International Journal of Clinical and Health Psychology (2016) 16, 21–29

International Journal of Clinical and Health Psychology

www.elsevier.es/ijchp

ORIGINAL ARTICLE

Happy Days: Positive Psychology interventions effects on affect in an N-of-1 trial

Rosalind Jane Woodworth, Angela O'Brien-Malone, Mark R. Diamond, Benjamin Schüz*

University of Tasmania, Australia

Received 22 April 2015; accepted 30 July 2015
Available online 8 September 2015

KEYWORDS
Positive affect;
Positive Psychology interventions;
Subjective well-being;
Multilevel modeling;
Cuasi-experimental study

Abstract Positive Psychology Interventions (PPIs) have been suggested as self-help tools to increase subjective well-being and happiness. However, most previous studies have been based on between-group comparisons, which are not informative with regard to trajectories of individual change over time. This study is a first attempt at examining whether completing frequently used PPIs — 'Three Good Things in Life', 'Using Signature Strengths in a New Way' and 'Gratitude Visit' —results in consistent changes in affect at the level of the individual. In an N-of-1-study design, participants were randomly allocated to one of six counterbalanced patterns of the PPIs over a 9–10 week period. The affective aspect of subjective well-being was measured daily using the Positive and Negative Affect Scale (PANAS). Hierarchical linear modelling showed significant changes in PANAS scores, but no statistically significant differential impact on positive affect of the PPIs, apart from a marginally significant time × intervention interaction for 'Using Signature Strengths in a New Way'. This suggests that frequently used PPIs do not result in changes in affect over time. This finding questions recommending the use of PPIs as self-help tools.

PALABRAS CLAVE
Afecto positivo;
intervenciones de Psicología Positiva;
bienestar subjetivo;
modelos multinivel;
estudio cuasi-experimental

Efectos de las intervenciones de la Psicología Positiva en el afecto en un ensayo N = 1

Resumen Las intervenciones de la Psicología Positiva (IPP) se han sugerido como herramientas de autoayuda para aumentar el bienestar subjetivo y la felicidad. Sin embargo, la mayoría de los estudios previos se ha basado en comparaciones entre grupos que no informan del cambio individual en el tiempo. Este estudio es un primer intento de examinar si las IPP habitualmente empleadas ''Tres cosas buenas de la vida'', ''Uso de las fortalezas características de un modo distinto'' y ''Visita de gratitud'' provocan cambios en el afecto a nivel individual. En un diseño N = 1, los participantes fueron asignados al azar a uno de los seis patrones contrabalanceados de las IPP durante 9-10 semanas. El aspecto afectivo del bienestar subjetivo se midió diariamente usando la Escala de Afecto Positivo y Afecto Negativo (PANAS). El modelo jerárquico lineal

* Corresponding author: University of Tasmania, Psychology, School of Medicine, Private Bag 30, Hobart, TAS 7001, Australia.
E-mail address: Benjamin.schuez@utas.edu.au (B. Schüz).

http://dx.doi.org/10.1016/j.ijchp.2015.07.006

mostró cambios estadísticamente significativos en las puntuaciones PANAS, pero ningún efecto diferencial estadísticamente significativo en el afecto positivo, excepto la interacción tiempo x intervención para ''fortalezas características''. Los resultados sugieren que las IPP empleadas habitualmente no provocan cambios en el afecto a lo largo del tiempo. Este hallazgo cuestiona el uso de las IPP como herramientas de autoayuda.

Positive psychology interventions (PPIs) to increase subjective well-being (SWB) and decrease depressive symptoms are becoming increasingly popular (Sin & Lyubomirsky, 2009). In particular, the exercises outlined in Seligman, Steen, Park and Peterson's seminal paper (2005) have enjoyed considerable popularity, and it has been suggested to use these interventions more widely (Rashid, 2015; Rashid & Seligman, 2013; Seligman, Rashid, & Parks, 2006). However, the current evidence base for the effects of PPIs is mixed, with effect sizes ranging from substantial (Seligman, Steen, Park, & Peterson, 2005) to negligible (Mongrain & Anselmo-Matthews, 2012). In addition, the effects of PPIs if used on a large scale (Challen, Machin, & Gillham, 2014; Coyne, 2013), the general validity of claims in some domains of positive psychology (Brown, Sokal, & Friedman, 2013) and general concepts (Fernández-Ríos & Novo, 2012) warrant more stringent studies and critical examination of PPIs. In order to inform evidence-based practice in the use of PPIs as self-help tools or even clinical practice, more and better-controlled trials of the effects of PPIs are needed. In this paper, we provide a first-ever evaluation of individual-level effects of PPIs.

Between-groups and N-of-1 studies of subjective well-being

Previous studies of the effects of PPIs (Mongrain & Anselmo-Matthews, 2012; Seligman et al., 2005, 2006) have examined between-group differences in SWB. For example, compared to a control group, participants completing a *Three Good Things* exercise had significantly higher levels of happiness and significantly lower levels of depression over time (Seligman et al., 2005). However, even if between-groups tests of effects support one intervention over a control condition or another intervention, there might be substantial variance within each intervention group, and participants might not all equally profit from, or respond to, each intervention (Ottenbacher, 1990, 1992). In other words, patterns found in between-group comparisons might not be observed at the level of individuals (Molenaar & Campbell, 2009). To address this, it has been suggested that research rather focus on individual changes in SWB to evaluate positive psychology interventions (Eid & Diener, 1999).

N-of-1-designs have advantages over between-groups designs. N-of-1 designs allow the examination of individual change in SWB, which means that recognizable clinical changes are emphasized (Barbot & Perchec, 2015). Furthermore, the delivery mode of the interventions captures some aspects of typical clinical interactions, namely the personalized delivery and the continued interaction with the experimenter. Similarly, N-of-1 designs are the preferable option when studying the effects of interventions that need repeated application such as the PPIs, which had to be applied on a daily basis. A common misconception regarding n-of-1 study designs is that only one subject is used in each study; more commonly multiple subjects are used to emphasize the strength and replicability of the intervention (Tervo, Estrem, Bryson-Brockmann, & Symons, 2003). In this study, each participant received multiple interventions, which were applied in counterbalanced order.

Increasing subjective well-being. Implications of PPIs

Seligman et al. (2005) used an internet-based study to examine the effect of five ''happiness exercises'' on happiness and depression over a six-month period. The five exercises were based on Authentic Happiness Theory (Seligman, 2002), which proposes that happiness can be increased by exercises that foster enjoyment, meaning, and engagement. These PPIs required participants to identify character strengths that defined themselves (*Identifying Signature Strengths*), to use these personal strengths in a novel way (*Using Signature Strengths in A New Way*), to focus on three good things that happened each day (*Three Good Things in Life*), to visit someone who had been kind to the participant, with the purpose of delivering, in person, a letter of appreciation (*Gratitude Visit*), or to write about a time when they were at their best and to reflect on the signature strengths that were highlighted by the description (*You At Your Best*). In particular, the two interventions *Using Signature Strengths in A New Way* and *Three Good Things in Life* were associated with increases in happiness and decreases in depression up to six months later. Similar results were reported in two smaller face-to-face studies (Seligman et al., 2006). A replication of the original study found substantially smaller effect sizes (Mongrain & Anselmo-Matthews, 2012). These inconsistencies suggest that further research is needed, and as the application of PPIs grows, and treatment programs are developed (Rashid & Seligman, 2013), it is essential to validate the efficacy of the techniques on which such therapy programs are based.

Measuring subjective well-being on a daily basis

The primary dependent variable in this study was the *affective* aspect of SWB as measured with the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988). SWB is a key component of happiness (Linley, Maltby, Wood, Osborne, & Hurling, 2009); in fact, the terms are often used interchangeably (Diener, 2012). Although the outcome measure in this study was restricted to the affective component of subjective well-being, this is not a significant limitation. Many authors have argued that positive affect is the central component of happiness (e.g., Diener, Sandvik, & Pavot, 1991), and others have asserted that happiness consists of a long-term propensity to frequently experience positive emotions (Lyubomirsky, King, & Diener, 2005), and it has been shown that experiencing negative affect conversely is related to lower levels of happiness (Pelechano, González-Leandro, Garcia, & Morán, 2013).

The aim in this study was to determine whether the widely used PPIs proposed by Seligman et al. (2005) improve subjective well-being at the individual level, where clinical and practical implications are more clearly recognized.

Method

Participants and procedure

This study was approved by the Tasmanian Human Research Ethics Committee (Approval No. H0011792). Recruitment was via a newspaper advertisement for a ''Happiness Training Program''. Inclusion criteria were being over 18 years of age and not being depressed, indicated by a score of above seven on the Hamilton Rating Scale for Depression (HRSD; Hamilton, 1960). At the outset of the study each participant was asked to provide basic demographic information and to complete a 60-minute semi-structured interview. Participants' mean age was 45.8 years ($SD = 11.77$) and ranged from 23 to 62 years. The majority of participants (73.3%) were women. After providing consent, participants were allocated to one of the six counterbalanced patterns of interventions (Table 1). Participants were sent one diary per week according to the intervention in their schedule. The diaries contained instructions on the particular intervention. At the end of each day, participants were required to complete the PANAS.

Power analysis

A power analysis based on Raudenbush and Liu's (2000) recommendations for cluster-randomised trials using Optimal Design (Spybrook et al., 2011) suggested that 12 sites (persons) with more than 64 units (days) are sufficient to detect small to medium-sized effects ($\delta = .29$; (Sin & Lyubomirsky, 2009)) of the interventions (clusters) on individual (daily) measures with sufficient power (.8) at an alpha level of .05.

Table 1 Participant characteristics and individual PANAS scores on intervention and control days.

Participant	Age	Sex	Affect balance score (*SD*)					Positive Affect (*SD*)					Negative Affect (*SD*)				
			B	S	T	G	TS	B	S	T	G	TS	B	S	T	G	TS
1	36	F	3.85 (0.20)	3.73 (0.18)	3.73 (0.11)		3.84 (0.35)	2.79 (0.43)	2.60 (0.25)	2.59 (0.19)		2.81 (0.49)	1.08 (0.10)	1.14 (0.19)	1.13 (0.13)		1.14 (0.24)
2	56	F	3.23 (0.39)	3.17 (0.54)	3.50 (0.37)		3.25 (0.50)	2.01 (0.58)	2.25 (0.62)	2.48 (0.62)		2.19 (0.48)	1.55 (0.53)	1.91 (0.69)	1.47 (0.25)		1.69 (0.72)
3	51	M	4.30 (0.24)	3.93 (0.71)	4.26 (0.30)	4.35 (0.09)	4.23 (0.33)	3.80 (0.27)	3.43 (0.72)	3.60 (0.58)	3.74 (0.13)	3.73 (0.38)	1.20 (0.24)	1.57 (0.74)	1.07 (0.13)		1.27 (0.48)
4	48	F	3.78 (0.46)	3.95 (0.28)	4.08 (0.28)	3.66 (0.36)	3.92 (0.28)	2.86 (0.76)	3.15 (0.41)	3.36 (0.45)	2.83 (0.46)	3.05 (0.42)	1.31 (0.25)	1.25 (0.27)	1.19 (0.19)	1.51 (0.37)	1.21 (0.23)
5	23	F	3.56 (0.31)	3.39 (0.23)	3.03 (0.14)	3.43 (0.36)	3.45 (0.24)	2.18 (0.57)	1.89 (0.45)	1.23 (0.15)	1.92 (0.66)	1.97 (0.46)	1.06 (0.13)	1.11 (0.12)	1.17 (0.16)	1.05 (0.08)	1.07 (0.07)
6	28	M	3.32 (0.24)	3.30 (0.18)	3.28 (0.23)		3.44 (0.26)	1.91 (0.38)	1.90 (0.28)	1.90 (0.34)		2.05 (0.47)	1.26 (0.12)	1.30 (0.16)	1.34 (0.20)		1.16 (0.12)
7	46	F	3.41 (0.82)	3.90 (0.65)	3.50 (0.76)	3.26 (0.65)	3.23 (0.62)	3.21 (1.05)	3.61 (0.95)	3.44 (0.94)	3.41 (0.87)	3.09 (0.80)	2.39 (0.89)	1.81 (0.63)	2.44 (0.82)	2.89 (0.81)	2.62 (0.92)
8	37	F	3.24 (0.22)	3.11 (0.12)	3.15 (0.18)	3.33 (0.14)	3.28 (0.14)	1.54 (0.44)	1.32 (0.31)	1.41 (0.29)	1.65 (0.27)	1.59 (0.26)	1.07 (0.11)	1.09 (0.14)	1.12 (0.17)	1.00 (0)	1.03 (0.07)
9	46	M	3.76 (0.60)	3.92 (0.48)	3.80 (0.38)	3.91 (0.45)	3.64 (0.46)	.3.03 (0.81)	3.12 (0.85)	2.80 (0.76)	3.14 (0.56)	2.80 (0.65)	1.50 (0.46)	1.29 (0.29)	1.19 (0.25)	1.32 (0.44)	1.52 (0.39)
10	54	F	3.61 (0.43)	3.39 (0.49)	3.28 (0.49)	3.36 (0.46)	3.54 (0.48)	2.73 (0.76)	2.39 (0.79)	2.36 (0.67)	2.29 (0.67)	2.59 (0.73)	1.51 (0.35)	1.61 (0.33)	1.79 (0.58)	1.56 (0.36)	1.51 (0.33)
11	55	M	3.99 (0.13)	4.01 (0.06)	4.02 (0.08)	3.92 (0.14)	3.98 (0.11)	3.02 (0.23)	3.03 (0.10)	3.05 (0.15)	2.97 (0.21)	2.99 (0.18)	1.03 (0.10)	1.01 (0.05)	1.01 (0.03)	1.13 (0.12)	1.03 (0.07)
12	34	F	3.75 (0.35)	3.98 (0.33)	3.99 (0.24)		3.69 (0.40)	2.79 (0.56)	3.15 (0.55)	3.19 (0.43)		2.65 (0.55)	1.29 (0.34)	1.18 (0.23)	1.20 (0.26)		1.28 (0.32)
13	60	F	3.36 (0.75)	3.70 (0.45)	3.65 (0.42)		3.69 (0.57)	2.44 (0.95)	2.75 (1.01)	2.56 (0.93)		2.53 (1.07)	1.67 (0.73)	1.36 (0.37)	1.26 (0.25)		1.14 (0.21)
14	62	M	4.13 (0.16)	4.09 (0.11)	3.99 (0.14)		4.08 (0.08)	3.33 (0.32)	3.24 (0.16)	3.16 (0.17)		3.19 (0.16)	1.06 (0.09)	1.06 (0.14)	1.18 (0.20)		1.04 (0.05)
15	52	M	3.88 (0.52)	4.06 (0.46)	3.94 (0.43)	4.18 (0.56)	3.93 (0.28)	3.37 (0.70)	3.45 (0.61)	3.21 (0.59)	3.76 (0.79)	2.94 (0.52)	1.60 (0.48)	1.32 (0.33)	1.33 (0.40)	1.39 (0.36)	1.06 (0.11)

Note. B = Baseline/Control (PANAS assessment only), T = Three Good Things in Life, S = Using Signature Strengths in A New Way, G = Gratitude Visit, TS = Three Good Things in Life together with Using Signature Strengths in A New Way; M = male, F = female.

Measures

The PANAS (Watson et al., 1988) was used to measure the primary outcome, the affective facet of subjective well-being. Neither the AHI nor the CES-D used in the original study were designed for repeated daily use, whereas the PANAS is sensitive to short-term fluctuations in the affective component of subjective well-being (e.g., Brose, Voelkle, Lövdén, Lindenberger, & Schmiedek, 2015) and therefore more suitable for use in the current N-of-1 design. In the PANAS, respondents rate the extent to which they have experienced feelings and emotions such as ''scared'', ''inspired'' and ''hostile'' every day using a 5-point scale from ''very slightly or not at all'' to ''extremely''. Three scores were computed: A positive affect (PA) score, which is the mean score of the 10 positive emotion adjectives; a negative affect (NA) score, which is the mean score of the 10 negative emotion adjectives; and an affect balance score, calculated by subtracting the negative from the positive affect scores. As there is evidence that PA and NA are relatively independent dimensions, we considered PA and NA separately as well as examining the affect balance score (Crawford & Henry, 2004; Tellegen, Watson, & Clark, 1999).

Research design

This study used a counterbalanced N-of-1 design. Counterbalancing was achieved by having participants complete a predetermined sequence of interventions in the first half of the study and then complete the reverse sequence of the same interventions in the second half of the study (Tervo et al., 2003). The particular ordering of interventions is shown in Table 1. Participants were randomly allocated to one of the six counterbalanced patterns of interventions.

Interventions

Three of the six PPIs used by Seligman et al. (2005) were used in this study.

Gratitude visit: Participants were asked to write and deliver personally a letter of appreciation to someone who had been kind to them, but who they had never properly thanked.

Three good things in life: Participants were instructed to write down three good things that happened each day, together with a causal explanation for each of these things.

Using signature strengths in a new way: After completing the Inventory of Character Strengths (Peterson, Park, & Seligman, 2005) at the beginning of the program and receiving their top five signature strengths, participants were asked to use one of these five over the week, in a new way for each day of the week.

Based on previous recommendations (Seligman et al., 2005), we also tested a combination of the *Three Good Things in Life* and *Using Signature Strengths in a New Way* exercises, in which participants were asked to complete both exercises.

The control condition consisted of a week with daily affect assessments only.

Statistical analyses

In order to account for the hierarchical structure of the data (daily measurements nested within participants), multilevel analyses were performed using the lme4 package for R (Bates, Maechler, Bolker, & Walker, 2014). Multilevel analyses allow decomposing the variance of the dependent variables (repeated daily assessments of affect balance scores, PA score and NA score) into within- and between-person variance. The proportion of the total variance in PANAS scores accounted for by between-person (level-2) variance is represented by the intraclass correlation coefficient (ICC). Substantial ICCs (> .05) indicate that the data is structured in multiple levels (Snijders & Boskers, 2012).

Both the affect balance score and the PA and NA subscores (level-1 dependent variable) can be decomposed as follows:

$$Y_{ti} = \pi_{0i} + \pi_{1i} TIME_{ti} + \pi_{2i} PPI_{ti} + \pi_{3i} TIME \times PPI_{ti} + e_{ti}$$

Here, Y_{ti} represents a PANAS score of a measurement occasion t (level-1) within the level-2-unit (participant) i. Y_{ti} is regressed on the level-1-variables $TIME_{ti}$ (time indicated by study day), PPI_{ti} (dummy-coded intervention group), and the interaction of time and intervention group $TIME{*}PPI_{ti}$ with the regression coefficients π_{1i}, π_{2i}, and π_{3i} and a level-1 residual e_{ti}.

On level 2 (participant), both the intercept and the regression coefficients can be decomposed into mean levels and individual differences from this mean:

$$\pi_{0i} = \beta_{00} + r_{0i} \text{ and } \pi_{ni} = \beta_{n0} + r_{ni}$$

This implies that the mean intercept π_{0i} (across all participants) can be decomposed into a mean intercept β_{00} on level-2 and individual differences from this mean r_{0i}. Similarly, for all regression coefficients on level-1, π_{ni}, a mean coefficient β_{n0}, and individual differences from this mean coefficient r_{ni}, can be estimated to account for individual differences between participants.

The level-1-predictors (time, intervention, time x intervention) were group-mean-centered. First, a null model containing the intercept only was analyzed to test for substantial ICCs of the primary outcome variables (affect balance score, PA score, and NA score). Second, a model using all level-1 predictors but ignoring the multilevel structure was fitted to obtain a baseline model. Thirdly, a model with random intercepts was used to examine whether there were differences in the intercepts of the level-1 outcome variables according to the level-2 units (in our case, basically whether there were between-individuals differences in the within-individual means of the outcome variables). Fourth, we examined whether the effects of the interventions differed between persons in a random slopes model in which we allowed the slopes of the intervention in predicting the outcomes to vary between persons. The difference in fit between model 2 (ignoring the multilevel structure), random intercepts and random slopes models was tested using the−2 Log-likelihood (−2LL) test (Snijders & Boskers, 2012). The study was not powered to detect cross-level interactions. This process of analysis was analogously repeated

Table 2 Fixed effects estimates (top) and random effects estimates (bottom) for affect balance score.

	Parameter Estimate (SE)			
Parameter	Model 1	Model 2	Model 3	Model 4
Intercept	3.69 (.08)	3.65 (.05)	3.68 (.09)	3.68 (.09)
Level-1 (measurement occasion)				
Time (study day)		.0002 (.001)	-.0002 (.001)	-.0002 (.001)
S		-.07 (.10)	-.07 (.08)	-.07 (.09)
G		.03 (.15)	-.04 (.13)	-.04 (.15)
T		-.05 (.10)	-.06 (.09)	-.07 (.09)
TS		-.002 (.10)	-.01 (.08)	-.02 (.09)
S × time		.004 (.002)	.003 (.002)	.004 (.002)†
G × time		.0002 (.005)	.002 (.004)	.002 (.005)
T × time		.002 (.003)	.003 (.002)	.003 (.002)
TS × Time		.001 (.003)	.001 (.002)	.001 (.002)
Intercept (σ^2)	.096**		.096**	.094*
Slope Intervention (σ^2)				.01†
-2LL (*df*)		1315.02_a (11)	1027.35_b (12)	1020.87_c (13)

Note. ** $p < .01$, * $p < .05$, † $p < .1$; -2LL: -2 Log-likelihood. Values with different subscripts differ at $p < .01$; T = Three Good Things in Life, S = Using Signature Strengths in A New Way, G = Gratitude Visit, TS = Three Good Things in Life together with Using Signature Strengths in A New Way.

for all primary outcome variables (affect balance score, PA score and NA score).

Results

The intraclass correlation coefficients of all outcomes (affect balance score ICC, $\rho = .36$; PA ICC, $\rho = .50$; NA ICC, $\rho = .42$) suggested that a substantial part of the variance in level-1 dependent variables is due to level-2 (individual person) units, and that the multilevel structure of the data cannot be ignored (Snijders & Boskers, 2012). We subsequently analyzed the outcomes as outlined above.

Affect balance score

Model 2 (Table 2) found no significant effects of time, intervention, and time x intervention. Although the -2LL test suggested a significantly better fit for the random intercepts model (Model 3), ($\Delta_{\text{-2LL}} = 287.67$, df = 1, $p < .01$), indicating that there are substantial individual differences in the mean level of affect balance, patterns of results did not change. The -2LL test suggested a significantly better fit of the random slopes model where the slopes of the intervention were allowed to vary between participants (Model 4; $\Delta_{\text{-2LL}} = 6.48$, df = 1, $p < .05$). The residual variance of the slopes however only approached significance.

Table 3 Fixed effects estimates (top) and random effects estimates (bottom) for PANAS positive affect score.

	Parameter Estimate (SE)			
Parameter	Model 1	Model 2	Model 3	Model 4
Intercept	2.72 (.16)	2.68 (.09)	2.74 (.17)	2.74 (.17)
Level-1 (measurement occasion)				
Time (study day)		.001 (.002)	-.001 (.002)	-.001 (.002)
S		-.20(.16)	-.20 (.12)	-.21 (.13)†
G		-.01 (.24)	-.07 (.19)	-.07 (.20)
T		-.07 (.17)	-.09 (13)	-.10 (.13)
TS		-.11 (.16)	-.13 (.12)	-.14 (.13)
S × time		.01 (.004)†	.01 (.003)*	.01 (.003)*
G × time		.01 (.01)	.005 (.006)	.005 (.007)
T × time		.003 (.005)	.003 (.003)	.003 (.003)
TS × Time		.003 (.004)	.002 (.003)	.002 (.003)
Intercept (σ^2)	.37*		0.37*	.37*
Slope Intervention (σ^2)				.01
-2LL (*df*)		2149.06_a (11)	1689.32_b (12)	1688.14_b (13)

Note. ** $p < .01$, * $p < .05$, † $p < .1$; -2LL: -2 Log-likelihood. Values with different subscripts differ at $p < .01$; T = Three Good Things in Life, S = Using Signature Strengths in A New Way, G = Gratitude Visit, TS = Three Good Things in Life together with Using Signature Strengths in A New Way.

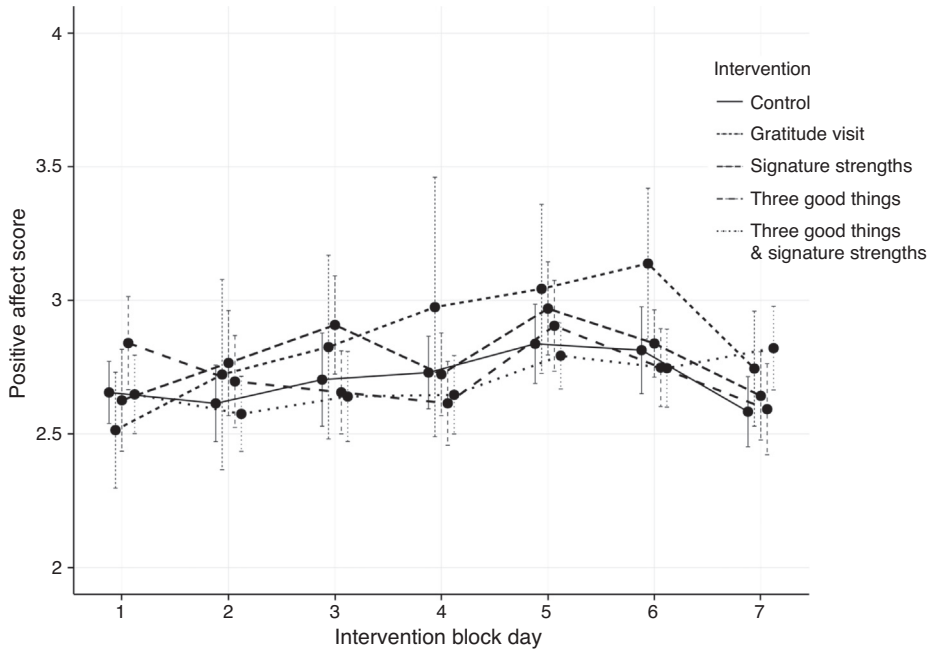

Figure 1 Means and 95% confidence intervals of positive affect over the 7 days in the intervention blocks.

Positive affect

Model 2 (Table 3) found no significant effects of time, or intervention on PA. However, a significant effect for the interaction term of time and Using Signature Strengths in a New Way was found. The -2LL test suggested a significantly better fit for the random intercepts model (Model 3), ($\Delta_{-2LL} = 459.74$, df = 1, $p < .01$). Allowing for random intercepts, the effect of time within the Using Signature Strengths in a New Way intervention was significant at B = .01 $p < .05$. Figure 1 illustrates the differential changes between interventions over time.

This effect was further probed using simple slopes analyses at three time points (for illustrative purposes): 10, 40, and 70 days into the study. The slopes of signature strength in predicting PA increased from B = -.1 at 10 days over B = .2 at 40 days to 0.5 at 70 days, suggesting that the effects of *Using Signature Strengths in A New Way* increased with time (Figure 2). Comparing Model 3 to Model 4, the -2LL test suggested no significantly better fit of the random slopes model where the slopes of the intervention were allowed to vary between participants ($\Delta_{-2LL} = 1.18$, df = 1, *n.s.*).

Negative affect

Model 2 (Table 4) found no significant effects of time, intervention or time*intervention on NA. Although the -2LL test suggested a significantly better fit for the random intercepts model (Model 3), ($\Delta_{-2LL} = 407.09$, df = 1, $p < .01$), the pattern of results did not change. This suggests that participants differ with regard to their mean NA scores, but that these scores are not different between interventions. The -2LL test suggested a significantly better fit of the random slopes model (Model 4; $\Delta_{-2LL} = 22.72$, df = 1, $p < .01$). The residual variance of the slopes was significant as well, suggesting that there might be differences between participants in the effects of the interventions on NA.

Discussion

Since Seligman et al. published the results of a large-scale placebo-controlled internet study of the effect of five PPIs on happiness (Seligman et al., 2005), there has been considerable interest in the possibility of increasing individual happiness through PPIs. However, to date, no study has focused on the effects of PPIs on the level of the individual, and this study was a first attempt. Previous studies have focused on mean change in happiness between groups, with most of the studies reporting smaller effect sizes than the original study (e.g., Mongrain & Anselmo-Matthews, 2012)

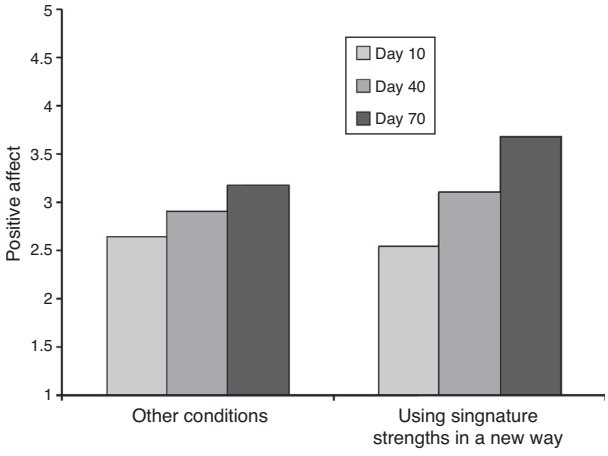

Figure 2 Interaction of Using Signature Strength in a New Way and time in predicting positive affect.

Table 4 Fixed effects estimates (top) and random effects estimates (bottom) for PANAS negative affect score.

	Parameter Estimate (SE)			
Parameter	Model 1	Model 2	Model 3	Model 4
Intercept	1.34 (.09)	1.31 (.15)	1.38 (.10)	1.38 (.09)
Level-1 (measurement occasion)				
Time (study day)		.000 (.001)	.001 (.004)	-.000 (.001)
S		-.06 (.11)	-.07 (.08)	-.07 (.09)
G		-.07 (.16)	.01 (.12)	.01 (.16)
T		.03 (.11)	.04 (.08)	.05 (.09)
TS		-.10 (.10)	-.10 (.08)	-.10 (.09)
S × time		.000 (.003)	-.000 (.002)	.001 (.002)
G × time		.01 (.01)	.001 (.004)	.001 (.005)
T × time		-.002 (.002)	-.003 (.002)	-.003 (.002)
TS × Time		.002 (.003)	.001 (.002)	.001 (.002)
Intercept (σ^2)	.11*		.11*	.11*
Slope Intervention (σ^2)				.02**
-2LL (*df*)		1385.10_a (11)	978.01_b (12)	955.29_c (13)

Note. ** $p < .01$, * $p < .05$, † $p < .1$; -2LL: -2 Log-likelihood. Values with different subscripts differ at $p < .01$; T = Three Good Things in Life, S = Using Signature Strengths in A New Way, G = Gratitude Visit, TS = Three Good Things in Life together with Using Signature Strengths in A New Way.

The purpose of the present study was to examine whether the -widely-used PPIs outlined by Seligman et al. (Seligman et al., 2005) impact on subjective well-being (SWB) at the individual level. We examined changes in affect in a controlled n-of-1-design. Four PPIs ('signature strengths', 'three good things', 'gratitude visit' and a combined 'signature strengths and three good things' intervention) were completed by all participants in one of six counterbalanced orderings, allowing the examination of within-person changes that might be masked in a between-subjects design. As noted earlier, the conclusions drawn from between-group comparisons might not extend to individuals, as the aggregate treatment of individual data in between-group comparisons might mask individual changes following an intervention (Molenaar & Campbell, 2009). Furthermore, examining individual change over time provides a stricter test of the effectiveness and potential clinical usefulness of the interventions.

One of the key aims of positive psychology is the development of interventions that improve individuals' subjective well-being, which makes the dearth of research into intra-individual changes following interventions both surprising and a serious limitation of research in the field. Our study is a first attempt at examining within-person effects of ''happiness'' interventions.

We found no overall change in any of the three affective indicators of SWB (positive affect scores, negative affect scores, and the affect balance score) over time although there was a small effect for Time on positive affect for participants who implemented the exercise of 'Using Signature Strengths In A New Way'.

Our study further suggests that the effects of PPIs on negative affect might differ considerably between participants, as evidenced by the significant random slopes variance of the intervention in predicting negative affect (Table 4).

Lack of effects on subjective well-being

Apart from the small interaction effect between the *Using Signature Strengths* intervention and Time, our study found none of the effects of the PPIs suggested by Seligman et al. (2005). Specifically, the two interventions *Gratitude Visit* and *Three Good things* had no significant effects on positive affect, and all four interventions had no significant effects on negative affect or overall well-being as indicated by the affect balance score.

Apart from the obvious fact that our study used the PANAS, as opposed to the AHI, a further possible explanation why we found no effects of the PPIs on well-being may be due to differences between our sample and that of Seligman et al. (2005). Whereas they used a relatively well-educated, financially comfortable, mildly depressed, motivated to become happier sample recruited through the university website, our sample was a non-depressed Australian community sample who responded to a newspaper advertisement. It is possible that a subject-expectancy effect might have contributed to the considerable effect sizes of the interventions in Seligman et al.'s research and to the lack of effect in our study.

A direct replication (Mongrain & Anselmo-Matthews, 2012) of Seligman et al.'s (2005) research found that the PPIs increased happiness levels, albeit with much smaller effect sizes. Furthermore, in this study, the PPIs did not exceed the control condition in reducing depression levels. The results from our study, using a strict test of within-individual changes in affect, when considered together with previous replications (Mongrain & Anselmo-Matthews, 2012), suggest that the PPI effects need further replication before conclusions can be drawn either about their general effectiveness, their support of basic tenets of positive psychology (Fernández-Ríos & Novo, 2012), or about their use

in evidence-based practice. The significant residual variance in the slopes of the interventions in our study suggest that the PPIs might affect people differentially, which suggests more research into moderators.

Signature Strengths Intervention

Seligman et al. (2005) suggest that the *Using Signature Strengths in a New Way* exercise is effective because participants should, with practice, improve in their ability to effectively implement the exercise and will become more inclined to keep using the exercise. However, this describes nothing more than a positive feedback loop (i.e., the intervention keeps working because it already worked). Moreover, Seligman et al. provide this same 'explanation' for why the *Three Good Things in Life* exercise is effective in their original study, yet our study found no significant effects for the *Three Good Things in Life* exercise. As long as no clear theoretical framework identifying potential mediators of the effects (or lack thereof) of these interventions is provided, it is very difficult to speculate about the effective ingredients in the interventions (Michie & Abraham, 2004).

Another possible explanation for the small but significant increase in positive affect of the *Using Signature Strengths in a New Way* intervention is that there exists great variety in how to implement it. According to the instructions, participants have the opportunity to choose from five signature strengths, and the specific implementation of the signature strength is left to the participants. This extent of freedom in implementing the exercise might itself have led to increases in well-being, as previous theory and research has suggested that being able to choose and implement paths of action is associated with increases in well-being (Fredrickson, 2008).

Intervention delivery

Our study assigned participants to various tasks for 9-10 weeks, whereas Seligman et al. (Seligman et al., 2005) relied on self-selected adherence to interventions over time. A meta-analysis of positive psychology interventions (Sin & Lyubomirsky, 2009) showed that self-selected individuals benefited more from the interventions than individuals who were assigned a task. This suggests that interventions with a good person-activity fit might have more substantial effects on happiness (Giannopoulos & Vella-Brodrick, 2011; Schueller & Parks, 2014). However, if PPIs are to be implemented as evidence-based practice (Rashid & Seligman, 2013; Seligman et al., 2006) and recommended as self-help tools, their effectiveness should not rely on the self-selection of participants.

Limitations

A potential limitation of our study is the measure used. Seligman et al. used the Authentic Happiness Inventory and the CES-D (Radloff, 1977) to measure happiness and depression. This study used the PANAS (Watson et al., 1988) to indicate the affective facet of subjective well-being. There is evidence for the validity of the PANAS as a measure of subjective well-being (Crawford & Henry, 2004), negative affect has been related to lower levels of happiness (Pelechano et al., 2013), and the PANAS has often been used in studies requiring frequent repeated assessments of affect (e.g., Brose et al., 2015), but it is possible that using different measures, other results might have emerged. Due to their relative length and stability assumption, both the AHI and CES-D are not appropriate for daily use and therefore were not suitable for this study. Related to this limitation, even though the PANAS was phrased to examine daily well-being levels, there are substantial fluctuations of well-being over a day, which the design of our study could not capture.

It should also be noted that this study was not a randomized n-of-1 design but a counterbalanced design, although the assignment of subjects to counterbalanced sequence was random. While it is generally preferable to use a randomized ordering of interventions in an n-of-1 design (Sniehotta, Presseau, Hobbs, & Araújo-Soares, 2012) randomization in a small sample ($n = 15$) such as this study may bias results as interventions may not be equally represented amongst few participants.

Implications

The lack of effects of widely used and recommended Positive Psychology Interventions on subjective well-being imply that the usefulness of these interventions in the clinical setting and their recommendation for self-help use is at least questionable. Although such interventions may produce between-group changes in well-being, this does not necessarily mean they produce clinically relevant intra-individual changes. In the light of recent debates on the effects of PPIs in large-scale interventions (Challen et al., 2014; Coyne, 2013) and the validity of some general claims of positive psychology (Brown et al., 2013), based on the findings of our study, these PPIs should not be recommended for use in evidence-based practice or as effective self-help tools.

References

Barbot, B., & Perchec, C. (2015). New directions for the study of within-individual variability in development: The power of N = 1. *New Directions for Child and Adolescent Development*, *147*, 57–67. http://dx.doi.org/10.1002/cad.20085

Bates, D., Maechler, M., Bolker, B., & Walker, S. (2014). lme4: Linear mixed-effects models using Eigen and S4. R package version 1. 1-7. Retrieved 8 April, 2015 from http://CRAN.R-project.org/package = lme4

Brose, A., Voelkle, M. C., Lövdén, M., Lindenberger, U., & Schmiedek, F. (2015). Differences in the Between-Person and Within-Person Structures of Affect Are a Matter of Degree. *European Journal of Personality*, *29*, 55–71. http://dx.doi.org/10.1002/per.1961

Brown, N. J. L., Sokal, A. D., & Friedman, H. L. (2013). The complex dynamics of wishful thinking: The critical positivity ratio. *American Psychologist*, *68*, 801–813. http://dx.doi.org/10.1037/a0032850

Challen, A. R., Machin, S. J., & Gillham, J. E. (2014). The UK Resilience Programme: A school-based universal nonrandomized pragmatic controlled trial. *Journal of Consulting and Clinical Psychology*, *82*, 75–89. http://dx.doi.org/10.1037/a0034854

Coyne, J. D. (2013, 25 Novermber 2013). Positive psychology in the schools: The UK Resilience Project. Mind the Brain Retrieved 25 March, 2015 from

http://blogs.plos.org/mindthebrain/2013/11/25/positive-psychology-in-the-schools-the-uk-resilience-project/

Crawford, J. R., & Henry, J. D. (2004). The positive and negative affect schedule (PANAS): Construct validity. measurement properties and normative data in a large non-clinical sample. *British Journal of Clinical Psychology*, *43*, 245–265.

Diener, E. (2012). New findings and future directions for subjective well-being research. *American Psychologist*, *67*, 590–597. http://dx.doi.org/10.1037/a0029541

Diener, E., Sandvik, E., & Pavot, W. (1991). Happiness is the frequency, not the intensity, of positive versus negative affect. In M. A. F. Strack, & N. Schwartz (Eds.), *Subjective well-being: An interdisciplinary perspective* (pp. 119–193). Oxford, UK: Pergamon.

Eid, M., & Diener, E. (1999). Intraindividual variability in affect: Reliability, validity, and personality correlates. *Journal of Personality and Social Psychology*, *76*, 662–676.

Fernández-Ríos, L., & Novo, M. (2012). Positive pychology: Zeigeist (or spirit of the times) or ignorance (or disinformation) of history? *International Journal of Clinical and Health Psychology*, *12*, 333–344.

Fredrickson, B. L. (2008). Promoting positive affect. In M. Eid, & R. J. Larsen (Eds.), *The Science of Subjective Well-Being* (pp. 449–468). New York, London: Guilford.

Giannopoulos, V. L., & Vella-Brodrick, D. A. (2011). Effects of positive interventions and orientations to happiness on subjective well-being. *Journal of Positive Psychology*, *6*, 95–105. http://dx.doi.org/10.1080/17439760.2010.545428

Hamilton, M. (1960). A rating scale for depression. *Journal of Neurology, Neurosurgery & Psychiatry*, *23*, 56–62.

Linley, P. A., Maltby, J., Wood, A. M., Osborne, G., & Hurling, R. (2009). Measuring happiness: The higher order factor structure of subjective and psychological well-being measures. *Personality and Individual Differences*, *47*, 878–884. http://dx.doi.org/10.1016/j.paid.2009.07.010

Lyubomirsky, S., King, L., & Diener, E. (2005). The benefits of frequent positive affect: Does happiness lead to success? *Psychological Bulletin*, *131*, 803–855. http://dx.doi.org/10.1037/0033-2909.131.6.803

Michie, S., & Abraham, C. (2004). Interventions to change health behaviours: Evidence-based or evidence-inspired? *Psychology and Health*, *19*, 29–49.

Molenaar, P. C. M., & Campbell, C. G. (2009). The new person-specific paradigm in psychology. *Current Directions in Psychological Science*, *18*, 112–117. http://dx.doi.org/10.1111/j. 1467-8721.2009.01619.x

Mongrain, M., & Anselmo-Matthews, T. (2012). Do Positive Psychology Exercises Work? A Replication of Seligman et al. *Journal of Clinical Psychology*, *6*, 8. http://dx.doi.org/10.1002/Jclp.21839

Ottenbacher, K. J. (1990). Clinically relevant designs for rehabilitation research: The idiographic model. *American Journal of Physical Medicine and Rehabilitation*, *69*, 286–292.

Ottenbacher, K. J. (1992). Analysis of data in idiographic research: Issues and methods. *American Journal of Physical Medicine and Rehabilitation*, *71*, 202–208.

Pelechano, V., González-Leandro, P., García, L., & Morán, C. (2013). Is it possible to be too happy? Happiness, personality, and psychopathology. *International Journal of Clinical and Health Psychology*, *13*, 18–24.

Peterson, C., Park, N., & Seligman, M. E. (2005). Assessment of character strengths. In G. P. Koocher, J. C. Norcross, & S. S. Hill (Eds.), *Psychologists' desk reference* (3rd ed., pp. 93–98). New York: Oxford University Press.

Radloff, L. S. (1977). The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement*, *1*, 385–401.

Rashid, T. (2015). Positive psychotherapy: A strength-based approach. *Journal of Positive Psychology*, *10*, 25–40. http://dx.doi.org/10.1080/17439760.2014.920411

Rashid, T., & Seligman, M. E. (2013). Positive Psychotherapy. In R. J. Corsini, & D. Wedding (Eds.), *Current Psychotherapies* (10th ed., pp. 461–498). Belmont, CA: Cengage.

Raudenbush, S. W., & Liu, X. (2000). Statistical power and optimal design for multisite randomized trials. *Psychological Methods*, *5*, 199–213.

Schueller, S. M., & Parks, A. C. (2014). The science of self-help: Translating positive psychology research into increased individual happiness. *European Psychologist*, *19*, 145–155. http://dx.doi.org/10.1027/1016-9040/a000181

Seligman, M. E. (2002). *Authentic happiness: using the new positive psychology to realize your potential for lasting fulfillment*. New York. NY: The Free Press.

Seligman, M. E., Rashid, T., & Parks, A. C. (2006). Positive psychotherapy. *American Psychologist*, *61*, 774–788. http://dx.doi.org/10.1037/0003-066X.61.8.774

Seligman, M. E., Steen, T. A., Park, N., & Peterson, C. (2005). Positive psychology progress - Empirical validation of interventions. *American Psychologist*, *60*, 410–421. http://dx.doi.org/10.1037/0003-066x.60.5.410

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. http://dx.doi.org/10.1002/Jclp.20593

Sniehotta, F. F., Presseau, J., Hobbs, N., & Araújo-Soares, V. (2012). Testing Self-Regulation Interventions to Increase Walking Using Factorial Randomized N-of-1 Trials. *Health Psychology*, *31*, 733–737. http://dx.doi.org/10.1037/a0027337

Snijders, T. A. B., & Boskers, R. J. (2012). *Multilevel Analysis: An introduction to basic and advanced multilevel modeling* (2nd ed.). London: Sage.

Spybrook, J., Bloom, H., Congdon, R., Hill, C., Liu, X., Martinez, A., & Raudenbush, S. W. (2011). Optimal Design Plus Empirical Evidence (v 3.01). Retrieved July 27, 2015 from http://hlmsoft.net/od/

Tellegen, A., Watson, D., & Clark, L. A. (1999). On the dimensional and hierarchical structure of affect. *Psychological Science*, *10*, 297–303.

Tervo, R. C., Estrem, T. L., Bryson-Brockmann, W., & Symons, F. J. (2003). Single-case experimental designs: applications in developmental-behavioral pediatrics. *Journal of Developmental & Behavioral Pediatrics*, *24*, 438–448.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: the PANAS scales. *Journal of Personality and Social Psychology*, *54*, 1063–1070.