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Power to the patients

Effects of two strengths-based interventions on emotions and pain and the mediating influence of extraversion in people with chronic pain

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Abstract

Chronic pain is a complex problem resulting from physical, psychological and social factors. Recent advancements in the field of positive psychology led to development of several interventions that could increase positive emotions, decrease negative emotions and decrease pain symptoms in people with chronic pain. An element of these positive-psychological interventions are strengths-based interventions, which aim to help people find their strengths and use them to cope with chronic pain. This study aimed to test the effect of two different brief strengths-based interventions (*identifying strengths* and *using strengths*) on negative and positive emotions, pain intensity and pain interference and the mediating influence of the personality trait extraversion on this effect. A randomized quantitative experimental design with pretest, posttest and follow-up measurements with two groups was used. In total, 52 participants finished the pre- and posttest measurements and 19 participants (37%) finished follow-up measurements. The results showed a significant decrease of negative emotions and pain interference. No significant results were found for positive emotions, pain intensity, the mediating effect of extraversion and the two interventions showed the same results, meaning that the *using strengths* intervention did not outperform the *identifying strengths* intervention, as hypothesized. Overall, these results are promising for the usefulness of brief strengths-based interventions for people with chronic pain in decreasing negative emotions and ease the burden of chronic pain. Several recommendations for future research are stated in this study, including increasing the amount of participants, improving adherence rates, including a control condition and using additional variables like pain catastrophizing and well-being.

Introduction

Strengths-based approach

In 1980, Antonovsky introduced the concept of salutogenesis to the scientific world (Antonovsky, 1980). This concept is the opposite of the "disease care system" or "pathogenic orientation which suffuses all western medical thinking" (Antonovsky, 1996), which focuses on risks, ill health and disease. A more salutogenic approach focuses on peoples' resources and capacities to create health (Lindström & Eriksson, 2005). A strengths-based approach to health is an example of a salutogenic approach and it aims at using strengths, which have been defined as "the characteristics people use to achieve well-being and to flourish, and include attributes such as hope, gratitude, love of learning, honesty, humor and learning" (Seligman & Csikszentmihalyi, 2000).

The two key strategies of the strengths-based approach are to first identify strengths and then apply these strengths in daily life (Seligman, Steen, Park, & Peterson, 2005). This means that to accomplish the possibility of using a strengths-based approach it is crucial to first be able to explore someone's strengths, so they could be used in an intervention. However, study shows that fewer than one third of individuals have meaningful understanding of the strengths they possess (Linley, 2008; Saleebey, 1996). To ease this process of finding one's strengths, a strengths finder could be used. One example of such a strengths finder is the Norwegian strengths finder, which consists of 42 strengths divided in four subgroups and was translated from Norwegian to Dutch (Kristjansdottir et al., 2018). This strengths finder is specifically made for patients with a chronic illness, because study shows that to live well with a chronic disease it is an essential process for these patients to identify one's strengths (Lorig & Holman, 2003). Prior research has shown that when asked about their strengths, patients with chronic illness report similar processes to those that are known to promote successful self-management and resilience, including increased knowledge, positive emotions and sense of purpose (Kristjansdottir et al., 2018). On the other hand, people might experience negative effects of a strengths-based intervention like feelings of discouragement and sadness (Müller et al., 2016). Therefore, it could be stated that filling out a strengths finder could be considered as an independent strengths-based intervention, aimed at the first key strategy of the strengths-based approach. To accomplish the second key strategy of the strengths-based approach, application of someone's strengths, multiple strengths-based interventions are developed which can reliably promote life satisfaction (Duan, Ho, Tang, Li, & Zhang, 2014) and decrease depressive symptomatology (Wellenzohn, Proyer, & Ruch, 2016). An example of such a strengths-based intervention that could increase happiness and decrease depressive symptoms is the "using signature strengths in a new way" intervention (Seligman et al., 2005). To my knowledge, no research has yet been done to explore the

effectiveness of a strengths-based intervention which only concerns the first key strategy of identifying strengths, compared to a strengths-based interventions which concerns both key strategies of identifying and applying strengths. This study will try to provide information regarding this gap in existing literature.

Emotions

Research shows that strengths-based interventions influence emotions. Emotions can change within seconds (Picard, 1997) and could be split in positive and negative emotions, which have shown to be relatively independent dimensions (Watson, Clark, & Tellegen, 1988). This counterintuitive idea was proposed by Bradburn in 1969, which showed that instead of an expected tendency of a correlation between for example high positive affect and low negative affect, these two constructs are statistically independent (Bradburn, 1969). For example, his research found significant correlations between negative affect and worry or anxiety, but not with lower levels of positive affect.

Study showed that a strengths-based intervention could lead to an increase of positive emotions (Proctor et al., 2011) and a decrease of negative emotions (Duan & Bu, 2017). The strengths-based intervention increases positive emotions by counteracting the effects of hedonic adaption and not taking positive traits for granted (Lyubomirsky, Sheldon, & Schkade, 2005). Furthermore, prior research showed that these positive emotions buffer or counteract negative emotions (Fredrickson, Cohn, Coffey, Pek, & Finkel, 2008; Tugade & Fredrickson, 2004), which could be explained using the broaden-and-built theory of positive emotions (Fredrickson, 1998). This theory states that positive emotions increase the range of individuals' thought-action repertoires, characterized by more flexible and creative ways of acting and thinking. While on the other hand, negative emotions seem to decrease this range of thought-action repertoires. An increase of positive emotions will counteract the narrowing of thought-action repertoires related to negative emotions (Fredrickson, 2001; Fredrickson & Levenson, 1998). In other words, positive emotions might "undo" the effects negative emotions have on the body (Fredrickson, Mancuso, Branigan, & Tugade, 2000). This theory is supported by the dynamic model of affect (DMA) proposed by Zautra et al. (2001), which hypothesizes that people that tend to experience more positive emotions will experience lower levels of negative affect in times of pain (Zautra, Smith, Affleck, & Tennen, 2001). Additionally, the positive-activity model, further elaborated in the extraversion paragraph, states that performing positive activities (like a strengths-based intervention) increases positive emotions (Lyubomirsky & Layous, 2013). To sum up, it could be stated that participating in a strengths-based intervention increases positive emotions and decreases negative emotions. This increase of positive emotions and

decrease of negative emotions is also clearly visible in the affect balance, a single balance score between positive and negative emotions (Schimmack, 2008).

Pain

Emotions and (chronic) pain are closely related, as explained in the next paragraph. Chronic pain, defined as pain lasting longer than three months or past the normal time for tissue healing (Chou et al., 2015), is a large problem in the Netherlands. Approximately 18% of Dutch adults report having moderate to severe chronic pain (Bekkering et al., 2011). This pain is located mostly in the lower back (21.2%), shoulders (15.1%) and neck (14.3%) (Picavet & Schouten, 2003). Further, chronic pain is a symptom of many diseases like fibromyalgia, arthritis, whiplash and multiple sclerosis. Chronic pain has an extensive impact on the lives of people suffering from chronic pain and their environment. One study with people with moderate to severe chronic pain reported that 54% of these people cannot function normally, 46% cannot take care of themselves and 19% reported being diagnosed with depression (Breivik, Collett, Ventafridda, Cohen, & Gallacher, 2006). Additionally, the costs, both direct and indirect, of people with chronic pain are high. For example, the annual costs for one patient with fibromyalgia are €7.814 and for chronic low back pain €8.533 (Boonen et al., 2005). This large impact is partly due to the multidimensional nature of chronic pain. To illustrate this, lower back pain has been shown to be influenced by an interplay of multiple factors besides the apparent physical dimension, including psychological, social, lifestyle and non-modifiable factors (O'Sullivan, Caneiro, O'Keeffe, & O'Sullivan, 2016).

To get an impression to what extent someone is suffering from pain, the intensity of pain could be measured. However, pain intensity primarily measures the physical dimension of pain. To measure the multidimensional effects of the debilitating influence of chronic pain, pain interference could be measured, defined as 'a measure of the extent to which pain hinders engagement with physical, cognitive, emotional, and recreational activities' (Karayannis, Sturgeon, Chih-Kao, Cooley, & Mackey, 2017). In general, the relationship between pain intensity and pain interference could be described as a relationship with a threshold effect in which low pain intensity is rarely associated with pain interference and moderate to severe levels of pain intensity are more often associated with higher levels of pain interference (Arnstein, Caudill, Mandle, Norris, & Beasley, 1999; Jensen, Smith, Ehde, & Robinsin, 2001). A recent qualitative study showed that in individuals with chronic pain, the psychological consequences mattered even more than the physical pain intensity (Ojala et al., 2015). Due to this complex character of chronic pain and pain interference, it takes longer for these factors to change after an intervention.

Relationship between emotions & pain (interference)

Study shows that there is a relationship between emotions and pain. Positive affect has been shown to decrease pain intensity in people with chronic pain (Finan, Quartana, & Smith, 2013; Thong, Tan, & Jensen, 2017; Zautra, Johnson, & Davis, 2005) This could be explained using the previously mentioned broaden-and-built theory of positive emotions (Fredrickson, 1998), which states that interventions that increase positive emotions can build psychological, cognitive, physical and social resources by broadening thoughts and actions (Fredrickson et al., 2008) and this way decrease pain complaints (Carson et al., 2005). Furthermore, study showed that negative affect on the other hand, may cause sensitization to pain (Janssen, 2002). The underlying mechanism for this process is that functionally viewed, negative emotions serve to increase vigilance to the threat of tissue damage (Watson & Pennebaker, 1989) and to promote recovery of tissue by avoidance (Vlaeyen & Linton, 2000). Given the above, interventions that decrease negative emotions and increase positive emotions might indirectly decrease pain complaints, by decreasing sensitization to pain.

Moreover, research has shown that positive-psychology interventions not only decrease pain intensity in patients, but also decrease pain interference (Müller et al., 2016). Research shows that positive affect could decrease pain interference in people with chronic pain by acting as a resource that could increase resilience during an episode of increased pain intensity. This resilient effect could be the result of several factors, including changes in cognitive appraisals of self-efficacy, reframing of pain beliefs, or through increased affective resources as proposed in the broaden-and-built theory (Fredrickson & Joiner, 2002; Thong et al., 2017). In contrast, negative affect could increase pain interference in people with chronic pain. To illustrate, patients who are anxious may be hesitant to participate in activities they regard as too demanding or patients with depressive symptoms might feel helpless and therefore have minimal initiative to comply to therapy (Gatchel, Peng, Peters, Fuchs, & Turk, 2007).

However, it should be noted that most of these mechanisms explaining the effect of emotions on pain intensity and pain interference come from research on a broad range of positive-psychology interventions and not solely from strengths-based interventions, since information about the mechanisms explaining the effects of strengths-based interventions is lacking.

The heuristic model (figure 1) summarizes the information provided in the previous paragraphs about the expected working mechanisms behind the strengths-based approach.

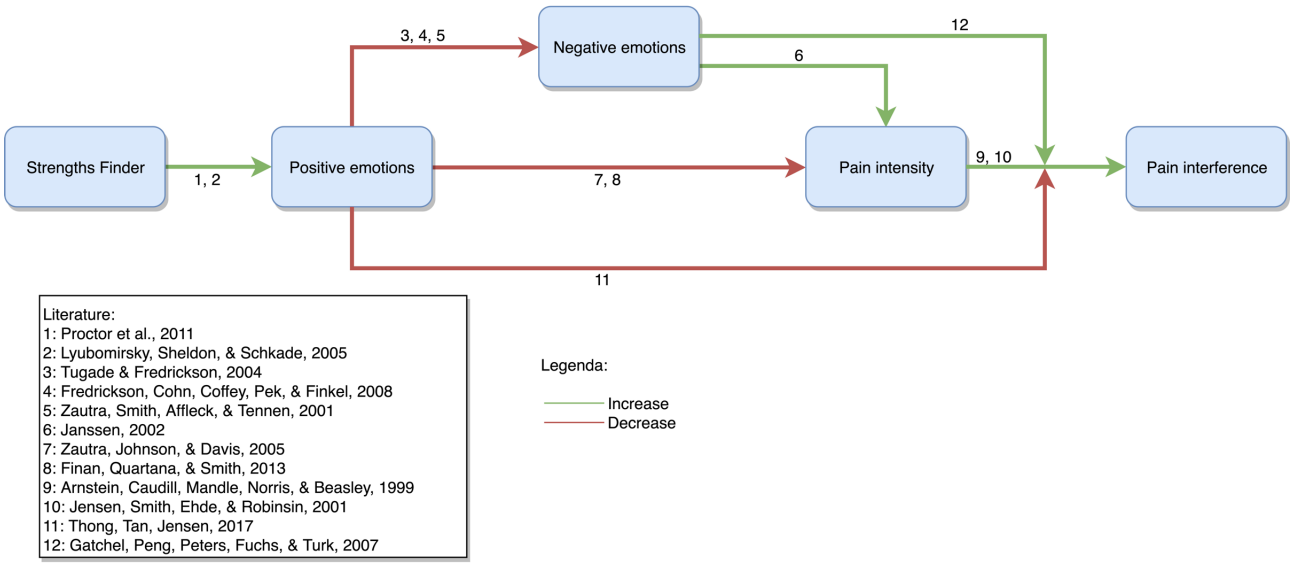

Figure 1. *Heuristic model of psychological effects of strengths-based interventions*

Extraversion

Previous research has shown that several mediators influence the effectiveness of a strengths-based intervention including personality characteristics. Multiple dimensions of the big five personality characteristics (openness to experience, conscientiousness, extraversion, agreeableness and neuroticism (McCrae & John, 1992)) are shown to be mediating in strengths-based interventions. Study showed that an increased level of the personality trait extraversion increased the likelihood of a strengths-based intervention to be effective on decreasing depressive symptoms, including effect on negative emotions (Senf & Liau, 2013). On the other hand, another study showed that a high score of the dimension neuroticism decreased the sustainability of the effects of a strengths-based intervention (Ng, 2016). Previous study found that extraversion and neuroticism are respectively positively and negatively related to happiness (Furnham & Christoforou, 2007), which could contribute to the explanation why these personality characteristics mediate the effect of strengths-based interventions. Additionally, a literature review showed that literature agrees on the mechanisms responsible for a successful strengths-based intervention (Ghielen, van Woerkom, & Meyers, 2017). This review states that all investigated mechanisms that influence a strengths-based intervention function because of the four mediators proposed by the positive-activity model (positive emotions, positive thoughts, positive behavior and need satisfaction) (Lyubomirsky & Layous, 2013). In conclusion, it is expected that personality characteristics related to happiness could be mediating factors in a successful strengths-based intervention.

This study

As mentioned before, filling out a strengths finder could be considered an independent strengths-based intervention. However, it makes sense to assume that a strengths-based intervention in which participants are thinking about and using the strengths they possess in a more conscious and profound manner, will increase the effectiveness of the intervention. This is supported by literature that suggests that for participants to increase their quality of life it is important to first be conscious of valuable strengths (Saleebey, 2008). Because of this reasoning, this study will use two intervention groups. The first intervention group will only fill out the strengths finder, solely including the first key strategy of the strengths-based approach of identifying someone's strengths (*identifying strengths*). The second intervention group will be filling out the strengths finder (*identifying strengths*) in a more profound manner and will receive an additional strengths-based exercise, including both key strategies of the strengths-based approach (*using strengths*).

Additionally, no research has yet been done to examine the mediating effect of the personality trait extraversion on the strengths-based intervention of filling out the Dutch version of the Norwegian strengths finder and the effect of this intervention on emotions, pain intensity and pain interference. To answer this gap in current literature, this research will aim to investigate the influence of the big five personality dimension extraversion as mediating factor in increasing effectiveness of the two strengths-based interventions used in this study. This effectiveness will be measured in increase of positive emotions and decrease of negative emotions, pain intensity and pain interference. The following research questions will be answered in this study:

Research question 1: what is the effect of the strengths-based intervention *identifying strengths* on negative emotions, positive emotions and affect balance?

Research question 2: what is the effect of the strengths-based interventions *identifying strengths* and *using strengths* on pain intensity and pain interference?

Research question 3: what is the difference of the effects on pain intensity and pain interference between the *identifying strengths* and *using strengths* interventions?

Research question 4: to what extent is the personality trait extraversion a mediating factor in the effectiveness of the two interventions (*identifying strengths* and *using strengths*) used in this study?

Methods

Participants

Using convenience sampling 52 participants with chronic pain were recruited from four physiotherapy practices. All participants voluntarily agreed to participate in this research and signed a written informed consent. The following inclusion criteria were used: 1) age above 18; 2) presence of chronic pain (≥ three months); 3) sufficient knowledge of the Dutch language. Participants were either patients in one out of two physiotherapy practices with a trajectory for patients with chronic pain and chronic fatigue (Ortius and OCA) or patients from one out of two primary care physiotherapy practice (Pro Corpus and Fysio Twente). Demographic characteristics of the sample with 52 participants (13 men) are shown in table 1 divided in the group that only received the *identifying strengths* intervention, the group that received both intervention and total. Participants with chronic pain reported having different conditions, including fibromyalgia, back pain, whiplash and Ehler-Danlos syndrome and comorbidities like arthritis, depression and COPD.

Table 1. *Participants' demographic characteristics per group*

Characteristics		**Group 1, n (%)**	**Group 2, n (%)**	**Total, n (%)**
Participants		21	31	52
Age mean (range)		52 (22-77)	47 (20-79)	49 (20-79)
Marital status	Married	15 (71%)	26 (84%)	41 (79%)
	Not married/divorced	6 (29%)	5 (16%)	11 (21%)
Highest level of education*	1-3	6 (29%)	5 (16%)	11 (22%)
	4-5	7 (33%)	19 (61%)	26 (50%)
	6-8	8 (38%)	7 (23%)	15 (28%)
Duration of chronic pain	3 months – 1 year	2 (10%)	11 (35%)	13 (25%)
	1 year – 5 years	7 (33%)	4 (13%)	11 (21%)
	5 years – 10 years	9 (43%)	9 (29%)	18 (35%)
	> 10 years	3 (14%)	7 (23%)	10 (19%)
Comorbidities	0	9 (43%)	14 (45%)	23 (44%)
	1	10 (47%)	13 (42%)	23 (44%)
	> 2	2 (10%)	4 (13%)	6 (12%)

* 1-3: lower education; 4-6: intermediate education; 7-8: higher education:

1. Geen opleiding, 2. Basisonderwijs, 3. Lager beroepsonderwijs, 4. MAVO, (M)ULO, 3-jarige HBS, VMBO, 5. Middelbaar beroepsonderwijs, 6. 5-jarige HBS, HAVO, MMS, atheneum, gymnasium, 7. Hoger beroepsonderwijs, 8. Wetenschappelijk onderwijs

Interventions

The current study included two different strengths-based interventions.
The first intervention, called *identifying strengths*, was listing one's strengths that helped patients cope with their chronic illness, using the Dutch version of the Norwegian strengths finder, which only appealed to the first key strategy of the strengths-based approach of identifying one's strengths.
The second intervention, called *using strengths*, was making a top five of core strengths using the listed strengths reported in the first intervention and explaining why these five strengths were their core strengths. Further, participants were asked to use their five core strengths for the next seven days in a new or different way. This exercise, called "using signature strengths in a new way" has previously been shown to increase happiness and decrease depressive symptomatology (including negative emotions) (Seligman et al., 2005). Instructions regarding the *using strengths* intervention are added as appendix I. This intervention appealed to the second key strategy of the strengths-based approach, applying one's strengths.

Design

A randomized quantitative experiment with two groups was used to study the effects of two different strengths-based interventions.

Participants from the two practices with trajectories for patients with chronic pain were cluster-randomized in a group with participants that only received the *identifying strengths* intervention and a group that received the *identifying strengths* and the *using strengths* interventions. The fact that the participants of the chronic pain trajectories received physiotherapy in a group setting increased the chance of a contamination bias and therefore cluster-randomization was used. Since the patients in the primary care physiotherapy practices received physiotherapy individually, the chance of contamination bias was minimal and patients in this group were alternately assigned to the group that received the *identifying strengths* intervention and the group that received the *identifying strengths* and the *using strengths* interventions.
The two subject groups with participants from the primary care physiotherapy practices were called group A and group C, while the two subject groups from the practices with chronic pain trajectories were called group B and group D. The participants in groups A and B only received *identifying strengths*, while participants in groups C and D received both *identifying strengths* and *using strengths.*

The three times of measurement were T0 (pre-intervention), T1 (post-intervention) and T2 (online follow-up after two weeks). A schematic overview of the design is provided in figure 2.

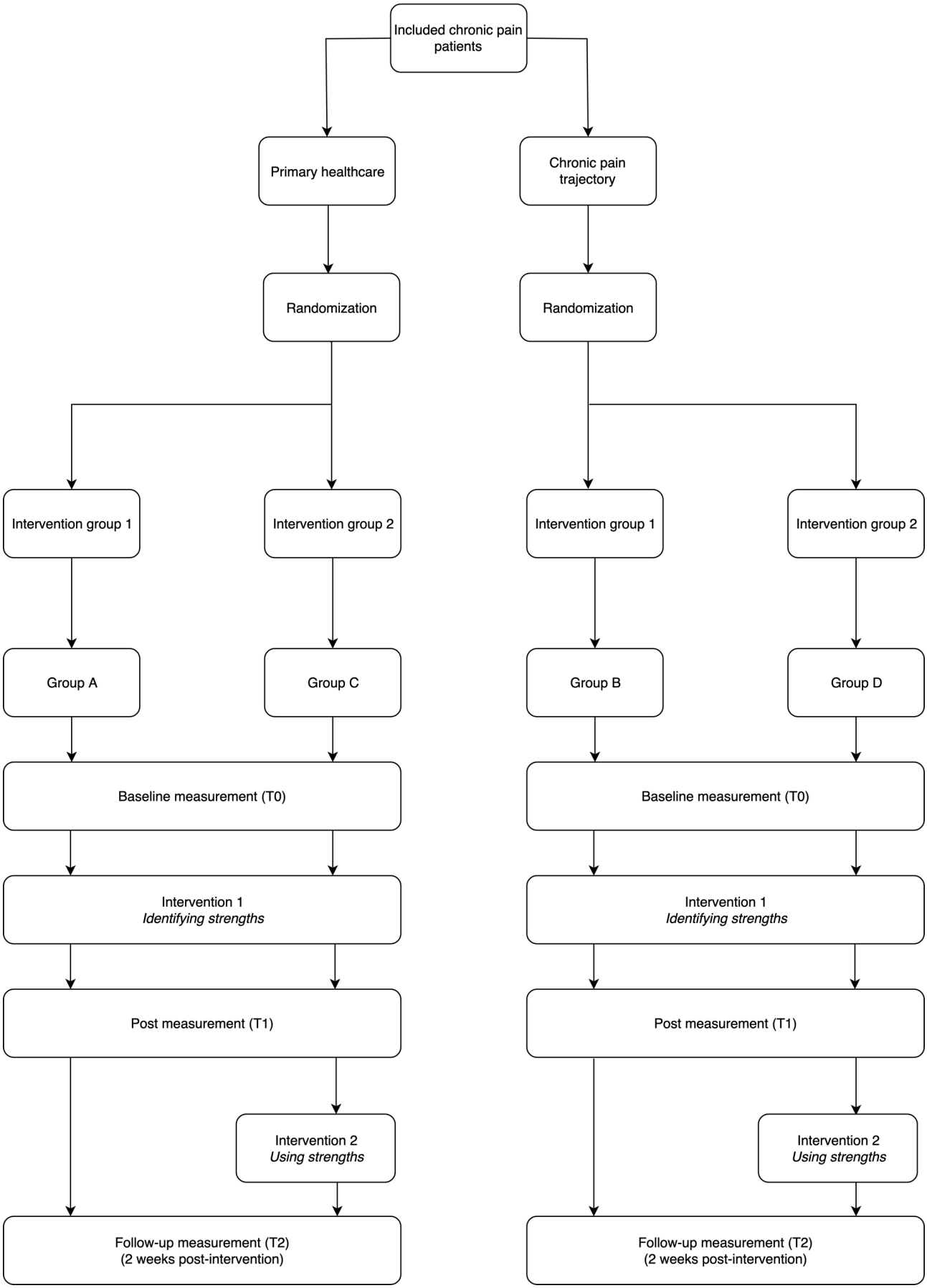

Figure 2. *Schematic overview of study design*

Materials

Personality

The big five dimension extraversion was assessed using the Quick Big Five (QBF) (Vermulst & Gerris, 2005), added as appendix D. This questionnaire consisted of six adjectives (reserved, quiet, introverted, talkative, bashful and withdrawn). Participants were asked to rate these adjectives on a 7-point Likert Scale (ranging from 0 "does not apply to me at all" to 6 "applies to me very well") to what extent these adjectives applied to them. Prior research reported adequate reliability and validity of this questionnaire (Branje, van Lieshout, & Gerris, 2007). The Cronbach's alpha for this scale in this study was $\alpha = .84$.

Emotions

Emotions were measured using the Positive And Negative Affect Schedule (PANAS) (Watson et al., 1988). This schedule, provided in appendix B, consisted of ten positive and ten negative emotions, which could be scored using a 5-point Likert Scale (ranging from 1 "very slightly" to 5 "very much"). The positive emotions were: interested, excited, strong, enthusiastic, proud, alert, inspired, determined, attentive and active. The negative emotions were: distressed, upset, guilty, scared, hostile, irritable, ashamed, nervous, jittery, afraid. Previous research showed that the Dutch version of this schedule had sufficient validity and reliability (Peeters, Ponds, & Vermeeren, 1996). In this study, the Cronbach's alpha was $\alpha = .88$ on T0 and $\alpha = .91$ on T1 for the positive affect scale and $\alpha = .84$ on T0 and $\alpha = .90$ on T1 for the negative affect scale. However, if the positive emotion excited was deleted, the Cronbach's alpha would increase to $\alpha = 0.90$ on T0 and $\alpha = 0.93$ on T1.

Pain intensity

The Numeric (Pain) Rating Scale (NPRS), provided in appendix C, was used to assess the participant's pain intensity. This valid and reliable scale (Huskisson, 1974) scored pain from 0 "no pain" to 10 "worst pain imaginable".

Pain interference

Pain interference was measured using the pain interference part of the Dutch version of the Multidimensional Pain Inventory (MPI-DLV), provided in appendix E. This valid and reliable questionnaire consisted of nine items that measured the consequences of pain of relevant aspects of one's life, by scoring the statements (e.g. to which extend has pain influenced your possibility to work") on a 7-point Likert Scale (ranging from 0 "no interference" to 6 "very strong interference") (Lousberg, Schmidt, Groenman, Vendrig, & Dijkman-Caes, 1997). Cronbach's alpha for this scale in this study was $\alpha = .90$ on T0 and $\alpha = .83$ on T2.

Strengths

The Dutch version of the Norwegian strengths finder, provided in appendix A, was used to measure participants' strengths. This strengths finder consisted of 42 strengths, categorized in four categories: personal attributes, meaningful engagement and positive emotions, external strengths and self-management strategies (Kristjansdottir et al., 2018). Prior research has shown that the Dutch version of the Norwegian strengths finder is a feasible tool in detecting strengths in patients with chronic pain (Slatman, 2018).

Procedure

This study was approved by an accredited Medical Research Ethics Committee in the Netherlands (file number: K19-09) and the Medical Ethical Committee of the University of Twente (file number: 190059).

Participants were informed about the aim of the research and asked if they wanted to participate. When a participant agreed, an informed consent was signed, which is provided in appendix G. Following, the demographic information (appendix F), the extraversion dimension of the QBF, the PANAS, the NPRS and the pain interference part of the MPI-DLV were filled out. Then, all participants were asked to fill out the Dutch version of the Norwegian strengths finder, previously described as the *identifying strengths* intervention. Immediately after this intervention, participants were asked to fill out the PANAS again. Next, participants from the *using strengths* intervention group were asked to complete the *using strengths* intervention, mentioned in the intervention paragraph.

At the two weeks online follow-up, participants were once more asked to fill out the NPRS and MPI-DLV (pain interference part). One week after the follow-up, a reminder email was send to participants that did not answer the follow-up email.

A schematic overview of the used questionnaires at different measurement moments is given in table 2.

Table 2. *Overview of used questionnaires at different measurement times*

T0 **(pre-intervention)**	**T1** **(directly post-intervention)**	**T2** **(2 weeks post-intervention)**
PANAS	PANAS	-
NPRS	-	NPRS
MPI-DLV (pain interference)	-	MPI-DLV (pain interference)
Informed consent	-	-
Demographic information	-	-
QBF (extraversion)	-	-

Power analysis

To calculate how many participants had to be included in this study, a power analysis was performed. Since information about the effect size of strengths-based interventions was lacking, effect sizes of different positive-psychology interventions were used in this analysis. The only meta-analysis regarding positive-psychology interventions found an average effect size of 0.34 (Cohen's d) for subjective well-being (Bolier et al., 2013). Further, a one-tailed test was chosen because the previous mentioned meta-analysis showed that virtually every intervention found a positive effect on subjective well-being. The analysis, executed with G* Power, calculated that a minimum of 55 participants were needed to demonstrate a moderate effect size of 0.34 with a statistical power of 0.80 in a one-tailed paired samples t-test ($p < 0.05$).

Analyses

Research question 1: what is the effect of the strengths-based intervention *identifying strengths* on negative emotions, positive emotions and affect balance?

The influence of the strengths-based intervention on emotions, measured using the PANAS, was analyzed by first calculating a summed positive emotional score. This summed positive emotional score was calculated for T0 and T1 by adding all ten positive emotion scores from all participants and dividing by ten and the number of participants (scores ranged between 0 = least positive to 5 = most positive). These scores were compared between T0 and T1 using a t-test. Next, this step was also done in the same manner for the summed negative emotional score. Further, the affect balance was calculated by adding all 20 emotions, after reverse scoring the negative emotions, and dividing by 20 (scores were ranging from 0 = most negative to 5 = most positive). Then, these scores were compared between T0 and T1 using a t-test. To increase insight regarding the influence on separate emotions, a summed score per emotion was calculated on T0 and T1 by adding all scores of one emotion and divided by the number of participants. Then, these scores per emotion were compared between T0 and T1 using a t-test. In case the data were not distributed normally, a Wilcoxon signed rank test was used instead of a t-test for all previously mentioned calculations.

Research question 2: what is the effect of the strengths-based interventions *identifying strengths* and *using strengths* on pain intensity and pain interference?

First, to analyze how selective the drop-out is, a one-way ANOVA was used to compare the drop-out group with the completers group on socio-demographic characteristics (gender, age, marital status and educational level), pain intensity and pain interference at T0 with the group (completer or drop-out) as factor and pain intensity, pain interference, summed positive emotions, summed negative emotions and affect balance as dependent variables.

Next, pain intensity scores, measured with the NPRS, were compared between T0 and T2 using a t-test. Correspondingly, the scores of pain interference were summed and divided by nine (number of items in questionnaire) and this way merged into one score. Next, these scores were compared between T0 and T2 using a t-test. In case the data were not distributed normally, a Wilcoxon signed-rank test was used instead of a t-test.

Research question 3: what is the difference on the effects on pain intensity and pain interference between the *identifying strengths* and *using strengths* interventions?

To calculate the difference of effects of the two intervention groups on pain intensity and pain interference a MANOVA (Wilks' Λ) was used with the groups as fixed factors and the pain intensity on T0 and T2 as dependent variables. This was also done with the pain interference on T0 and T2 as dependent variables.

Research question 4: to what extent is the personality trait extraversion a mediating factor in the effectiveness of the two interventions used in this study?

The mediating effect of the personality trait extraversion on the two strengths-based interventions was examined with a mediation analysis using the PROCESS macro (v3.3) in SPSS on the variables positive emotions, negative emotions, pain intensity and pain interference (Hayes, 2013). Figure 3 schematically shows the mediating influence of extraversion on the different tested variables.

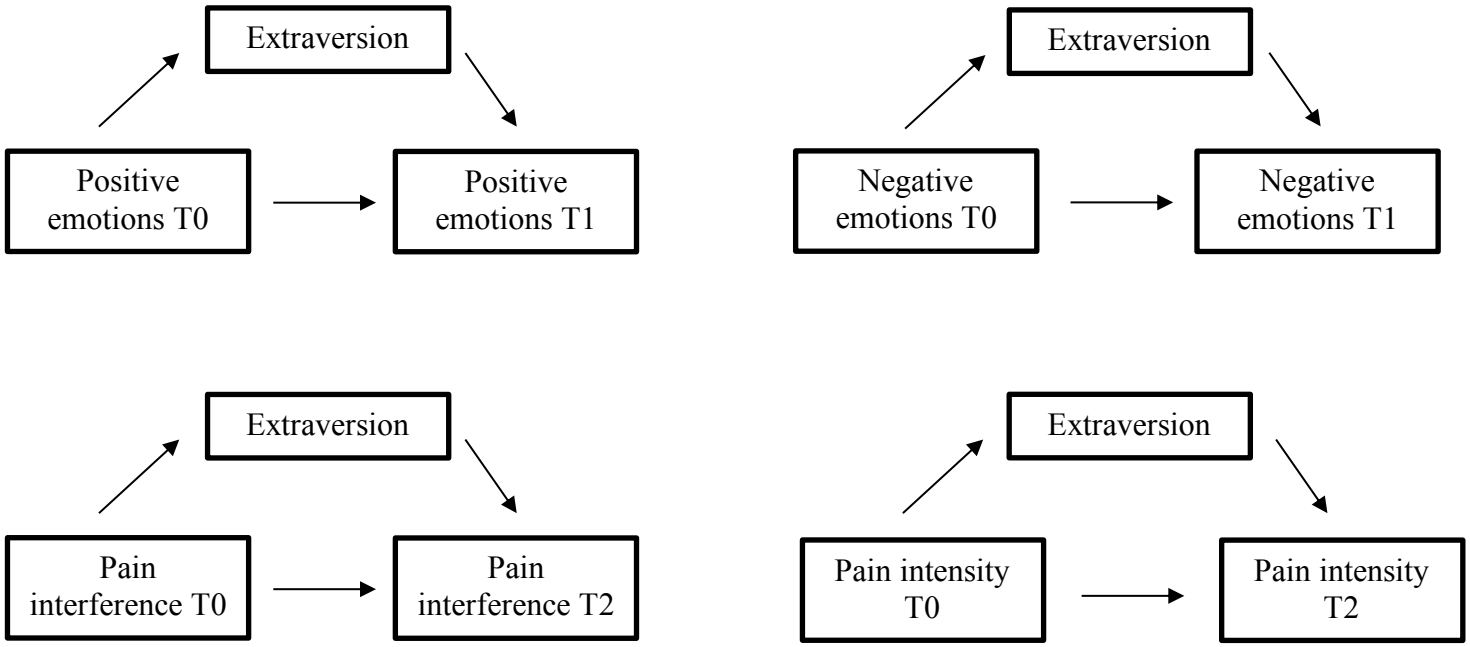

Figure 3. *Schematic overview of the hypothesized mediation process*

Results

The flow of participants is shown below in figure 4. Since pre-measurement and post-measurement were done in one session, there was no drop-out. However, follow-up measurements were done after two weeks using email, resulting in a drop-out between 42.9% (group C) and 66.7% (group A, B and D) and a total of 19 completed follow-up measurements (37%). This high drop-out rate could have been due to the fact that the follow-up measurement was performed using email, without any face-to-face interaction. Calculations showed that there were no baseline differences on any of the questionnaires and demographics, between the group that only received the *identifying strengths* intervention and the group that received both interventions.

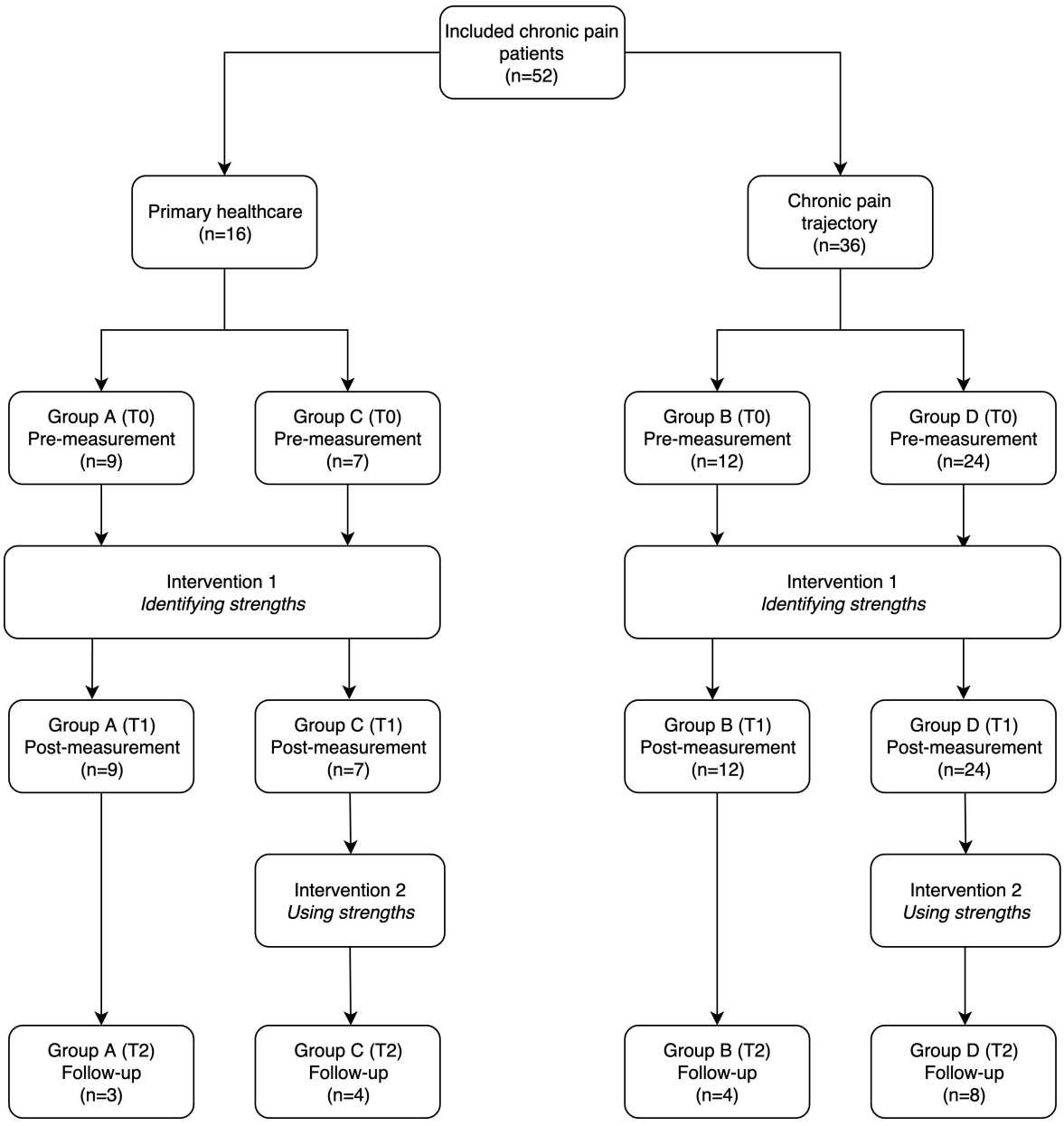

Figure 4. *Flow of participants*

Strengths

The strengths participants reported to have are given in appendix H. On average, participants reported to possess 27 strengths that helped them cope with their chronic pain, ranging from 8 to all 42 strengths. Additionally, the most chosen strength (96%) was "I live in a safe environment" and the least chosen strength was "I can set boundaries" (25%). Furthermore, participants from the *using strengths* intervention group were asked to compile a top five out of their chosen strengths. All these top fives combined let to the creation of the six top strengths participants reported that helped them most to cope with their chronic pain, presented in table 3.

Table 3. *Participants' reported top 6 strengths*

Top 6	
1	I am persistent
2	I have family and friends I can count on
3	I try to help others
4	I am thankful for the good in my life
5	I have a sense of humor
6	I like to try out or learn new things

Research question 1: what is the effect between T0 and T1 of the strengths-based intervention *identifying strengths* on negative emotions, positive emotions and affect balance?

To answer this research question, the effectiveness of the interventions on emotions was calculated, shown in table 4. The scores for the summed positive emotions, summed negative emotions and affect balance were not distributed normally (respectively Shapiro-Wilk test: T0 = .024 and T1 = .009, T0 < .001 and T1 < .001 and T0 = .004 and T1 < .001), so the Wilcoxon signed-rank test was used for all calculations. To clarify the results, the means of the scores on T0 and T1 are shown in the table as well, even though this statistic was not used in the Wilcoxon signed-rank test. The results of the tests showed no difference at T1 on summed positive emotions, but showed a significant difference on summed negative emotions towards less negative emotions at T1, and a significant difference on affect balance towards a more positive affect balance at T1. Further, each individual emotion was examined to see which emotions caused the previously discussed results, as shown in table 5. Since the scores of the emotions were not distributed normally, the Wilcoxon signed-rank test was used. To clarify the results, the means of the emotions on T0 and T1 are given, even though this statistic was not used in the test, as shown in table 5. The results showed no significant differences at T1 for any positive emotion. However, regarding negative emotions, six out of ten negative emotions decreased significantly at T1 (distressed, scared, irritable, nervous, jittery, and afraid). In contrast to the hypothesized independence, the dimensions of positive and negative emotions were actually correlated (Pearson's r T0 = -.422 (p = .002) and T1 = -.364 (p = .008)).

Table 4. *Differences on emotions, pain and pain interference on T0, T1 and T2*

Variable	**T0 (SD)**	**T1 (SD)**	**Z-value**	**p-value**	**T2 (SD)**	**Z-value**	**p-value**
Positive emotions	3.32 (.72)	3.32 (.79)	-.22	.824	-	-	-
Negative emotions	1.74 (.63)	1.51 (.70)	-4.38	< .001*	-	-	-
Affect balance	3.79 (.57)	3.90 (.62)	-3.51	< .001*	-	-	-
Pain intensity total	5.42 (1.95)	-	-	-	4.95 (2.09)	-1.18	.238
Pain intensity group 1	6.00 (2.16)	-	-	-	5.14 (2.41)	-1.09	.276
Pain intensity group 2	5.08 (1.83)	-		-	4.83 (1.99)	-.60	.546
Pain interference total	4.05 (1.22)	-	-	-	3.12 (1.04)	-3.73	< .001*
Pain interference group 1	4.24 (1.24)	-	-	-	3.19 (.98)	-2.39	.017*
Pain interference group 2	3.93 (1.26)	-	-	-	3.07 (1.12)	-2.94	.003*

* significant at a 0.05 significance level

Table 5. *Differences in separate emotions between T0 and T1*

Emotion	**Mean score T0 (SD)**	**Mean score T1 (SD)**	**Z-value**	**p-value**
Interested	3.96 (.82)	3.79 (.85)	-1.70	.089
Excited	2.15 (1.09)	2.13 (1.14)	-.11	.911
Strong	3.15 (1.06)	3.27 (1.07)	-1.17	.243
Enthusiastic	3.44 (1.11)	3.60 (1.05)	-1.31	.189
Proud	3.15 (1.16)	3.35 (1.08)	-1.66	.097
Alert	3.42 (.94)	3.44 (.96)	-.23	.819
Inspired	3.17 (1.08)	3.27 (1.09)	-1.03	.305
Determined	3.73 (1.01)	3.60 (1.16)	-1.17	.242
Attentive	3.67 (1.02)	3.52 (1.09)	-1.80	.073
Active	3.31 (1.00)	3.21 (1.04)	-.99	.320
Distressed	1.75 (.97)	1.40 (.75)	-3.05	.002*
Upset	1.40 (.82)	1.29 (.82)	-.93	.352
Guilty	1.73 (1.03)	1.67 (1.10)	-.81	.417
Scared	1.65 (.95)	1.42 (.91)	-2.40	.016*
Hostile	1.10 (.30)	1.12 (.47)	.00	1.00
Irritable	2.60 (1.18)	1.98 (1.23)	-3.46	.001*
Ashamed	1.77 (.98)	1.62 (1.03)	-1.64	.102
Nervous	1.92 (1.15)	1.56 (1.07)	-3.58	< .001*
Jittery	1.81 (1.16)	1.58 (1.09)	-3.00	.003*
Afraid	1.69 (1.06)	1.46 (1.04)	-2.67	.008*

* significant at a 0.05 significance level

Negative emotion

Research question 2: what is the effect between T0 and T2 of the strengths-based interventions *identifying strengths* and *using strengths* on pain intensity and pain interference?

At the follow-up after two weeks, 33 participants dropped out. To get more insight to what extent the drop-out was selective, the completers group was compared to the drop-out group, see table 6. Regarding socio-demographic characteristics, the completers groups did not differ from the drop-out group on all characteristics, except for educational level ($p = .012$, higher educational level in completers group). Regarding pain, the calculations showed that the groups only differed significantly on pain intensity at baseline, in which the completers group reported lower levels of pain intensity compared to the drop-out group.

To get an overall impression of the effect of the strengths-based interventions on pain intensity and pain interference, the difference on pain intensity and interference scores were calculated between T0 and T2 for all participants that finished follow-up measurements (19 participants) for both groups and total, see table 4. Since the data were not distributed normally, the Wilcoxon signed-rank test was used for all calculations. To clarify the results, the means of the scores on T0 and T2 are shown in the table as well, even though this statistic was not used in the Wilcoxon signed-rank test. Regarding pain intensity, the results showed no significant difference at the two week follow-up in both groups and total. For pain interference, the calculations showed a significant decrease at T2 for both intervention groups and for both groups combined.

Table 6. *Baseline differences between completers and drop-out groups*

Variable	**T0 total (SD)**	**T0 completers (SD)**	**T0 drop-out (SD)**	**F-value**	**p-value**
Pain intensity	6.29 (1.92)	5.42 (1.95)	6.79 (1.75)	6.779	.012*
Pain interference	4.02 (1.16)	4.05 (1.22)	4.00 (1.13)	.019	.891
Summed positive emotions	3.32 (.72)	3.41 (.57)	3.27 (.80)	.441	.510
Summed negative emotions	1.74 (.63)	1.62 (.60)	1.81 (.65)	1.102	.299
Affect balance	3.79 (.57)	3.89 (.40)	3.73 (.65)	1.004	.321

*significant at a 0.05 significance level

Research question 3: what is the difference between T0 and T2 of the effects on pain intensity and pain interference between the *identifying strengths* and *using strengths* interventions?

To see the differences of effect on pain intensity and pain interference between the two interventions groups, both groups were compared on effectiveness on pain intensity and pain interference between T0 and T2, shown in table 7 and figure 5. These results showed no significant difference between the effectiveness of the *identifying strengths* intervention and the combination of the *identifying strengths* and *using strengths* interventions, on pain intensity and pain interference. However, it seemed that in the *identifying strengths* group, pain intensity and pain interference decreased more than in the participants from the group that received both the *identifying strengths* and *using strengths* interventions. In conclusion, it seemed that the *using strengths* intervention could not outperform the *identifying strengths* intervention on pain intensity and pain interference.

Table 7. *Differences between group 1, group 2 and total*

Variable	**Group 1 T0 (SD)**	**Group 1 T1/T2 (SD)**	**Group 2 T0 (SD)**	**Group 2 T1/T2 (SD)**	**Wilks' Λ**	**p-value**
Pain intensity	6.00 (2.16)	5.14 (2.41)	5.08 (1.83)	4.83 (1.99)	.936	.588
Pain interference	4.24 (1.24)	3.19 (.98)	3.93 (1.26)	3.07 (1.12)	.974	.821

*significant at a 0.05 significance level

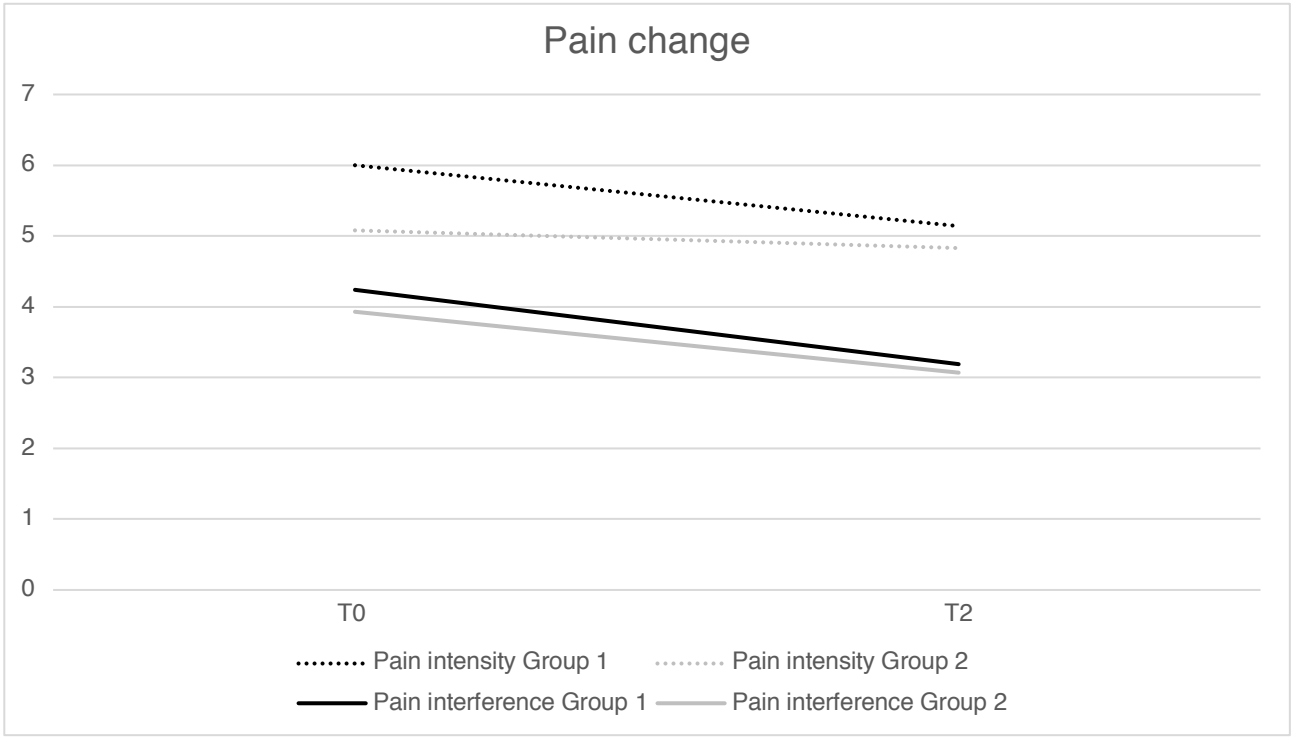

Figure 5. *Pain differences between group 1 and group*

Research question 4: to what extent is the personality trait extraversion a mediating factor in the immediate- and short-term effectiveness of the two interventions used in this study?

The results of the mediation analysis are shown below in figure 6. These calculations showed that extraversion was not a significant mediator for any of the four used variables (positive emotions, negative emotions, pain interference and pain intensity), since every confidence interval of the indirect effect contained zero and the effect sizes were very small or negative.

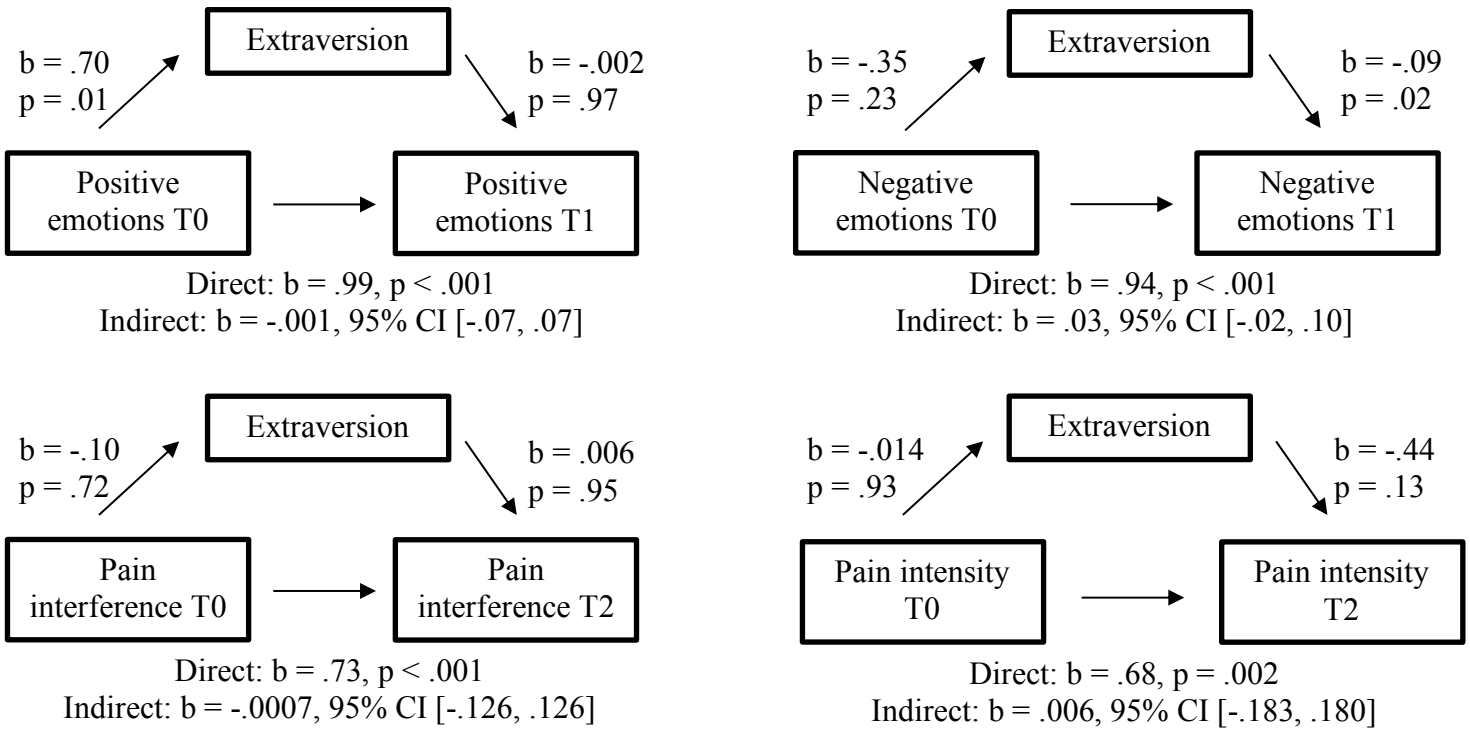

Figure 6. *Model of mediating effect of extraversion on outcome variables, BCa bootstrapped CI based on 5000 samples*

Discussion

Main findings

This study measured the effectiveness of a strengths-based intervention (*identifying strengths*) on emotions (positive emotions, negative emotions and affect balance) and pain (intensity and interference), the effect of a second strengths-based intervention (*using strengths*) on pain intensity and pain interference and the mediating effect of personality trait extraversion on the effectiveness of these interventions. The results indicated that the *identifying strengths* intervention decreased negative emotions, did not alter positive emotions and changed affect balance towards a more positive balance. Additionally, it seemed that the *identifying strengths* intervention decreased pain interference, but did not change pain intensity. Although it should be noted that the power of the follow-up results regarding pain was low, due to the low response rate. The results about the *using strengths* intervention showed that this intervention did not outperform the *identifying strengths* intervention in decreasing pain intensity and pain interference. Further, extraversion seemed to not be a mediating factor in the effectiveness of the two interventions for any of the tested variables.

Emotions

This study supported the hypothesis that the *identifying strengths* intervention could decrease negative affect. Especially negative emotions regarding stress (distress and irritableness) and anxiety (nervousness and being afraid) decreased significantly. This result is similar to the result found in a study by Duan & Bu (2017), who also used a single-session strengths-based intervention aimed at decreasing negative affect. Another study also reported decrease in negative affect after several different positive-psychological interventions (Seligman et al., 2005). The result found in the current study is notable because negative affect decreased significantly, while the *identifying strengths* intervention is easy to perform and very brief, even compared to the single-session intervention (with a duration of 90 minutes) used in the study by Duan & Bu (2017) for example.

On the other hand, the current study did not confirm the initial hypothesis that the *identifying strengths* intervention would increase positive emotions, even though prior research showed an immediate increase of positive emotions after a positive-psychological intervention (Sheldon & Lyubomirsky, 2006). This result is striking, since positive-psychological interventions tend to focus on increasing positivity over decreasing negativity (Schutte & Malouff, 2019). However, this striking result could partially be explained using the process model of emotion regulation (Gross, 1998), which states that positive-psychological interventions could increase positive emotions through five

strategies: situation selection, situation modification, attentional deployment, cognitive change, and response modulation (Quoidbach, Mikolajczak, & Gross, 2015). To illustrate, mindfulness interventions could increase positive emotions by applying the attentional deployment strategy (Erisman & Roemer, 2010) and an "acts of kindness" intervention, in which participants are asked to perform random acts of kindness, could increase positive emotions by applying the situation selection strategy (Alden & Trew, 2013). The goal of the *identifying strengths* intervention was to increase awareness of one's strengths by filling out the strengths finder, which could be considered an intervention aimed at using the cognitive change strategy to increase positive emotions. More specifically, the *identifying strengths* intervention used the cognitive reappraisal strategy, a component of the cognitive change strategy, which has been shown to particularly diminish negative emotions, which is in line with the results from the current study (Gross & John, 2003; Gross, 2002; Gross & Richards, 2006; Ochsner & Gross, 2005). Since the strategy used in current study is primarily effective in decreasing negative emotions, future research could implement other strategies that are more effective in increasing positive emotions, like situation selection (Quoidbach et al., 2015). Moreover, it should be noted that the length of the intervention could be a contributor to the absence of results on increase in positive emotions, since research has shown that longer and more profound interventions tend to have larger impact on positive emotions (Sin & Lyubomirsky, 2009). Alternatively, in regard to the circumplex model (Russell, 1980), the PANAS exclusively measures activated emotions (e.g. excited or enthusiastic) and no deactivated emotions (e.g. content or relaxed), while prior research found an increase of deactivated, but not activated, positive emotions after a positive-psychological intervention (Iyer, 2008). Also, multiple participants reported being confused by the positive emotion 'excited', since the Dutch translation of this word could be interpreted as a negative emotion instead of a positive emotion. Even though the reliability of the positive affect scale was high, it could be increased considerably by deleting this item. The problem with the interpretation of this word has been reported in a previous study as well (Westerhof, Lamers, & de Vries, 2010), in which all positive emotions were loaded substantially on the same factor, except for the emotion 'excited'. Also, the variable affect balance was used in this study, but in spite of the significant increase of affect balance towards a more positive affective state, the meaning of this variable was minimal in this study. The reason for this lack of meaning was that the components that construct the affect balance (positive affect and negative affect) provide more information about the effect of the intervention than solely the affect balance. The finding that the affect balance had minimal added effect is in line with other studies, which mainly used the affect balance in case only one variable for a total emotional state was needed (e.g. for mediation-analyses), but not to get more insight in specific emotional changes (Liu, Wang, & Lü, 2013; Sirois & Hirsch, 2015; Zhu, 2015).

Pain

Regarding pain intensity and pain interference, the hypothesis that the *identifying strengths* intervention would decrease pain intensity was not confirmed. Next to the explanation that this intervention does not decrease pain intensity, it could also be possible that the intervention was not profound or long-lasting enough to cause a significant difference or the measure chosen to assess this domain was not sensitive enough to detect differences in a small sample of only 19 participants. Since information about the specific working mechanisms behind strengths-based interventions are lacking, due to the novelty of these interventions, working mechanisms behind the psychological field of acceptance and commitment therapy (ACT) were reviewed (Hayes, Strosahl, & Wilson, 2012), because ACT has been substantially studied in regard to chronic pain (McCracken & Vowles, 2014). ACT and positive-psychological interventions have the same aim of promoting human flourishing and are rather closely related, for example when looking at their overlapping technologies, like goal setting, mindfulness and focus on psychological strengths (Ciarrochi & Kashdan, 2013). More specific for the current study, character strengths, regarded as the centerpiece of positive psychology (Peterson & Seligman, 2004), often have an element of valuing which in turn is a key element of ACT (Ciarrochi & Kashdan, 2013). A study that reviewed literature regarding the effectiveness of ACT-interventions on decreasing pain intensity in people with chronic pain found that there is not sufficient evidence that these interventions were effective in decreasing pain intensity, possibly due to the complex nature of chronic pain (Chiesa & Serretti, 2011). Further, a meta-analysis of ACT-interventions for treatment of chronic pain found, in line with the findings of the current study, that decreases in pain interference were larger than decreases in pain intensity, because pain interference is a more proximate indicator of the goals of ACT-interventions (Veehof, Oskam, Schreurs, & Bohlmeijer, 2011). In conclusion, it seems that both positive-psychological- and ACT-interventions are more effective in decreasing pain interference than pain intensity, because they both aim to cope better with chronic pain and related experiences, instead of decreasing the pain stimulus and therefore it could be stated that it was rather optimistic to hypothesize that a brief intervention like the *identifying strengths* intervention could decrease pain intensity after two weeks. In addition, study showed that other psychological factors like pain catastrophizing, defined as "the degree to which a patient employs overly negative, exaggerated cognitive appraisals of the pain experience" (Sullivan et al., 2001), could be decreased by ACT-interventions as well (Buhrman et al., 2013; Vowles, McCracken, & Eccleston, 2007). Future research could include pain catastrophizing and other factors like hope, sense of meaning and well-being since research showed that these factors could be improved using positive-psychological interventions (Howell, Jacobson, & Larsen, 2015; Littman-Ovadia & Niemiec, 2016).

The hypothesis that a positive-psychological intervention could decrease pain interference, as shown in previous studies (Müller et al., 2016; Peters et al., 2017), was also confirmed in this study despite the relatively small sample size and brief intervention. However, the study by Müller et al. (2016) among participants with chronic pain, used four different tailored online positive-psychological interventions that had to be carried out at least once a week for 15 minutes with a duration of eight weeks. Additionally, the study by Peters et al. (2017) among participants with chronic pain used an eight week long, one hour a week, online positive-psychology intervention containing multiple positive-psychological interventions. A meta-analysis on the effects of positive-psychological interventions showed that interventions with a longer duration are more effective (Bolier et al., 2013), which suggests that the effectiveness of the current intervention could be increased by prolonging the intervention. Also, the studies by Müller et al. (2016) and Peters et al. (2017) used multiple positive-psychological interventions, while the current study only used the one *identifying strengths* intervention. Even though, research shows that a "shotgun" approach in which individuals practice multiple positive-psychological interventions are more effective and engaging (Fordyce, 1977; Hausmann, Parks, Youk, & Kwoh, 2014; Seligman et al., 2005). All in all, the results from the current study are promising, because they showed that only a five to ten minute, single-session strengths-based intervention could decrease pain interference, while research showed that the effectiveness of a strengths-based intervention could be increased by prolonging the intervention and increasing the amount of interventions.

Using strengths

The expected effect of the *using strengths* intervention (also called "using signature strengths in a new way") on pain intensity and pain interference turned out to be absent. This result is notable, since a recent meta-analysis has shown that positive-psychological interventions could decrease pain (Iddon, Dickson, & Unwin, 2016) and that an increased amount of positive-psychological interventions increased its effectiveness (Seligman et al., 2005). This led to the hypothesis that the combination of the *identifying strengths* and *using strengths* interventions would yield larger results in decreasing pain intensity and pain interference than only the *identifying strengths* intervention. This lack of significant results could have several reasons. First of all, only 12 participants remained in the *using strengths* intervention after two weeks, in opposition to seven participants not assigned to this intervention, which made it hard to detect differences. Also, compared to positive-psychological interventions that are successful in significantly decreasing pain intensity and pain interference, like the interventions used by respectively Tse et al. (2010) and Müller et al. (2016), the *using strengths* intervention is very short (one week compared to eight weeks). Further, when looking

at the content of the interventions in regard to the previously mentioned psychological field of ACT, the intervention by Müller et al. (2016) for example, has one intervention called 'Savoring' that is about "taking delight and replaying life's momentary pleasures and wonders", which is very close to the present moment awareness that is one of the six psychological skills used in ACT (Hayes et al., 2012). This example illustrates how other positive-psychological interventions correspond better with known mechanisms in decreasing pain intensity and especially pain interference. Therefore, it could be possible that the *using strengths* intervention is not ideal in decreasing pain intensity and pain interference and is more useful as an intervention for decreasing depressive symptoms and increasing happiness, as study (Seligman et al., 2005) and replication of this study showed (Mongrain & Anselmo-Matthews, 2012) or in decreasing negative emotions and increasing positive emotions, like the *identifying strengths* intervention used in the current study. Additionally, it should be noted that participants were asked to perform the intervention only once, without any form of reminder. This could have resulted in lower rates of adherence to the intervention, since study shows that forgetfulness regarding the intervention is a large factor in non-compliance (Jin, Sklar, Min Sen Oh, & Chuen Li, 2008). Another reason for the adherence rate could be the absence of immediate positive effect, which decreases adherence according to literature (Meichenbaum & Turk, 1987). To increase adherence, a lottery for the completers could have been used, like Seligman et al. (2005) did with the same intervention or adherence could have been improved using persuasive technology (like a reminder-app). Also, the way participants conducted the intervention could have influenced the results, as previous study found that the more effort participants invested, the larger the results were that were found in a short intervention like this *using strengths* intervention (Proyer, Wellenzohn, Gander, & Ruch, 2015). In conclusion, it seems that the *using strengths* intervention was not effective in decreasing pain intensity and pain interference, but it should be noted that this result is based on only 19 participants that finished follow-up measurement, the intervention is relatively short, adherence rates were unclear and the intervention might be more suitable in changing other factors like emotions and well-being. To tackle the problems found in the current study, future research could increase the amount of participants, use tools to increase adherence and might include more variables the intervention could influence.

Extraversion

The assumption that extraversion was a mediating factor in the effectiveness of the strengths-based interventions on emotions, pain intensity and pain interference was rejected. The main reason for formulation of this hypothesis was prior research that found extraversion was associated with well-being and a mediating factor in the effectiveness of another positive-psychological intervention

(Diener, Oishi, & Lucas, 2003; Senf & Liau, 2013). When looking at the type of intervention, the study by Senf & Liau (2013) used a gratitude- and a savoring intervention. This result is in accordance with another study that found that extraversion is a mediating factor in the effectiveness of gratitude and savoring interventions (Schueller, 2012). However, latter study also found that signature strengths interventions, like the two interventions used in the current study, were more beneficial for introverts than extraverts. A possible reasoning explaining this finding is that extraverts prefer social situations and social interventions like expressing gratitude to someone, while introverts prefer individual interventions like the interventions used in the current study (Lucas & Diener, 2001). Further, these two studies only focused on happiness and depressive symptoms, which overlaps with the affective outcome measure used in the current study, but did not focus on pain. Additionally, another study that used a combination of different positive-psychological interventions to increase happiness among healthy adults found that extraversion had no mediating effect on any of the measured effects of the intervention (Proyer, Gander, Wellenzohn, & Ruch, 2016).

Since it seems that extraversion might not be a mediating factor in increasing positive emotions and decreasing negative emotions and pain in the individual strengths-based interventions used in the current study, maybe other internal or external factors have a more apparent mediating effect. For example, psychometric intelligence has been shown to increase effectiveness of positive-psychological interventions (Proyer et al., 2016) and another study showed that positive-psychological interventions tend to be more effective in individualistic cultures than collectivistic cultures (Hendriks, Schotanus-Dijkstra, Hassankhan, de Jong, & Bohlmeijer, 2019; Lyubomirsky, Dickerhoof, Boehm, & Sheldon, 2011). Therefore, future research regarding mediating factors in strengths-based interventions could include personal characteristics like psychometric intelligence and cultural background, since these factors might have a larger mediating effect than the personality trait extraversion. Furthermore, it should be mentioned that self-selection might have altered the results of the current study. Participants were asked if they wanted to participate, so it could be possible that interest among introverts was lower than extraverts, as introverts might have preferred an online intervention for example (Harrington & Loffredo, 2010; Tsan & Day, 2007). Moreover, the current research used a sample with 39 females and 13 males. This could have altered the results, since study showed that women tend to have higher levels of extraversion (Weisberg, DeYoung, & Hirsh, 2011), even though it should be taken into consideration that women are more likely to suffer from chronic pain in general (Breivik et al., 2006; Fillingim, 2000). Overall, it seems that extraversion was not a mediating factor in the effectiveness of the strengths-based interventions used in the current study, which could be due to the content of the used interventions.

Strengths

The strengths participants from the *using strengths* intervention reported as their top 5 strengths, corresponded with existing literature. A study regarding successful self-management found three main categories of self-management processes (Schulman-Green et al., 2012), which were all represented in the top strengths participants reported: activating resources ("I have family and friends I can count on"), focusing on illness needs ("I am persistent") and living with a chronic illness ("I am thankful for the good in my life"). Additionally, the self-determination theory states that three psychological needs (competence, autonomy and relatedness) motivate someone to participate in health behavior (Deci & Ryan, 1985). These three psychological needs are found in the top strengths participants reported: competence ("I am persistent"), autonomy ("I like to try out or learn new things") and relatedness ("I have family and friends I can count on" and "I try to help others").

Heuristic model

The heuristic model provided in the introduction regarding the working mechanisms behind a strengths-based approach needs reconsideration, given the results from this study. The hypothesized key role of positive emotions in this model seems to be smaller than expected, as it seems that a strengths-based intervention could decrease negative emotions without changing positive emotions. Moreover, the results from this study show that a strengths-based intervention could decrease pain interference without changing pain intensity. With these results in mind, the original heuristic model was adapted, as shown in figure 7. However, it is clear that more research is warranted to further develop the working mechanisms of the strengths-based approach proposed in this model.

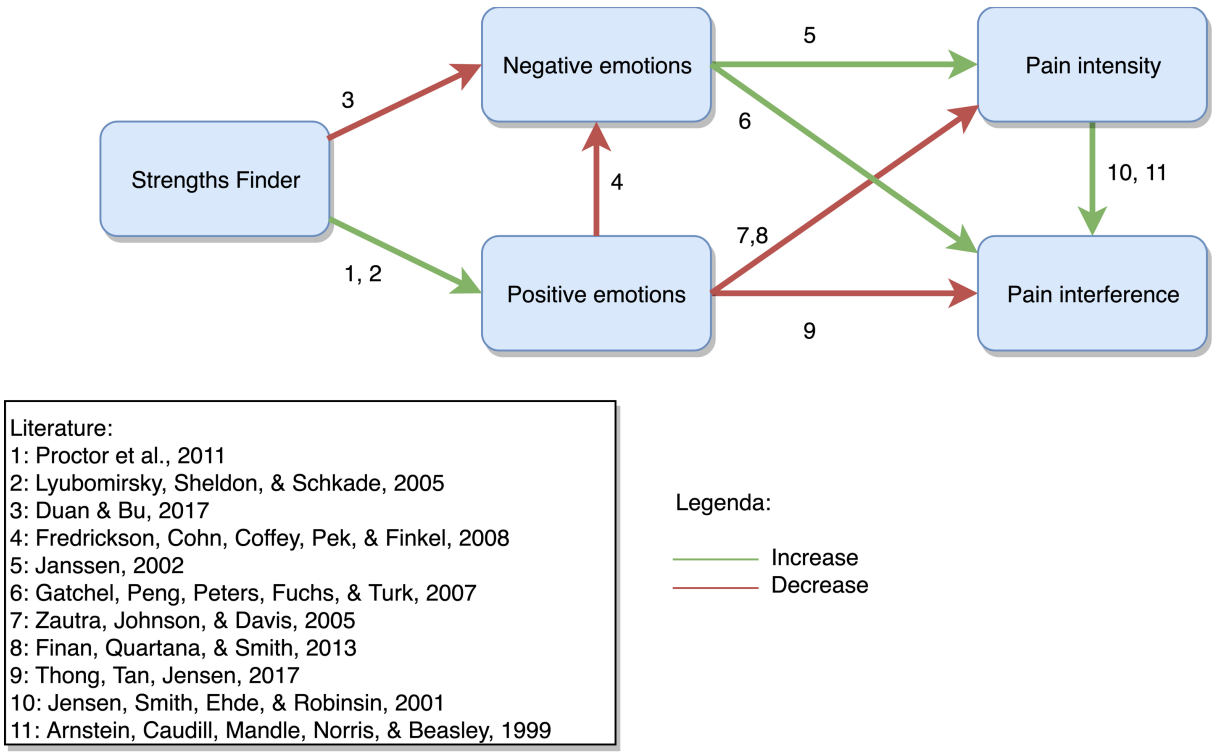

Figure 7. *Adapted heuristic model of psychological effects of strengths-based interventions*

Limitations & strengths

Limitations

This study had multiple important limitations that should be noted when considering the findings and implications of this study. The most prominent limitation is the high drop-out rate at the follow-up measurement of 63%. This high rate is far above the recommended attrition rate of 20% at most for study validity in general (Sackett, Richardson, & Rosenberg, 1997). Study shows that adherence in people with chronic pain is low, with rates between 70% for prescribed medication (Broekmans, Dobbels, Milisen, Morlion, & Vanderschueren, 2009) and physical therapy (Kolt & McEvoy, 2003) to 50% for cognitive behavioral therapy (Nicholas et al., 2012), which has a significant impact on the effectiveness of the interventions (Butow & Sharpe, 2013). The most plausible reason for this drop-out rate is the lack of face-to-face contact at the follow-up measurement. Also, people could have had trouble responding to the email or do not check for new email regularly. To decrease the attrition rate, future studies could provide reminders or increase face-to-face contact with the participants. Furthermore, the lack of a control group is another limitation, since found results might be due to another cause than the intervention (e.g. Hawthorne-effect), especially because previous studies regarding positive-psychological interventions found increases in life satisfaction and happiness and decreases in depressive symptomology in the control groups that did not receive a positive-psychological intervention (Müller et al., 2016; Seligman et al., 2005). For that reason, future research should include a control condition to get more insight in the effectiveness of the positive-psychological intervention. Another limitation could be that the results were influenced by a social desirability bias, because the researcher was present while the participants completed the questionnaires. Additionally, it should be noted that the researcher was working as a physiotherapist at one of the practices used in this study (Pro Corpus). Even though none of the participants were one of his patients, it could be that this and the social desirability bias influenced the results in the sense that participants might have discovered the goal of the intervention and therefore reported more socially desirable answer like feeling less negative emotions or more positive emotions. Finally, the fact that this entire study was based on self-report should be noted as well.

Strengths

Besides limitations, this study had some strengths that should be highlighted. First of all, the number of participants could be considered a strength, even though the a priori calculated needed sample size of 55 participants was not achieved. Further, the sample consisted of a heterogeneous group of participants with ages ranging from 20 to 79, suffering from different (psycho)somatic conditions, recruited from various physiotherapy practices and reported having chronic pain for several months to several decades. As mentioned before, this is the first study to use the Dutch version of the Norwegian strengths finder in a Dutch sample, which could be considered a strength of this study.

Conclusion

Although no improvement was found for positive emotions or pain intensity, this study showed that a very brief strengths-based intervention of just identifying one's strengths is effective in decreasing negative emotions and pain interference. Also, a second intervention aimed at using strengths in a new way did not have any effect after the first intervention and the personality trait extraversion showed to not have a mediating role in the effectiveness in any of the two interventions. Further research is recommended to further support the promising results found in the current study, preferably with sufficient participants as suggested after running a power analysis, with a control group and higher adherence rates. Additionally, future research could potentially utilize a longer and more profound intervention and include other variables like pain catastrophizing and well-being, to see if this will yield more results.

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Appendix A. Strengths finder

Kruis alstublieft aan welke van deze krachten u helpen omgaan met uw chronische pijn.

	Persoonlijke kenmerken
1	Ik ben een doorzetter
2	Ik ben empathisch
3	Ik probeer anderen te helpen
4	Ik kan gedachten en ervaringen delen met anderen
5	Ik probeer of leer graag nieuwe dingen
6	Ik kan grenzen stellen
7	Ik probeer goed voor mijzelf te zijn
8	Ik heb kennis over mijn ziekte en behandeling
9	Ik heb een bewegingsvorm gevonden die ik leuk vind
10	Over het algemeen accepteer ik mijn situatie
11	Ik kan dingen achter me laten en vooruitkijken
12	Ik heb al eerder moeilijkheden overwonnen en ik denk dat ik dat weer kan
13	Ik heb een gevoel van controle in mijn leven
14	Over het algemeen ben ik me bewust van mijn lichaam en geest
	Zinvolle betrokkenheid en positieve emoties

15	Ik prioriteer wat ik belangrijk vind
16	Ik heb betekenisvolle relaties en activiteiten
17	Ik heb dingen waar ik van geniet en naar uit kijk
18	Ik heb meestal een positief vooruitzicht
19	Ik ben vaak goedgehumeurd
20	Ik ben dankbaar voor het goede in mijn leven
21	Ik heb dromen en hoop voor de toekomst
22	Ik ben graag in de natuur
23	Ik voel me gewaardeerd door anderen
24	Ik heb een geloof
25	Ik heb gevoel voor humor
	Externe krachten
26	Ik heb mensen die me begrijpen
27	Ik heb familie of vrienden waar ik op kan vertrouwen
28	Ik heb behandelaars die ik vertrouw
29	Ik woon in een veilige omgeving
30	Ik kan me financieel dingen veroorloven die belangrijk voor me zijn
31	Ik heb mensen in mijn leven die me motiveren om gezond te zijn

32	Ik heb beschikking tot faciliteiten die een gezonde leefstijl ondersteunen
	Zelfmanagement strategieën
33	Ik zoek de kennis die ik nodig heb
34	Ik zoek hulp wanneer ik die nodig heb
35	Over het algemeen heb ik een gezonde leefstijl en zorg voor mijzelf
36	Ik heb strategieën om om te gaan met onaangename symptomen en stress
37	Ik kan doelen stellen waar ik naartoe werk
38	Ik kan activiteiten balanceren afhankelijk van hoe ik mij voel
39	Ik leer van mensen met soortgelijke ervaringen en zorgen
40	Ik kan me kwetsbaar opstellen
41	Ik ben creatief
42	Ik weet hoe ik met stress om kan gaan
43	

Appendix B. PANAS

Hieronder ziet u een aantal woorden, die gevoelens van mensen beschrijven. We willen graag van u weten hoe u zich op dit moment voelt. Er wordt gevraagd bij elk gevoel aan te geven in hoeverre u dit gevoel heeft: U kunt aangeven of u een gevoel heel weinig, een beetje, matig, veel of heel veel voelt. Als u niet helemaal zeker bent, geef dan het antwoord dat het dichtst bij uw inschatting in de buurt komt.

		1	2	3	4	5
		heel weinig	een beetje	matig	veel	heel veel
1.	geïnteresseerd	1	2	3	4	5
2.	bedroefd	1	2	3	4	5
3.	opgewonden	1	2	3	4	5
4.	overstuur	1	2	3	4	5
5.	sterk	1	2	3	4	5
6.	schuldig	1	2	3	4	5
7.	angstig	1	2	3	4	5
8.	vijandig	1	2	3	4	5
9.	enthousiast	1	2	3	4	5
10.	trots	1	2	3	4	5

		1	2	3	4	5
		heel weinig	een beetje	matig	veel	heel veel
11.	prikkelbaar	1	2	3	4	5
12.	alert	1	2	3	4	5
13.	beschaamd	1	2	3	4	5
14.	geïnspireerd	1	2	3	4	5
15.	nerveus	1	2	3	4	5
16.	vastbesloten	1	2	3	4	5
17.	aandachtig	1	2	3	4	5
18.	zenuwachtig	1	2	3	4	5
19.	actief	1	2	3	4	5
20.	bang	1	2	3	4	5

Appendix C. NPRS

Selecteer het cijfer dat het best de ernst van uw pijn weergeeft.
Hoe hevig was uw pijn (gemiddeld) de afgelopen week (7 dagen)?

0	1	2	3	4	5	6	7	8	9	10
Geen enkele pijn										Meest voorstelbare pijn

Appendix D. QBF (extraversion)

In hoeverre beschrijven de volgende 6 woorden uw persoonlijkheid?

	Klopt helemaal niet			Neutraal			Klopt helemaal wel
Terughoudend							
Stil							
Gesloten							
Spraakzaam							
Schuchter							
Teruggetrokken							

Appendix E. MPI-DLV (pain interference)

We willen graag iets meer weten over uw pijn en hoe de pijn uw leven beïnvloedt. In deze lijst krijgt u een aantal vragen voorgelegd. Onder elke vraag is een schaal aangebracht waarop u uw antwoord kunt aangeven. Lees elke vraag zorgvuldig. Omcirkel het nummer dat voor u van toepassing is.

1. In welke mate heeft de pijn uw vermogen te werken veranderd, sinds de pijn begon? (Als u niet meer werkt om andere reden dan de pijn, zet dan hier een kruisje:)

0	**1**	**2**	**3**	**4**	**5**	**6**	
Geen verandering							Heel veel verandering

2. In hoeverre heeft uw pijn de mate van tevredenheid of plezier dat u ondervindt door deelname aan sociale en ontspannende activiteiten veranderd?

0	**1**	**2**	**3**	**4**	**5**	**6**	
Geen verandering							Heel veel verandering

3. In hoeverre wordt u door de pijn belemmerd bij de deelname aan ontspanning en sociale contacten?

0	**1**	**2**	**3**	**4**	**5**	**6**	
Helemaal geen belemmering							Heel veel belemmering

4. In hoeverre beperkt u uw bezigheden om zodoende uw pijn niet erger te laten worden?

0	**1**	**2**	**3**	**4**	**5**	**6**	
Helemaal geen beperking							Heel veel beperking

5. In hoeverre heeft uw pijn de mate van tevredenheid of plezier dat u ondervindt door deelname aan gezinsbezigheden veranderd?

0	**1**	**2**	**3**	**4**	**5**	**6**	
Helemaal geen verandering							Heel veel verandering

6. In welke mate heeft uw pijn uw relatie met uw echtgeno(o)t(e)/partner of gezin veranderd?

0	**1**	**2**	**3**	**4**	**5**	**6**	
Helemaal geen verandering							Heel veel verandering

7. In welke mate heeft uw pijn de mogelijkheid tot het uitvoeren van huishoudelijke werkzaamheden veranderd?

0	**1**	**2**	**3**	**4**	**5**	**6**	
Geen verandering							Heel veel verandering

8. In hoeverre heeft uw pijn uw vermogen bezigheden te plannen belemmerd?

0	**1**	**2**	**3**	**4**	**5**	**6**	
Helemaal niet							Heel sterk

9. In hoeverre zijn vriendschappelijke contacten buiten het gezin veranderd of beïnvloed door de pijn?

0	**1**	**2**	**3**	**4**	**5**	**6**	
Geen verandering							Heel veel verandering

Appendix F. Demographic information

PERSOONSGEGEVENS ONDERZOEK STRENGTH FINDER

Geslacht: Man / Vrouw

Geboortedatum:

Soort aandoening:

Duur chronische pijn:

Overige aandoening(en):

Contact gegevens:

Woonsituatie:

Opleidingsniveau:

❒ Geen opleiding
❒ Basisonderwijs (lager onderwijs)
❒ Lager beroepsonderwijs (LBO, huishoudschool, LEAO, LTS, etc.)
❒ MAVO, (M)ULO, 3-jarige HBS, VMBO
❒ Middelbaar beroepsonderwijs (bijv. MTS, MEAO)
❒ 5-jarige HBS, HAVO, MMS, atheneum, VWO, gymnasium
❒ Hoger beroepsonderwijs (bijv. HTS, HEAO)
❒ Wetenschappelijk onderwijs (universiteit, post-doctoraal onderwijs)

Appendix G. Informed consent

INFORMED CONSENT FORMULIER

De effecten van verschillende sterke-kanten oefeningen en de invloed van het persoonlijkheidskenmerk extraversie op deze effecten

Ik heb de informatiebrief voor deelname aan het onderzoek gelezen. Ik kon aanvullende vragen stellen. Mijn vragen zijn genoeg beantwoord. Ik had genoeg tijd om te beslissen of ik meedoe.

Ik weet dat meedoen helemaal vrijwillig is. Ik weet dat ik op ieder moment kan beslissen om toch niet mee te doen. Daarvoor hoef ik geen reden te geven.

Ik weet dat sommige mensen mijn gegevens kunnen zien. Die mensen staan vermeld in de informatiebrief.

Ik geef toestemming om mijn gegevens te gebruiken, voor de doelen die in de informatiebrief staan.

Ik geef toestemming om mijn onderzoeksgegevens 10 jaar na afloop van dit onderzoek te bewaren.

Ik wil meedoen aan dit onderzoek.

Naam deelnemer:
Handtekening: Datum : __ / __ / __

Ik verklaar hierbij dat ik deze deelnemer volledig heb geïnformeerd over het genoemde onderzoek.
Als er tijdens het onderzoek informatie bekend wordt die de toestemming van de deelnemer zou kunnen beïnvloeden, dan breng ik hem/haar daarvan tijdig op de hoogte.

Naam onderzoeker (of diens vertegenwoordiger):
Handtekening: Datum: __ / __ / __

Appendix H. Reported strengths

Strengths → Participant ↓	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	x	x	x	x	x		x	x	x			x				x	x	x	x	x	x
2	x		x	x	x											x	x				x
3	x	x	x	x	x					x		x			x	x		x	x	x	x
4	x		x	x		x	x	x		x	x	x	x		x		x	x	x	x	
5	x	x	x	x	x			x		x	x	x		x	x	x		x		x	x
6	x	x	x	x	x	x	x	x				x			x	x	x	x			x
7	x		x		x																
8	x	x	x		x			x							x	x	x				x
9	x	x	x	x	x							x				x	x	x	x	x	x
10	x	x	x		x		x	x	x	x		x	x	x		x	x	x		x	
11		x	x							x		x		x		x	x			x	
12	x		x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
13	x		x		x			x		x		x	x	x		x	x	x	x	x	x
14	x		x	x		x	x	x		x	x			x	x	x	x	x	x	x	x
15	x				x			x						x	x						
16	x	x	x	x	x	x	x	x		x		x			x				x	x	
17	x	x	x		x			x	x			x		x		x	x			x	x
18	x	x	x	x	x							x							x		
19	x		x	x			x	x			x	x		x		x				x	x
20	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
21	x	x	x			x	x	x	x			x	x	x	x	x	x	x	x	x	
22	x	x	x	x				x	x	x	x	x	x	x	x	x	x	x	x	x	x
23	x	x	x	x	x		x	x	x	x						x	x			x	
24	x	x			x		x		x												
25	x	x	x			x	x											x			x
26	x	x	x	x	x	x	x	x			x	x		x	x	x	x	x	x	x	
27		x	x				x					x					x	x	x		

28	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
29	x		x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
30	x	x	x	x	x		x	x				x	x			x	x			x	
31	x		x	x	x			x					x	x	x	x	x	x	x		x
32		x	x	x						x					x	x	x		x	x	
33	x	x	x	x	x		x	x	x			x		x		x	x	x	x	x	x
34	x	x	x	x			x	x		x		x	x	x	x	x	x	x	x	x	
35	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
36	x	x	x	x		x		x	x	x	x	x	x	x	x				x		x
37	x	x	x		x		x	x	x	x	x			x		x	x	x	x	x	
38	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x
39	x	x	x	x	x		x	x		x				x		x	x	x	x	x	x
40	x	x		x	x		x	x	x	x	x	x	x	x	x		x	x	x	x	x
41	x	x	x	x	x			x	x		x	x	x	x	x	x	x	x	x	x	x
42	x	x	x	x	x			x	x		x	x	x	x	x	x	x	x	x	x	x
43	x		x		x			x	x		x	x		x		x		x	x	x	
44	x		x	x	x			x	x		x	x		x	x	x	x	x		x	
45		x	x				x	x							x	x				x	
46	x		x	x			x	x	x	x		x		x		x	x	x	x	x	x
47	x	x	x		x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	
48	x		x		x	x		x		x	x	x	x	x	x	x	x	x	x		
49	x		x		x	x		x	x	x	x	x				x		x	x	x	
50	x	x	x	x	x		x	x			x	x	x			x	x			x	x
51	x	x	x		x		x	x		x		x	x	x	x	x	x		x	x	x
52	x	x	x	x	x			x		x	x	x		x		x	x	x	x	x	x
	48	37	49	34	38	13	30	42	23	27	24	39	22	33	29	42	39	35	35	40	29

Strengths → Participant ↓	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	Total
1		x		x	x	x	x	x	x	x	x	x	x		x	x		x	x	x		32
2	x			x	x	x	x	x		x			x	x			x			x		19
3	x			x	x	x	x	x		x		x	x			x			x	x		26
4	x	x		x	x	x	x	x	x				x	x			x	x		x	x	30
5	x	x		x	x	x	x	x	x	x	x	x	x	x		x		x			x	32
6	x	x		x	x		x	x	x		x		x			x	x	x		x		28
7						x	x	x		x			x			x						10
8	x					x		x	x	x		x					x	x		x		19
9				x	x	x	x	x	x		x			x		x			x			23
10	x		x	x	x		x	x	x	x	x	x	x	x	x			x		x		31
11					x	x	x	x	x				x			x	x		x			18
12	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	40
13	x			x	x	x		x	x	x	x	x		x		x	x			x		28
14	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x		x	x	36
15	x	x			x	x	x	x		x		x		x						x		16
16			x				x	x		x	x	x		x	x	x		x		x		25
17	x	x		x	x	x	x	x	x	x	x	x	x	x		x			x	x		29
18	x			x	x	x	x	x		x		x						x		x		18
19		x	x	x	x	x	x	x		x	x					x			x			23
20	x	x		x	x	x	x	x	x	x		x		x	x	x	x	x	x	x	x	39
21	x	x		x	x	x	x	x	x	x	x	x	x	x		x	x					32
22	x			x	x	x	x	x	x	x	x	x		x	x	x	x	x		x	x	36
23	x	x		x	x	x	x	x	x	x	x	x		x	x			x		x		28
24							x	x					x									9
25		x	x	x	x	x		x	x	x			x	x						x		19
26		x	x	x	x	x	x	x	x			x	x	x	x		x	x	x		x	34
27	x		x	x	x	x		x	x		x							x	x			18
28	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	43

29	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x		x		x	37
30	x		x	x	x	x	x	x	x	x	x		x	x	x		x			x		28
31		x	x	x	x	x	x	x	x			x				x				x		25
32	x			x		x	x	x	x	x	x	x	x	x					x			22
33	x	x		x	x	x	x	x	x	x	x	x		x	x	x		x	x	x	x	35
34	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x		x		x		34
35	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	42
36	x			x	x	x	x	x	x			x		x	x	x	x	x		x		30
37	x	x		x	x	x	x	x	x	x	x	x	x	x			x	x		x		32
38	x	x	x	x	x	x	x	x		x		x	x	x		x	x		x	x	x	37
39				x	x	x	x			x	x	x	x	x			x			x	x	28
40	x			x	x		x	x	x	x	x	x	x	x	x	x	x	x		x	x	36
41	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	39
42	x	x		x		x	x		x		x	x	x	x	x	x	x	x	x	x	x	36
43	x	x		x	x	x		x	x		x	x	x	x	x				x	x	x	28
44	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x		x	32
45		x	x		x	x	x	x	x					x								16
46		x		x	x	x	x	x	x				x	x						x	x	x	28
47	x	x		x	x	x	x	x	x	x	x	x		x	x	x		x		x	x	36
48		x		x		x	x	x	x	x	x	x	x	x			x			x		29
49	x		x	x	x	x	x	x	x	x	x	x				x		x		x	x	29
50	x			x	x	x	x	x	x	x	x			x		x	x			x		28
51	x	x	x	x	x	x		x	x	x	x	x	x	x		x				x	x	33
52				x	x	x	x	x	x				x		x	x	x			x	x	29
	37	30	16	45	45	47	45	50	42	38	34	37	34	39	23	33	25	27	21	39	23	

Appendix I. Instruction *using strengths* intervention

Participants were asked to report all strengths they believed to possess that helped them cope with their chronic pain using the strengths finder provided in appendix A. Next, participants were asked to compile a top 5 out of these strengths, in which the number 1 strength was the strength that helped them cope with their pain best. Additionally, participants were asked to use one or more of these top 5 strengths in a new or different manner every day for the next 7 days, the "using signature strengths in a new way" exercise.