Quality	<i>High</i>	8	0.24	(0.02 - 0.47) ns	35.67	2.09
		<i>Medium</i>	7	0.63	(0.31 - 0.95) ns	19.82	3.87
		<i>Low</i>	9	0.42	(0.15 - 0.68) ns	28.39	3.09
	Region	<i>Western</i>	18	0.32	(0.15 - 0.44) ns	73.63	3.76
		<i>Non-Western</i>	6	0.64	(0.31 - 0.98) ns	79.82	3.75
<b>Depression</b>	Population	<i>Clinical</i>	21	0.27	(0.07 - 0.47) ns	48.67	2.64
		<i>Non-clinical</i>	10	0.34	(0.08 - 0.60) ns	90.25	2.57
	Intervention	<i>PPI</i>	29	0.27	(0.11 - 0.43) ns	76.53	3.37
		<i>PPI + other</i>	2	0.52	(-0.02 - 1.05) ns	72.53	1.90
		<i>PPT</i>	1	0.47	(-0.46 - 1.39) ns	0.00	0.99
	Delivery	<i>Group</i>	17	0.38	(0.16 - 0.60) ns	81.23	3.43
		<i>Individual</i>	3	0.40	(-0.17 - 0.97) ns	77.18	1.39
		<i>Self-help</i>	11	0.17	(-0.06 - 0.40) ns	62.38	1.44
	Control	<i>Active</i>	17	0.13	(-0.08 - 0.34) ns	41.32	1.20
		<i>Non-active</i>	14	0.46	(0.25 - 0.66) ns	84.29	4.28
	Sessions	<i>≤ 8 sessions</i>	24	0.26	(-0.09 - 0.60) ns	68.66	1.47
		<i>&gt; 8 sessions</i>	7	0.31	(0.13 - 0.49) ns	77.98	3.36
	Duration	<i>≤ 8 weeks</i>	20	0.37	(0.18 - 0.56) ns	62.42	3.84
		<i>&gt; 8 weeks</i>	11	0.15	(-0.11 - 0.41) ns	79.52	1.11
	Quality	<i>High</i>	9	0.22	(0.00 - 0.45) **	72.30	1.94
		<i>Moderate</i>	12	0.06	(-0.16 - 0.29) ns	0.00	0.55
		<i>Low</i>	10	0.75	(0.47 - 1.04) ***	84.46	5.15
	Region	<i>Western</i>	23	0.13	(0.41 - 1.03) *	87.68	4.57
<i>Non-Western</i>		8	0.65	(0.01 - 0.32) ***	56.00	2.10	

\*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$ ; ns: non-significant

<b>Anxiety</b>	Population	<i>Clinical</i>	7	0.27	(0.13- 0.40) ns	0.00	3.85
		<i>Non-clinical</i>	4	0.49	(0.32 - 0.70) ns	34.08	5.90
	Intervention	<i>PPI</i>	7	0.36	(0.22 - 0.50) ns	11.92	0.00
		<i>PPI + other</i>	4	0.29	(-0.06- 0.65) ns	0.00	0.11
	Delivery	<i>Group</i>	6	0.40	(0.15 - 0.44) ns	38.24	4.19
		<i>Individual</i>	1	0.16	(0.31 - 0.98) ns	0.00	0.35
		<i>Self-help</i>	4	0.32	(0.07 - 0.47) ns	0.00	3.47
	Control	<i>Active</i>	6	0.21	(0.01 - 0.41) ns	0.00	2.09
		<i>Non-active</i>	5	0.42	(0.29 - 0.54) ns	26.90	6.54
	Sessions	<i>≤ 8 sessions</i>	2	0.05	(-0.29 - 3.97) ns	0.07	0.31
		<i>&gt; 8 sessions</i>	9	0.39	(0.28 - 0.50) ns	8.72	6.98
	Duration	<i>≤ 8 weeks</i>	4	0.21	(0.05 - 0.37) ns	0.00	2.50
		<i>&gt; 8 weeks</i>	7	0.47	(0.33 - 0.61) ns	0.00	6.71
	Quality	<i>High</i>	4	0.40	(0.27 - 0.53) ns	37.00	5.86
		<i>Moderate</i>	2	0.20	(0.00 - 0.40) ns	0.00	3.21
		<i>Low</i>	5	0.55	(0.21 - 0.89) ns	0.00	1.91
Region	<i>Western</i>	2	0.42	(0.11 - 0.74) ns	0.00	2.65	
	<i>Non-Western</i>	9	0.34	(0.20 - 0.48) ns	28.19	4.72	
<b>Stress</b>	Population	<i>Clinical</i>	3	-0.09	(-0.52 - 0.36) ns	73.26	-0.55
		<i>Non-clinical</i>	5	0.53	(0.35 - 0.71) ns	37.59	3.29
	Intervention	<i>PPI</i>	6	0.18	(-0.19 - 0.54) ns	64.85	0.95
		<i>PPI + other</i>	2	0.82	(0.21 - 1.41) ns	12.49	2.66
	Delivery	<i>Group</i>	4	0.17	(-0.32 - 0.67) ns	79.62	0.69
		<i>Individual</i>	1	0.07	(-1.07 - 1.20) ns	0.00	0.11
		<i>Self-help</i>	3	0.56	(0.06 - 1.05) ns	0.00	2.20
	Control	<i>Active</i>	4	-0.08	(-0.53 - 0.37) ns	60.75	-0.34
		<i>Non-active</i>	4	0.16	(0.29 - 0.93) ns	34.65	3.69
	Sessions	<i>≤ 8 sessions</i>	3	0.60	(0.04 - 1.15) ns	50.39	2.12
		<i>&gt; 8 sessions</i>	5	0.18	(-0.24 - 0.61) ns	72.34	0.84
	Duration	<i>≤ 8 weeks</i>	3	-0.13	(-0.65 - 0.40) ns	73.60	-0.47
		<i>&gt; 8 weeks</i>	5	0.56	(0.24 - 0.88) ns	30.91	3.39
	Quality	<i>High</i>	3	0.53	(0.27 - 0.80) ns	20.09	3.99
		<i>Moderate</i>	4	0.38	(-0.01 - 0.77) ns	37.16	1.90
		<i>Low</i>	1	-1.28	(-2.30 - -0.26) ns	0.00	-2.46
Region	<i>Western</i>	2	-0.14	(-0.78 - 0.51) ns	89.46	-0.41	
	<i>Non-Western</i>	6	0.50	(0.13 - 0.87) ns	21.28	2.67	

\*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$ ; ns: non-significant