MASTERTHESIS

THE ROLE OF PSYCHO-SOCIAL FACTORS AND ADHERENCE IN AN ONLINE ACT INTERVENTION

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Abstract

This study investigated if both, psycho-social factors and adherence correlated with the effect of a guided online ACT intervention. Further it tested if adherence had such a central role in the mechanism of change as postulated by the Internet Intervention Model by (Ritterband, Thorndike, Cox, Kovatchev, & Gonder-Frederick, 2009). Therefore, a mediation model was tested with psycho-social factors as predictors for the effectiveness of the intervention and adherence as a possible mediator.

This study was a follow-up on a RCT on the intervention 'living with pain'. People suffering from chronic pain participated in an online intervention which consisted of nine modules and had to be completed within 12 weeks. People were expected to work with the intervention for at least 3 hours a week and were supported by weekly e-mail counseling. The modules of the intervention were based on the six ACT processes and included for example psycho-education, mindfulness exercises and exercises to identify and implement personal values.

Results in this research showed that pain catastrophizing and psychological inflexibility were the only psycho-social factors which correlated significantly with the change in pain interference (effect) from baseline to three months after the intervention. Mental health, depression and anxiety did not correlate significantly with the change in pain interference. Furthermore the results revealed that adherence did not mediate that correlation. Contrary to the expectation based on the Internet Intervention Model by Ritterband et al. (2009), adherence did not show any significant correlation with either psycho-social factors or change in pain interference (effect).

Further research should investigate if the Internet Intervention Model is more accurate if user characteristics are arranged side by side with website use. Beside that the criteria for adherence should be reconsidered, it is advisable to include how concentrated or intensive participants worked with the intervention.

Samenvatting

In deze studie werd nagegaan of psychosociale factoren en adherentie voorspellers waren van het effect op een begeleide online ACT interventie. Verder werd onderzoekt of adherentie zulk een centrale rol speelt in het mechanisme van verandering als in het Internet Interventie Model van Ritterband et al. (2009) verondersteld. Daarom werd een mediatie model getest met psychosociale factoren als voorspellers voor effect van de interventie en adherentie als mogelijke mediator variabele.

Deze studie was een vervolgonderzoek op een RCT op de interventie 'leven met pijn'. Aan de online interventie namen mensen met chronische pijn deel. De interventie bestond uit 9 modules en moest binnen 12 weken worden afgerond. Deelnemers moesten minstens 3 uur per week aan de interventie besteden en zij werden begeleid door wekelijkse e-mails. De modules waren gebaseerd op de zes ACT processen en hielden, bijvoorbeeld psycho educatie, mindfulness oefeningen en oefeningen om persoonlijke waarden te identificeren en te implementeren, in.

Resultaten in deze studie lieten zien dat pijn catastrofering en psychologische inflexibiliteit de enige psychosociale voorspellers waren die significant met de verandering in pijn interferentie (van baseline tot 3 maanden nadat de interventie was afgerond) correleerden. Mentale gezondheid, depressie en angst lieten geen significante correlatie met de verandering in pijn interferentie zien. De resultaten lieten verder zien dat adherentie geen mediator was voor deze correlaties. Tegen de aannames gebaseerd op het Internet Interventie Model van Ritterband et al. (2009) liet adherentie geen significante correlatie met psychosociale factoren of de verandering in pijn interferentie zien.

Toekomstig onderzoek kan onderzoeken of het Internet Interventie Model beter wordt als de psychosociale factoren naast de website gebruik komt te staan. Bovendien zouden de criteria voor adherentie overdacht worden. Het is aan te raden op te nemen hoe geconcentreerd of intensief deelnemers met de interventie hebben gewerkt.

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Introduction

Online psychological treatment

About one in four European habitants suffer from a mental disorder once in their life, resulting in an enormous economic burden (EU-WMH, 2008). The number of people making use of psychological health care in order to treat those mental disorders is rising (Mojtabai & Jorm, 2015) and more efficient alternatives to face-to-face therapy are required (Reeves et al., 2011). A promising way to treat the large amount of people seeking help more (cost-)effective are online psychological interventions (Andersson & Cuijpers, 2009). Online treatment has several advantages such as cost-effectiveness, availability, low inhibition threshold and the possibility to treat many patients at the same time (Kelders, 2012). Research on psychological online treatment showed evidence for the effectiveness of those interventions (Andersson & Cuijpers, 2009; J. L. Bender, Radhakrishnan, Diorio, Englesakis, & Jadad, 2011). They were most often effective if they applied elements and techniques from Cognitive Behavioral Therapy (CBT) (J. L. Bender et al., 2011).

It is most important for psychological interventions to have a large effect size because that is what participants expect from an health care intervention. In order to understand and improve effectiveness, this study will examine to what extent psycho-social factors and adherence are influencing the effect size in online interventions based on Acceptance and Commitment Therapy (ACT). As the current study addressed patients suffering from chronic pain this will be first discussed.

Chronic pain

An effective treatment for chronic pain is very important as chronic pain causes a high economic burden. A survey with 50.000 respondents carried out by Breivik, Collett, Ventafridda, Cohen, and Gallacher (2006) showed that on average one in five adult European suffers from chronic pain. They also found that about 2/3 of these people suffer from moderate pain and about 1/3 from severe chronic pain (Breivik et al., 2006). Chronic pain has a large impact on all life domains and it is a burden for both, the individual and the society. The individual has to deal with physical, social and emotional impairments. The impact on the physical and psychological condition is huge. For example chronic pain is highly associated with negative mood, physical dysfunction and it contributes to depression (Jensen & Turk, 2014). A study by Kowal, Wilson, McWilliams, Péloquin, & Duong (2012) showed that more than 70% of the participants with chronic pain had a clinically relevant increased experience

of self-perceived burden. The self-perceived burden correlated with pain intensity ratings, functional limitations, depressive symptoms, attachment anxiety, pain self-efficacy, and caregiver burden (Kowal et al., 2012). Chronic pain also provides a high economic burden for the society on the one hand due to doctor's consultations and other forms of health care use and on the other hand due to indirect costs generated by for instance lost productivity and work absenteeism (Gaskin & Richard, 2012; Juniper, Le, & Mladsi, 2009; Lambeek et al., 2011). Research has shown that Acceptance and Commitment Therapy is a convenient treatment for chronic pain (Wetherell et al., 2011; Wicksell, Dahl, Magnusson, & Olsson, 2005).

Acceptance and Commitment Therapy

Acceptance and Commitment Therapy (ACT) is an evidence-based psychological intervention that gets more and more prominent. Research in the past decades have shown promising results in the treatment of for example chronic pain, tinnitus, depression and anxiety (Öst, 2014). The effect sizes of interventions based on ACT show small to medium effect sizes comparable to those of other psychological interventions like Cognitive Behavioral Therapy (Öst, 2014; Veehof, Oskam, Schreurs, & Bohlmeijer, 2011). Online versions of ACT interventions show similar effect sizes and are comparable to those of common cognitive therapy (Forman, Herbert, Moitra, Yeomans, & Geller, 2007). Wetherell et al. (2011) have shown that in comparison people treated with ACT are more satisfied afterwards than people treated with CBT.

The goal of ACT is to increase psychological flexibility (S. C. Hayes & Masuda, 2003). People who are psychologically flexible have the ability to maintain or adjust their behavior in consistency with their values and goals (Sturgeon, 2009). Therefore, ACT combines principles of Cognitive Behavioral Therapy and techniques of mindfulness and acceptance. In contrast to CBT, ACT does not focus on changing thoughts about the individuals' situation and problems, but tries to alter the responses to those thoughts (Sturgeon, 2009).

Acceptance and Commitment Therapy has six core processes which contribute to a state of psychological flexibility: acceptance, cognitive defusion, contacting the present moment, self-as-context, valued living and committed action (S. C. Hayes, Luoma, Bond, Masuda, & Lillis, 2006) (see figure 1).

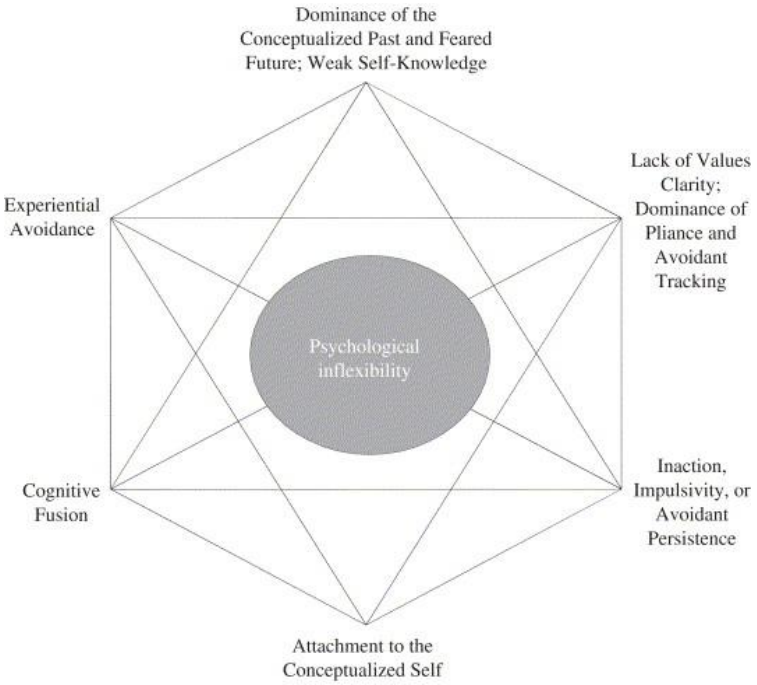

Figure 1. Six core processes of psychological inflexibility that are addressed by Acceptance and Commitment Therapy (S. C. Hayes et al., 2006)

Acceptance vs. experiential avoidance

In order to (re-)gain psychological flexibility, ACT teaches participants acceptance as an alternative to experiential avoidance. For chronic pain patients this means that not the form or frequency of thoughts about the pain is altered but ACT offers methods to quit the struggle with the pain (-thoughts).

Cognitive defusion vs. cognitive fusion

Closely linked is the second process, namely cognitive defusion. A state of cognitive defusion is reached if the patient has changed the functions of undesired thoughts. Again ACT does not aim at changing the form or frequency of these thoughts but wants patients to register the difference between the thought itself and the meaning of the thought. For example instead of thinking 'I am a bad person' ACT teaches the participants to register that thought as: 'Right now the thought occurs that I am a bad person'.

Both processes are important to counteract avoidance and withdrawal and to make patients amenable for value-based behavior.

Present moment vs. dominance of the conceptualized past & feared future; weak self-knowledge

The two processes in the middle of the model (present moment & self-as-context) refer to mindfulness (see figure1).

The first process implicates that the individual is led to a state of non-judgmental contact with psychological and environmental occurrences. The goal is to describe psychological and environmental events more directly without judging, so that patients still have the chance to react flexible on the new situations. Judging those events too soon makes it hard for patients to think about them in a different way and thus makes the patient inflexible.

Self-as-context vs. attachment to the conceptualized self

In short, this process wants that people detach themselves from negative labels and concepts about the self. Similar to the former process it is important that labels and concepts are recognized as utilities used by language but have to be discriminated from the content they deliver.

Both processes are necessary in order to prohibit an excess of interpretation and labeling. They also contribute to the readiness to be open for value-based behavior like the former two processes. As change is made possible through these four processes, the following step is to develop and live the values the person considers as worth living for.

Valued living vs. lack of values clarity

This process is concerned with developing and living out the values the person considers as worth living for. Therefore, patients are guided in the development and discovering of personal values and life directions.

Committed action vs. inaction, impulsivity, or avoidant persistence

On the basis of the personal values developed in the former process, patients acquire effective behavior, based on these values. The combination of all processes leads to the desired concept of psychological flexibility.

Adherence

Adherence is very important in the context of psychological interventions, especially when they are offered via internet. Adherence means that people stick to the intervention in the desired way (Kelders, 2012). A complete adherence of a participant is achieved if the person uses the intervention as defined in the intervention protocol (Kelders, 2012). Research found that non-adherence decreases the effect of online interventions dramatically (Kelders, 2012). Only about 50 % of the people starting an online psychological intervention adhere throughout the treatment (Kelders, 2012). This was also found in the current study. In many studies a lack of adherence is given as an explanation for low or medium effectiveness or as a limitation to the research design and objectives (B. Bender, Milgrom, & Apter, 2003). Studies

also found that there is a relation between adherence and increased effect (dose-effect relationship) (Kelders, 2012).

A systematic review by Kelders (2012) clarified the importance of certain intervention characteristics like updates, contact with peers or a counselor and persuasive system designs to result in an acceptable adherence. Those intervention characteristics can explain part of the adherence to an intervention but there is a lot more that has to be known in order to be able to design interventions with a good level of adherence. Many of those findings were used in the current intervention 'living with pain'.

'Living with pain'

Living with pain is a guided online ACT intervention for chronic pain based on an ACT intervention for mild to moderate depression (Trompetter, Bohlmeijer, Veehof, & Schreurs, 2014). It consisted of nine, one week lasting modules the participants could work through within a time period of 9-12 weeks. Living with pain has been shown to have significant positive effects in comparison with two control groups (expressive writing & waiting list) (Trompetter et al., 2014). Significant improvements three months after completing the intervention were found in for example depression and pain intensity compared to the control groups. On the primary outcome (pain-interference) significant improvements to the control groups three months after completing the intervention were only found if non-adherers were excluded. When non-adherers were included the results showed significant improvement compared to the expressive writing group but marginally not significant improvement compared to the waiting list condition.

Previous research has found that most often emotional domain factors were predictors of change in CBT (McCracken & Turk, 2002; Turner, Holtzman, & Mancl, 2007). This was also found for 'living with pain' (Trompetter et al., 2014). Additionally to those predictors, for example psychological flexibility and pain catastrophizing have been shown to have predictive value. Therefore this study will use the term of psycho-social factors to combine those factors in one concept.

The Internet Intervention Model

To this day, there is only one model trying to explain the effect mechanisms of internet interventions on the whole and therefore it is the basic model on which this study is built. This model developed by Ritterband et al. (2009) is called the Internet Intervention Model (see

figure 2). This model is very large and detailed so that this study had to limit the examination to some parts.

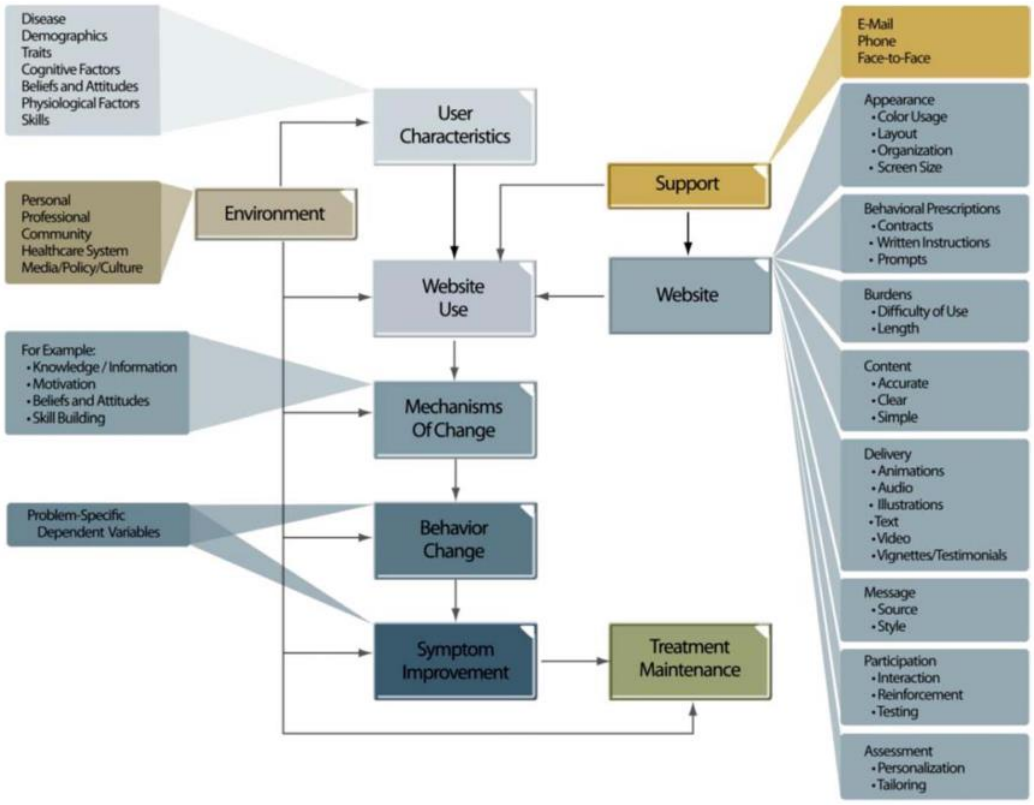

Figure 2. Internet Intervention Model (Ritterband et al., 2009)

Several reasons led to the decision to investigate the relationship of *user characteristics* and *website use* with the effect of internet interventions. In the Internet Intervention Model *website use* is a very central factor with direct influence on the *mechanisms of change*. In this research *website use* is equivalent to adherence. Ritterband et al. (2009) state that adherence is playing a crucial role in *website use* and that in any health intervention a better understanding of adherence can maximize the impact of the treatment. The factor 'environment' was excluded because it is hard to manipulate and control all factors coming from the participants' environment. Most recent findings by Kelders (2012) on the *website design* and *support* where used in the development of the intervention, so that it was assumed that these factors most likely did not constitute to the differences in effect in a significant way. The *user characteristics* in the model of Ritterband et al. (2009) combine many different aspects like demographics, physiological factors and beliefs and attitudes. They are the most complicated and diverse set of variables but at the same time they are the most promising predictor variables (Ritterband et al., 2009). In this study we will focus on those factors which have been found to have predictive value on the effect measured by change in pain interference and

they will be merged in the term ‘psycho-social factors’. In many studies either the relationship of psycho-social factors with effect or the relation of adherence with effect has been investigated but there is no research to this day that examines both factors at the same time.

Therefore, this study investigates the relationship of psycho-social factors with change in pain interference (effect of the intervention) between baseline and three months after the intervention and will test if adherence correlates with the change in pain interference. Additionally this study will test if adherence is mediating the relationship of psycho-social factors with pain interference. Results would contribute to the understanding of the mechanisms that make an internet intervention effective. Furthermore, it will test the theoretical assumptions postulated in the Internet Intervention Model by Ritterband et al. (2009). For practical purposes, results could indicate if several baseline data from patients make it more likely that the intervention will be effective. Additionally the results of this study can make further conclusions about the effectiveness of the intervention ‘living with pain’ in lowering pain interference in daily life.

All in all this leads to the following research question: Is there evidence for a mediation model suggesting that psycho-social factors at baseline are correlating with the change in pain interference and that adherence mediates this correlation in a guided online intervention with ACT for chronic pain?

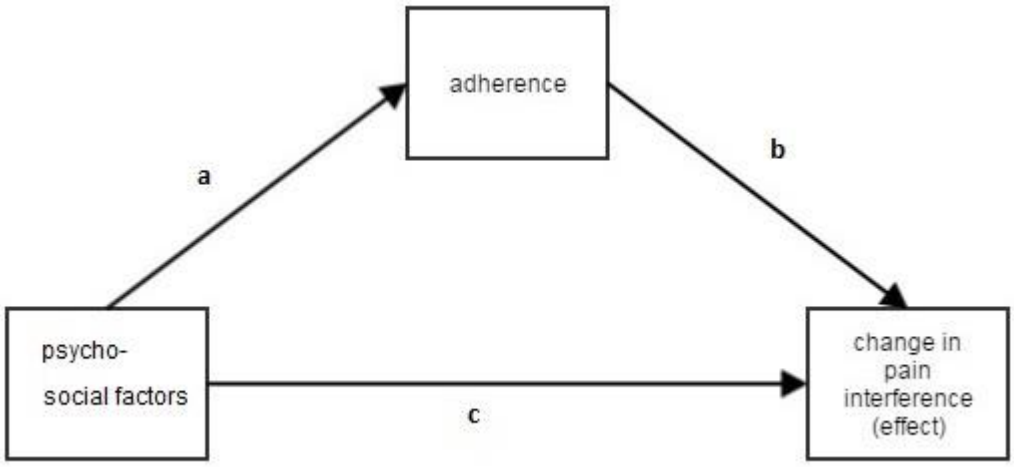

Figure 3. Mediation model

In order to examine this question, the following hypotheses will be tested:

1) Psycho-social factors correlate with the change in pain interference (effect) of a guided online intervention with ACT for chronic pain. (c)

2) Psycho-social factors correlate with adherence to a guided online intervention with ACT for chronic pain. (a)
3) Adherence to the intervention correlates with the change in pain interference (effect) in a guided online intervention with ACT for chronic pain. (b)
4) If all three hypotheses above were confirmed for one psycho-social factor:
   The psycho-social factor and adherence combined correlate more than each one apart.

Method

Participants

The current study is a follow-up on a RCT of a web-based ACT treatment for patients with chronic pain (Trompetter et al., 2014). This section will only refer to information and outcomes relevant for the current study. Participants were a heterogeneously diagnosed group of pain sufferers. Most of them were Dutch (97.6 %) and higher educated (80 %). Table 1 shows an overview of further information about the participants.

Table 1. Participants

Participants	N = 82
Gender	
Male	23 %
Female	77 %
Age	52.9 years
Suffering from pain >5 years	59 %
Employed	43 %
Adherent	48%

Participants were recruited through patient internet platforms and advertisements in national newspapers. Premises to take part in the intervention was a) being 18 years or older, b) having a minimum score of 4 on momentary pain intensity measured by the Numeric Rating Scale (11-point NRS), c) having pain at least three days a week, d) for at least six months. Exclusion criteria were primarily based on the Hospital Anxiety and Depression Scale (HADS) (Zigmond & Snaith, 1983) and the Psychological Inflexibility in Pain scale (PIPS) (Wicksell, Lekander, Sorjonen, & Olsson, 2010). They were excluded from the study if a)

severe psychological distress was indicated (HADS > 24), b) they scored low on psychological inflexibility (PIPS < 24), c) they were currently treated by another CBT-based intervention, d) they had no internet or e-mail address, e) there were reading problems due to insufficient Dutch language skills or illiteracy, and f) they did not want or were not able to invest approximately 30 minutes per day.

Procedure/Design

Participants were randomly allocated to the ACT-condition (n = 82) or one of the two control conditions. The control conditions were Expressive Writing (EW) (n = 79) and a Waiting List (WL) (n=77). Both control conditions were not relevant for this study so that no further information will be given. In the ACT-condition, participants completed nine modules within nine to twelve weeks. The modules consisted of text, metaphors and exercises based on the six ACT processes (S. C. Hayes et al., 2006) and were supported by weekly e-mail counseling that offered help with regard to the process and encouraged to continue the intervention. Additionally patients got access to a psycho-educational lesson about chronic pain, field reports from previous patients who participated in an ACT intervention, a diary and weekly downloadable audio mindfulness exercises. Table 2 gives an overview of the ACT intervention protocol as used by Trompetter et al. (2014).

Table 2. Schematic overview of ACT intervention protocol (Trompetter et al., 2014)

Module	Therapeutic processes	Mindfulness exercise
'Pain and pain treatment'	Psycho-education	Body scan
'Avoiding the pain'	Experiential avoidance of pain	Paying attention to breath
'Happy despite pain?'	Values	Body scan/ paying attention to breath
'Blossoming of the rose'	Values & committed action	Breathing towards the pain
'To give up the fight'	Pain acceptance	Create space & allow what is present
'Yes… but I have pain'	Cognitive (de)fusion	Observe your thinking
'I am … who am I actually?'	Self-as-context	Three minutes breathing space
'You don't suffer alone'	Pain, social context & communication	--
'Living with pain, a new story'	Committed action	Combination of above: 'All in one'

Materials

As not all measurements from the original study are important for the current study the reporting will be limited to those with relevance for the research question. All assessments were answered online at baseline (T0), after four weeks (T1), eight weeks (T2), at post-intervention (T3: 3 months after baseline), at follow-up (T4: 6 months after baseline) and after 9 months (T5). As the effects of the study could be indicated best 6 months after baseline and treatment goal should be to result in a long-term outcome, the analyses will use data from T0 and T4.

Adherence

Adherence was determined by two criteria. Firstly, participants had to complete the intervention. This was defined by completing at least the first six modules of the intervention. This decision was made because participants who completed the first six modules had worked with all six core processes (S. C. Hayes et al., 2006). 92% of the participants completing the

first six modules kept doing the last modules as well (Trompetter et al., 2014). The second criterion was that participants had to work with the ACT intervention ≥ 3 hours per week. The intervention expected patients to invest 30 minutes per day so that a minimum of 3 hours a week seemed reasonable. The recommended time-investment was based on results from previous research.

Pain interference

In order to quantify the effectiveness of the intervention pain interference in daily life was measured by means of the Multidimensional Pain Inventory, subscale pain interference (MPI-interference). Pain interference is measured by nine items and gives an estimation of the interference of the pain with among others work, household work and social activities (Kerns, Turk, & Rudy, 1985). The higher the score (range 0 – 54) the more the pain interferes with the daily life. The internal consistency in the study carried out by Trompetter et al. (2014) was $\alpha = .86$ at baseline.

There were five assessments that were assigned to the psycho-social factors.

Mental Health Continuum-Short Form

First of all the Mental Health Continuum-Short Form (MHC-SF) measures three dimensions of mental well-being (Keyes, 2002). There are three items to measure emotional well-being, six items to assess psychological well-being and five items for social well-being. Participants are rating the frequency of feelings in the past month. The current study used the total score. A higher score (range 14 – 84) indicated a better positive mental health. In the present study the internal consistency was $\alpha = .90$ at baseline.

Hospital Anxiety and Depression Scale

The second questionnaire was the Hospital Anxiety and Depression Scale (HADS) that identifies the amount of anxiety and depressive symptoms, each with seven items. Both subscales were used separately. Higher scores (range 0 – 21) indicate more anxiety or depression. The internal consistency at baseline was $\alpha = .80$ for depression and $\alpha = .71$ for anxiety.

Psychological Inflexibility in Pain Scale

The Psychological Inflexibility in Pain Scale (PIPS) (Wicksell et al., 2010) has 12 items to measure psychological inflexibility. Psychological inflexibility is divided into two subscales being avoidance (eight items) and cognitive fusion (four items). Higher scores on the

subscales were indicating more psychological inflexibility (range 12 – 84). At baseline an internal consistency of α = .88 determined. The total scale was used for statistical analyses.

Pain Catastrophizing Scale

The last psychological assessment used in this study was the Pain Catastrophizing Scale (PCS). The PCS was developed to measure pain catastrophizing by means of thirteen items (Sullivan, Bishop, & Pivik, 1995). It is measured by three subscales that are: rumination, magnification and helplessness. This study used the total scale with higher scores indicating more catastrophizing (range 0 – 52). At baseline the internal consistency was α = .90.

Statistical analyses

All statistical analyses were performed using SPSS 22 (IBM SPSS Statistics). There was no missing data at T0 but at T4 (follow-up after six months) 28% was missing. The change in pain interference was the only data were the value from T4 was used. Missing values for pain interference were replaced by means of the expectation maximization method. Linear regression analyses were conducted in order to test a mediation model that assumes a relationship of psycho-social factors and effect mediated by adherence (see figure 3). The change in pain interference from baseline measurement (T0) to the follow-up measurement three months after completing the intervention (T4) was used as indicator for the effectiveness of the intervention.

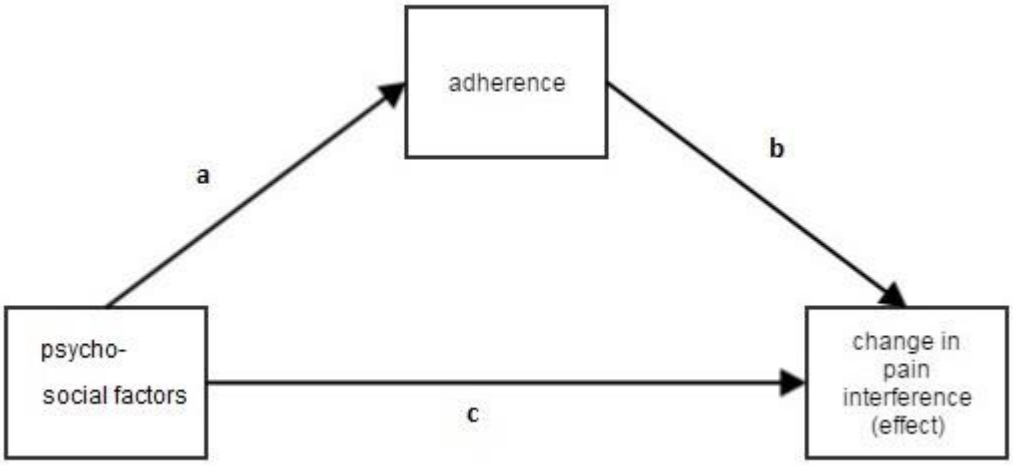

Figure 3. Mediation Model

All interpretations were done at $p < .05$. The mediation analyses were basically performed as described by Baron and Kenny (1986). According to Baron and Kenny (1986) a mediation analysis starts by testing the correlation of the independent variable with the dependent variable (c). Then, the correlation of the independent variable with the possible mediator is

tested (a), followed by testing the correlation of the mediator with the dependent variable (b). The last step is to test if the correlation with the dependent variable is higher when the independent and the mediator variable are entered. If one of the correlations is not significant, the procedure is supposed to stop. To this day, there has been a lot of criticism on this procedure and A. F. Hayes (2009) has suggested that it can be revealing to investigate all three correlations (a, b & c) even if one of them is not significant. He advises to analyze by means of the PROCESS macro for SPSS (A. F. Hayes, 2013) but this was not possible due to the fact that adherence was a binary variable (‘yes’ or ‘no’).

In order to test (c), a linear regression analyses were performed with the psycho-social factors as independent variables and the change in pain interference as dependent variable.

To test (a), a binary logistic regressions were performed with the psycho-social factors as independent variables and adherence as dependent variable.

In order to test (b), a linear regression analysis was performed with adherence as independent variable and the change in pain interference as dependent variable.

In case of a significant correlation in all three analyses, a linear regression analysis with the psycho-social factors and adherence as independent variables and the change in pain interference as dependent variable was conducted.

Results

Table 3 shows data from psycho-social factors, adherence and pain interference.

Table 3. Measures of psycho-social factors, adherence and pain interference

	T0			T4	
	N	m	SD	m	SD
HADS depression	82	6.12	3.52		
HADS anxiety	82	7.17	3.08		
MHC	82	52.63	12.01		
PIPS	82	55.00	11.94		
PCS	82	18.57	9.53		
Adherence	82	.64	.48		
Pain interference	82	32.57	9.81	26.02	8.57

Correlation of psycho-social factors and change in pain interference

The following table summarizes the linear regression model with respectively one psycho-social factor as independent variable and the change in pain interference as dependent variable.

Table 4. Linear regression model for the correlation of psycho-social factors and change in pain interference

	b	p	R^2
HADS anxiety	.082	.808	.001
HADS depression	.215	.466	.007
MHC	.059	.498	.006
PIPS	**.306**	**.000**	**.154**
PCS	**.316**	**.003**	**.105**

All significant results are bold

It was found that the only baseline data from psycho-social factors that correlated significantly with the change in pain interference were psychological inflexibility and pain catastrophizing. Higher scores on psychological inflexibility and pain catastrophizing resulted in more effect of the intervention. No further psycho-social factors correlated with the change in pain interference.

Correlation of psycho-social factors and adherence

The second step in the mediation analysis is presented in the table below. Binary logistic regressions were performed with respectively a psycho-social factor and adherence.

Table 5. Binary logistic regression on the correlation of emotional domain factors and adherence

	B	P	WALD
HADS anxiety	.044	.547	.362
HADS depression	.012	.988	.000
MHC	.012	.527	.401
PIPS	-.006	.751	.100
PCS	.005	.822	.051

The results showed that no psycho-social factor correlated significantly with adherence.

Correlation of adherence and change in pain interference

In order to investigate the third path in the mediation model, a linear regression analysis was performed with adherence as independent variable and the change in pain interference as dependent variable. The results showed no significant correlation.

Discussion

This study investigated if both, psycho-social factors and adherence were predictors for the change in pain interference (effect) three months after completing a guided online intervention with Acceptance and Commitment Therapy for chronic pain. Furthermore it was examined if 'adherence' takes such a central role as the Internet Intervention Model assumes.

Results showed that psychological inflexibility and pain catastrophizing were the only psycho-social factors that correlated with the change in pain interference (effect). Being more inflexible and catastrophize the pain more were indicators for more improvement in pain interference three months after the intervention was completed. The scores on depression, anxiety and mental health did not correlate significantly with the effect of the intervention.

Adherence and the Internet Intervention Model

Hardly any research has addressed a model which included both, adherence and psycho-social factors simultaneously. Previous research has shown that psycho-social factors were

correlating with effect (Trompetter et al., 2014; Turner et al., 2007; Wicksell, Olsson, & Hayes, 2011) and it has also been shown that adherence influences the effectiveness of treatments (DiMatteo, Giordani, Lepper, & Croghan, 2002; Donkin et al., 2011; Kelders, 2012; Ritterband et al., 2009). The only model to this day that tries to conceptualize the mechanisms of online interventions is the Internet Intervention Model developed by Ritterband et al. (2009). This study focused on adherence as an essential part of *website use* which is very central in the Internet Intervention Model (Ritterband et al., 2009). Moreover this study focused on *user characteristics* as a second factor in the model. To make a start, five psycho-social factors (mental health, anxiety, depression, psychological inflexibility and pain catastrophizing) were chosen in order to represent the *user characteristics*. The Internet Intervention Model suggests that *user characteristics* have only indirect influence on the effect. In the model, adherence stands between *user characteristics* and *effect (mechanism of change, behavior change and symptom improvement*). In primary research on this intervention Trompetter et al. (2014) tested the influence of adherence indirectly and suggested that adherence was altering the effectiveness of the intervention. These authors found that several differences in outcomes between the ACT group and the two control groups were only significant if corrected for adherence (Trompetter et al., 2014). The direct assessment of adherence in the current study did not support these findings by Trompetter et al. (2014) because adherence did neither show any correlation with psycho-social factors nor with adherence. Overall, these results indicate that either *website use* is not that central as suggested in the Internet Intervention Model or that adherence is not a good representation for *website use*.

An issue that has to be questioned is why research in the past found that adherence was influencing the effectiveness while it could not be found in this study. One possible explanation could be that in other studies fewer guidelines for an adherence-promoting design were applied. This study applied many findings by Kelders (2012) which were not applied in other studies. It could be that the effect of adherence, found in these other studies can be explained by those adherence-promoting design factors and thus the impact of adherence would be overestimated. As they were carefully attended to in the current study, the overestimation would not occur in this study.

Another reason could be that in other studies adherence was conceptualized in a different way. The criteria in this study were completion of at least six modules and investing at least three hours a week in the intervention. Those criteria did for example not include how

concentrated participants worked with the intervention or if they could make an accurate assessment of how long they had worked with the intervention. Research has shown that people's estimation of how much time they spent on an intervention is not always accurate (Wahbeh & Oken, 2012).

Especially for people with chronic pain it could be hard to concentrate on texts and exercises because of the distracting pain they feel. On the basis of the pain interference questionnaire it can be seen that chronic pain distracts from daily activities. It is likely that also the ability to concentrate on an online intervention is altered by the chronic pain. Both, the conceptualization and the ability to concentrate on the contents of the intervention could not be investigated in this study because it was neither monitored if people were indicating accurate how much time they had spent on the intervention nor how concentrated they worked with the intervention. Possible solutions for those problems will be presented below.

The role of pain catastrophizing and psychological inflexibility

Pain catastrophizing and psychological inflexibility were the only psycho-social factors which correlated significantly with the change in pain interference three months after the intervention had been completed. Higher scores on pain catastrophizing and psychological inflexibility were predictors of more effect of the intervention on pain interference.

It was expected that the intervention would be especially effective for participants who were psychological inflexible. The ACT-model assumes that ACT interventions increase psychological flexibility (S. C. Hayes et al., 2006). For that reason it is logical that for participants with low psychological flexibility there is more room for improvement.

More remarkable is that pain catastrophizing is also predicting more effectiveness. Pain catastrophizing is most often counted as a very cognitive factor which is therefore addressed by CBT interventions (Quartana, Campbell, & Edwards, 2009). Simplified the difference between ACT interventions and CBT interventions is, that CBT tries to change the form and frequency of several negative cognitions while ACT tries to change the function of these cognitions. The results of this study show that ACT is effective on both. Presumably, making sufferers from chronic pain more psychologically flexible also changes the form and frequency of those cognitions about chronic pain. If people are psychologically inflexible and they see no alternative way to handle the pain, it is likely that the pain will be catastrophized. Therefore obtaining more psychological flexibility could be a reason why pain catastrophizing is also affected by the ACT intervention. Overall, the conclusion that can be drawn from these findings is that the intervention 'living with pain' can address both, typical

ACT goals and CBT goals and that especially people really requiring help (because of high pain catastrophizing/ high psychological inflexibility) will improve more from 'living with pain'. This underlines the power and is an additional proof of quality of the intervention.

The role of mental health, depression and anxiety

The results showed that mental health, depression and anxiety did not correlate with the effectiveness of the intervention. There are studies that showed that anxiety (Landy, Schneider, & Arch, 2015) mental health (Fledderus, Bohlmeijer, Smit, & Westerhof, 2010) and depression (Bohlmeijer, Lamers, & Fledderus, 2015; Zettle, 2015) can be influenced by ACT interventions. The results of this study suggest that the baseline data on these psycho-social factors are not predicting if the intervention is effective. That again shows the power of the intervention 'living with pain' because it is not depending on the mental state but improves the dealing of participants who have deficits in psychological flexibility as well as for those people having too much pain catastrophizing (cognition).

Limitations and suggestions

The current study has some limitations and suggestions. First of all, it would be interesting to adjust the criteria for adherence. As chronic pain often leads to pain interference in daily life, it is likely that the chronic pain also interferes with the work with the intervention. One possibility would be to include the level of concentration or distraction in the conceptualization of adherence. This could be possible through self-monitoring questionnaires. Additionally the estimation of the time-investment should not rely on self-monitoring but should be monitored by the intervention automatically.

Furthermore, a limitation of this study is that variation was lost due to the binary variable for adherence. It would be advisable to conceptualize adherence as a continuous variable. If the level of concentration or distraction would be included in the definition of adherence, this would result in a continuous adherence variable. Another advantage would be that more recent statistical analyses could be applied. If adherence would be continuous it would be possible to use the PROCESS macro for SPSS (A. F. Hayes, 2013).

Finally, future research should examine if the Internet Intervention Model would be more accurate if *user characteristics* would be set side-by-side with website use.

All in all this study showed that psychological inflexibility and pain catastrophizing were predicting the effectiveness of the ACT intervention and that mental health, anxiety and depression did not predict the effectiveness. The predictive value of psychological

inflexibility and pain catastrophizing was independent from adherence. One explanation could be that adherence did not seem to have such a central role in the mechanism of effect as postulated by the Internet Intervention Model by Ritterband et al. (2009). Another explanation could be that adherence is not the most important part of *website use.* Furthermore this study showed evidence for the power of the intervention 'living with pain'. Success of the intervention was not depending on the mental state and was especially effective for participants having difficulties with pain catastrophizing or psychological inflexibility.

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