

The Relations between Psychological Flexibility

Fatigue and Sleep Disturbance

Master's thesis Clinical Psychology

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Abstract

Objective: Fatigue is a common, disabling problem which usually co-occurs with sleep disturbance. Psychological flexibility (PF) could have a positive role in sleep disturbance and fatigue. This cross-sectional study examined this role and whether there are indications for a mediating effect of sleep disturbance in the relation between psychological flexibility and fatigue.

Methods: Participants (N=339) completed an online survey, measuring psychological flexibility with The Flexibiliteits Index Test (FIT-60), fatigue using the energy scale of The Rand Short Form 36 (SF-36) and sleep disturbance using Insomnia Severity Index (ISI). These associations were examined with regression analysis.

Results: People who have low PF and more severe sleep problems reported more fatigue. For high levels of sleep disturbance, the association between PF and fatigue was low. For people with low PF, there was not a strong relationship between sleep disturbance and fatigue but for people with high PF, this association was stronger. The components acceptance, being present, values and committed action had the strongest associations with fatigue. There was a negative correlation between PF and sleep disturbance, and a positive correlation between sleep disturbance and fatigue consistent with other studies. PF and fatigue were negatively correlated and sleep disturbance mediated this relationship.

Discussion: The findings tentatively suggest that improving psychological flexibility might have an impact on fatigue but this requires further research on causality. It is also worth trying to treat sleep disturbances in addition to improving PF, because it may be more beneficial to reduce fatigue.

Keywords: Psychological Flexibility; Sleep Disturbance; Energy; Fatigue; Acceptance and Commitment Therapy

Preface

I would like to express my gratitude to my thesis supervisor Prof. Dr. Rinie Geenen for his support, constructive feedback and guidance. It was my pleasure to be part of this project; I learned a lot throughout this thesis period. Our meetings always gave me new ideas; I could not have been any luckier.

I would also like to thank to my family and Peer for their continuous support and motivational speeches. Thank you for making it possible for me and providing everything I needed during this period.

Introduction

Many people struggle with chronic fatigue, but do not meet the Fukuda criteria for Chronic Fatigue Syndrome (Jacobsen, Kallestad, Landro, Borchgrevink, & Stiles, 2017). This group of people has not been studied in an elaborative manner even though they suffer from it and fatigue may lead to long-term sick-leave. For the treatment of chronic somatic symptoms, third generation cognitive behavior therapies, such as Acceptance and Commitment Therapy (ACT) are usually applied (Jacobsen, Kallestad, Landro, Borchgrevink, & Stiles, 2017; Prevedini, Presti, Rabitti, Miselli, & Moderato, 2011). ACT suggests that a main reason for psychological suffering is avoiding unwanted private experiences (i.e. chronic fatigue). This avoidance behavior, however, decreases the frequency of personally-meaningful valueconsistent behavior (Rochea, Dawsona, Moghaddama, Abeyb, & Gresswella, 2017). ACT was developed particularly to improve Psychological Flexibility (PF) (Rochea, Dawsona, Moghaddama, Abeyb, & Gresswella, 2017). Through improved PF, individuals may learn how to direct their energy for functional behavior, so that fatigue severity decreases over time (Densham, Williams, Johnson, & Turner-Cobb, 2016). Jacobsen, Kallestad, Landro, Borchgrevink and Stiles (2017) found that ACT reduces fatigue, however this was not related to improved PF. In other studies however, they found that there is a significant direct effect of PF on chronic fatigue (Momeniarbat, Karimi, Erfani, & Kiani, 2017). Despite of contradicting evidence from clinical experimental work, PF as a personality characteristic or skill may be a means that protects individuals from vulnerability to fatigue.

Fatigue does not have a clear definition but one of the most explanative definitions is that it is "a sustained form of exhaustion that interferes with daily activities and thought processes" (Hegarty, Treharne, Stebbings, Graham, & Conner, 2019, p.1). Even though changing the level of fatigue through medical and psychological interventions is difficult, psychological interventions such as ACT are used to help patients gain new strategies in order

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to deal with the consequences of chronic conditions (Hayes, Luoma, Bond, Masuda, & Lillis, 2006). Maladaptive efforts to having control over behaviors and cognitions are related to psychological inflexibility, which, by time lead to fatigue (Jacobsen, Kallestad, Landro, Borchgrevink, & Stiles, 2017). Such efforts may also lead to avoiding experiences that have been linked to fatigue. In return individuals' behavioral repertoire and value-based actions shrink, which causes less meaningful actions and behaviors (Densham, Williams, Johnson, & Turner-Cobb, 2016).

Several studies investigating somatic complaints revealed the central relevance of PF for functioning (Jansjö, Wicksell, Holmström, Andreasson, & Olsson, 2019). There are 6 dynamic processes in the psychological flexibility model: acceptance, cognitive defusion, being present, self as context, values, and committed action (Hayes, Strosahl, & Wilson, 2011). Acceptance refers to the willingness to live with an illness rather than trying to avoid it or to have control over the uncontrollable (Rochea, Dawsona, Moghaddama, Abeyb, & Gresswella, 2017). Acceptance is an important component in dealing with chronic illnesses, it is also associated with reduced symptoms (Brooks, Rimes, & Chalder, 2011). Low acceptance is associated with higher fatigue and impairment in physical functioning (Brooks, Rimes, & Chalder, 2011), while, high acceptance is associated with better psychological well-being and decreased fatigue (Biron & van Veldhoven, 2012; Kuba, et al., 2019; Van Damme, Crombez, Van Houdenhove, Mariman, & Michielsen, 2006). Cognitive defusion is the ability to differentiate one's own thoughts and experiences. In other words, it refers to detaching from thoughts. Being present fosters a non-judgmental contact with psychological and environmental situations that in turn allows the person to become more flexible. Self as context refers to observing one's own experiences and recognizing that 'I' emerges due to context and not content. Values encourage a life pathway that corresponds with one's own values rather than the values that are followed due to compliance or fusion. Lastly, committed

action refers to acting based on the chosen values.

An association between psychological flexibility and sleep disturbance has been indicated before. Previous studies showed that low PF was a significant predictor of "insomnia severity, problems with sleep and rest, low sleep efficiency, and fatigue" (Ong, Ulmer, & Manber, 2012, p. 659). Especially the mindfulness domain of PF (cognitive defusion, being present, and acceptance) aims at stopping the fight of having control over cognitions, emotions and physical experiences which are found to prevent sleep onset (McCracken, Williams, & Tang, 2011). Using mindfulness meditation particularly for insomnia treatment helps learning to let go, acceptance, and non-striving, which in turn promote reduced sleep-related arousal (Ong, Shapiro, & Manber, 2007; Howell, Digdon, & Buro, 2010; Lundh, 2005). A study that was investigating the role of PF in sleep disturbance in undergraduate students found that high mindfulness is associated with better sleep quality, less day-time sleep, low levels of arousal before the sleep (McCracken, Williams, & Tang, 2011). Another study found that sleep functioning increases with mindfulness-based psychological treatments (Gross, et al., 2011). Those studies showed that PF is associated with sleep.

Also fatigue and sleep disturbance are related. Fatigue is one of the main characters among sleep disorders (Akerstedt, et al., 2004). Fatigue was predicted by disturbed sleep, thus Akerstedt and his colleagues (2004) suggested that disturbed sleep should be considered in the etiology of fatigue. The positive correlation between fatigue and sleep disturbance was further confirmed by Rychnovsky and Hunter (2009). Opposing to these findings, Stebbings and Treharne (2010) suggest that fatigue, tiredness and exhaustion have distinct meanings, and with improved sleep, tiredness may disseaper but fatigue may remain. A more recent systematic review about causes and consequences of fatigue in patients with rheumatoid arthritis showed that there were contradicting findings on the association between fatigue and

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sleep. Some studies supported that there is a significant association between fatigue and sleep disturbances whereas some other studies could find no association between those two variables (Nikolaus, Bode, Taal, & van de Laar, 2013). Overall, that review revealed that pain and physical functioning, specifically sleep quality and sleep disturbances, are more related to fatigue than to other variables, such as 'cognitive and emotional functioning' and 'social and environmental aspects'. Sleep disturbance and fatigue are found to be correlated in healthy individuals (Anderson, et al., 2003) as well as for patients with disorders such as HIV (Chen, et al., 2013), rheumatoid arthritis (Albayrak Gezer, et al., 2017; Treharne, et al., 2008), fibromyalgia (Bartley, Robinson, & Staud, 2007), cancer (Anderson, et al., 2003) or chronic conditions (Vincent, et al., 2013).

The three variables, fatigue, sleep and psychological flexibility, may be related. Insomnia, when not treated, increases the risk of fatigue and irritability, and decreases the day-time functioning (Carey, Moul, Pilkonis, Germain, & Buyyse, 2005; Cheatle, et al., 2016). PF is associated with sleep and this may be a path through which fatigue is affected. ACT is a well-known treatment that addresses processes and actions that interfere with sleep by increasing PF. Figure 1 shows the two models that are tested in this paper.

The aim of this study is to examine the potential buffering role of PF on fatigue when people have sleep problems and to examine the indications for a mediating effect of sleep disturbance in the relation between psychological flexibility and fatigue. People who have fatigue as well as sleep disturbances have not been studied from PF perspective. Decreasing or preventing fatigue level might be possible through interventions that focuses on PF and sleep disturbance; thus it is important to examine the relations between these variables. This study can help to develop interventions for chronic fatigue and sleep disturbances; to identify which PF components are associated with fatigue; and in light of those findings can guide more specifically targeted interventions for chronic fatigue.



Figure 1. The two hypotheses that are tested in the current study (PF = psychological flexibility).

Based on the previous research findings, following questions (Q) and hypotheses (H) are investigated:

H1: People who have more sleep disturbance and low PF experience more fatigue.

Q1: Which specific components of PF are more relevant to fatigue?

H2: High "acceptance" and "value-based" components are more predictive for lower levels of fatigue.

H3: There is a mediation effect of sleep disturbance in the relationship between PF and fatigue.

Methods

Design

It is a cross-sectional correlation study and following relations were examined:

(1) the interaction of PF and sleep with fatigue (the moderator model), (2) subscales of PF and

fatigue (3) a mediating role of sleep disturbance in the relationship between PF and fatigue.

Participants and Procedure

339 people (311 female, 28 male) from the general population completed online questionnaires which consisted of self-reports on psychological flexibility, fatigue, pain, physical functioning, sleep disturbance, obesity, physical functioning and disease activity. The link of the survey was shared on Facebook pages and via e-mails. The inclusion criteria of the study were being an adult and speaking Dutch. All the participants received a consent form and only after they agreed on the voluntary engagement, they could continue with the survey. The age of the participants ranged from 18 to 77 years (M= 46.70, SD = 13.98). There were 324 Dutch, 5 Turkish, 1 Surinamese and 9 participants from another nationality. Among participants 69% was married or cohabiting; 20.9% was single; 6.2% was divorced; 1.5% was widowed; and 2.4% chose other option.

The duration of the questionnaire was 20-40 minutes. At the beginning of the survey there were demographic questions such as age, gender, height, weight, relationship status, education, ethnic background (see Appendix A. 1.). Later on questionnaires were given to measure psychological flexibility, pain and fatigue, general health, and sleep patterns, respectively (see Appendix A).

Materials

The Flexibiliteits Index Test (FIT-60) (Appendix A. 2.)

FIT-60 (Batink, Jansen, & De Mey, 2012) is a self-report questionnaire that is used to measure psychological flexibility. In total it has 60 items divided into 6 subscales: 10 items for each ACT component: acceptance, cognitive defusion, self as context, being present, values, and committed action (Batink, et al., 2016). The items are scored on a 7-point Likert Scale: the answers to statements ranged from "Totally disagree" (0) to "Totally agree" (6).

Example statements are "I find it difficult to keep my attention to what is happening in the here and now", "I believe that some of my thoughts are abnormal or bad and that I should not think so". The internal consistency for the complete FIT-60 was high ($\alpha = .95$) and the internal consistency for the six subscales varied but from questionable to high (Acceptance; $\alpha = .86$, Cognitive defusion;

 α = .89, Observing the self; α = .56, Being Present; α = .82, Values; α = .77, Committed action; α = .84). Based on Batink and his colleagues the validity of the FIT-60 is satisfactory.

The Rand Short Form 36 (Appendix A. 3.)

SF-36 is a well-validated and standardized 36-item questionnaire that was developed to measure eight health aspects: "1) limitations in physical activities because of health problems;

2) limitations in social activities because of physical or emotional problems; 3) limitations in usual role activities because of physical health problems; 4) bodily pain; 5) general mental health (psychological distress and well-being); 6) limitations in usual role activities because of emotional problems; 7) vitality (also called energy or fatigue); and 8) general health perceptions" (Ware & Sherbone, 1992, s. 474). Because we scored this questionnaire in terms of energy, later in this study, the word 'energy' will be used instead of fatigue. The questionnaire has been used both in general and condition-specific population and translated to many other languages in variety of studies and showed that it is a psychometrically sound measure (ten Klooster, et al., 2013). Four items in the questionnaire are about energy/fatigue: 'How often during the past 4 weeks you felt full of life/ have a lot of energy/ feel worn out/ feel tired?'. Those items are scored based on 6-point Likert Scale (all/most/a good bit/some/a little/none of the time). Higher scores define higher energy level. Cronbach's alpha for the energy subscale in this study was adequate ($\alpha = .79$).

Insomnia Severity Index (Appendix A. 4.)

ISI is a short self-report that consists of 7-items to measure perceived insomnia symptoms and the level of distress which is a consequence of these symptoms (Omachi, 2011). The dimensions are as follows: (1) difficulty with sleep onset, (2) difficulty with sleep maintenance, (3) problem with early awakening, (4) satisfaction with sleep pattern, (5) interference with daily functioning as a result of sleep problems, (6) noticeability of sleep problem to others, and (7) degree of distress caused by sleep problem. It is based on DSM-IV criteria thus it has good face validity (Omachi, 2011). A 5-point Likert response format is used (i.e. 0 = no problem; 4 = very severe problem) to assess the total score ranges from 0 to 28. The responses are summed. Higher scores indicate higher insomnia severity. The internal consistency in this study was good ($\alpha = .90$). Previous research has shown that the ISI has good validity and reliability (Morin, Belleville, Bélanger, & Ivers, 2011).

Statistical Analyses

All analyses were performed using the Statistical Package for the Social Sciences (SPSS, version 25.0). Pearson's correlation coefficients were calculated to analyze the univariate associations between sleep disturbance, PF and fatigue. In analysis 1, to test the moderator effect, regression analyses were performed with PROCESS v3.3 by Andrew F. Hayes. Gender, education, the predictor (sleep disturbance), the moderator (PF) and the interaction variable (sleep disturbance x PF) were entered in the analyses. Sleep disturbance score was entered as an independent variable; PF score was entered as a moderator variable; age, gender and education levels were entered as potential covariates; and finally energy mean is entered as dependent variable (Note. the energy scale of the SF-36 is used to measure energy, the opposite of fatigue, thus in the results section it was referred as energy levels). Model 1 which represents moderator model in PROCESS was used. Predictor and moderator variables were centered and standardized with PROCESS software. Level of confidence for all confidence intervals were set at 95%.

In analysis 2, to assess which subscales of psychological flexibility are more correlated with fatigue. The same analyses as in block 1 were run for each subscale.

In analysis 3, whether or not sleep disturbance mediated the relationship between PF and fatigue was assessed. Correlational analyses were first computed to examine whether the potential mediator was associated with the predictor variable and the outcome variable. If the associations were significant; then regression analyses were performed with PROCESS v3.3 by Andrew F. Hayes. Model 4 which represents mediation analyses was used. PF was entered as predictor variable; sleep disturbance was entered as mediator variable; gender and education as covariates; energy mean was entered as outcome variable.

Results of 2-tailed tests were used; p < 0.05 was considered to be statistically significant.

Results

There were 538 participants who joined the online survey. Not everyone completed the whole questionnaire; those who only filled in the demographics were deleted from the data. Missing data was excluded from the analysis on pairwise basis. The final sample sizes of the analyses were n = 328 for energy/fatigue, n = 339 for Psychological Flexibility, and n = 288 for sleep disturbance. In table 1 the demographic characteristics of the participants are presented. Female gender and academic education level are overrepresented and the majority had at least one somatic disease.

Table 1

Age, Mean (SD)	46 (14.00)
Gender, n (%)	
Male	28 (8.3%)
Female	311 (91.7%)
Education Level, n (%)	
Academic	219 (48.5)
Other	213 (51.5%)
Chronic Somatic diseases, n (%)	
Psychiatric disease	41 (12.1%)
Osteoarthritis	60 (17.7%)
Fibromyalgia	141 (41.6%)
Rheumatic disease; not osteoarthritis or fibromyalgia	51 (15%)
Lung disease	33 (9.7%)
Diabetes	12 (3.5%)
Chronic skin condition	31 (9.1%)
Epilepsy	6 (1.8%)
Dementia	0 (0%)
Parkinson	0 (0%)
Burn-out	34 (10%)
Cancer	5 (1.5%)
Cardiovascular diseases	41 (12.1%)
Chronic fatigue syndrome	33 (9.7%)
Irritable bowel syndrome	67 (19.8%)
Somatic symptom disorder	1 (.1%)
Migraine	42 (12.4%)
Chronic headache (not migraine)	12 (3.5%)
Chronic pain (other than head)	46 (13.6%)
Addiction	29 (8.6%)
Severe obesity	30 (8.8%)
No disorder	35 (10.3%)
Other	263 (77.6%)

Demographic Characteristics of the Participants (N= 339)

Note. *SD*= standard deviation. Education level: Academic: university of applied sciences and university education; Other: primary school, preparatory vocational secondary education, intermediate vocational education, senior vocational education and general secondary education.

Table 2 shows the characteristics of the predictor and outcome variables used in the regression analysis.

Table 2

Variable	п	М	SD	Min	Max
Psychological Flexibility (FIT-60)	339	219.77	49.48	75.00	330.00
Acceptance	339	35.51	11.21	.00	59.00
Cognitive defusion	339	31.63	12.47	.00	60.00
Self as context	339	31.70	7.87	8.00	52.00
Here and now	339	37.84	10.19	11.00	60.00
Values	339	43.43	8.45	9.00	60.00
Committed action	339	39.66	9.65	8.00	60.00
Sleep disturbance (ISI)	288	13.51	7.87	.00	32.00
Energy Mean (SF-36)	328	32.87	18.25	1.25	88.50

Characteristics of Primary Variables in The Regression Analysis

Note. N= sample size; *M* = mean; *SD* = standard deviation; *Min* = minimum;

Max = maximum; FIT-60 = Flexibility Index Test; ISI = Insomnia Severity Index;

SF-36 = The Rand Short Form 36.

Table 3 shows the bivariate correlations of PF, sleep disturbance and possible covariates with energy. Bivariate correlations revealed that there is no association between age and energy. (Male) gender and (a higher) education level were significantly correlated with energy; they were controlled for in moderation and mediation analyses.

Table 3

Correlations of Gender, Age, Education, Psychological Flexibility, and Sleep Disturbance

	Energy (SF-36)
Gender	235**
Age	.061
Education	.166**
Psychological Flexibility (FIT-60)	.533**
Sleep Disturbance (ISI)	581**

with Energy

Notes. Women and people with low education levels reported less energy.

****. Correlation is significant at the <0.001 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Hypothesis: People who have both sleep disturbances and low psychological

flexibility will experience more fatigue. Table 3 shows that both high sleep disturbance and low psychological flexibility are correlated with low energy (high fatigue). Table 4 shows the statistics of the moderation analyses. The full model with the main effects and interaction of sleep disturbance and psychological flexibility accounted for a significant proportion of the variance in energy levels, [F (6, 278) = 45.37, p < .001, $R^2 = .50$].

In the moderation analyses, the R^2 change was 0.02, p = .002, indicating that there was a potentially significant moderation between Sleep Disturbance and PF on Energy. Of the two covariates, female gender was significantly associated with low Energy (p = .004), but education was not (p = 0.46). Both the main effects of PF and Sleep Disturbance and their interaction were significantly associated with Energy. This interaction is shown in figure 2 which displays the energy levels as observed with low (-1 SD) and high (+1 SD) levels of PF and sleep disturbance. The figure shows that especially people with high PF and low sleep disturbances experienced little fatigue (more energy). When the sleep disturbance is low, PF is more clearly associated with energy. For high levels of sleep disturbance, the association of PF with energy is less strong. For people with low level of PF, there was not a strong relationship between sleep disturbance and energy but for people with high PF, this association was stronger.

The regression analyses showed that the relationship between sleep disturbance and energy is moderated by PF, b = -0.007, CI [-0.011, -0.003], t = -3.194, p = .002. When PF is low, there is a significant negative relationship between sleep disturbance and energy, b = -0.57, 95% CI [-0.86, -0.28], t = -3.86, p < .001. At the mean value of PF, there is a significant negative relationship between sleep disturbance and energy, b = -0.90, 95%CI [-1.13, -0.67], t = -7.72, p < .001. For high PF, sleep disturbance negatively predicted energy, as sleep disturbance increases the energy decreases b = -1.23, 95% CI [-1.55, -0.91], t = -7.54, p < .001. These results showed that the relationship between sleep disturbance and energy emerges in people at all levels of PF but for high PF the relationship is stronger.

Table	4
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b SE B t р [**CI**] [32.964, 56.786] 7.42 6.05 <.001 Constant 44.87 Sleep [-1.126, -0.669] 0.12 -7.72 <.001 Disturbance -0.89 [0.120, 0.193]Psychological 0.02 8.19 <.001 0.15 Flexibility PF x Sleep [-0.011, -0.003].002 -3.19 .002 -0.007 disturbance F(6,278) =45.37, p < .001

Linear Regression Model predicting Energy

Note. PF = Psychological Flexibility, CI= confidence interval; $R^2 = 0.50$



Figure 2. Energy Predicted by Low and High Levels of PF and Sleep Disturbance.

High "acceptance" and "values-based components" will be more predictive for lower levels of fatigue. Subscales of PF were computed as moderators in the regression analysis for the relationship between sleep disturbance and energy. Table 5 shows the correlation of the subscales of PF with energy.

Table 5

Correlations Between Psychological Flexibility Subscales and Energy

	ENERGY (SF-36)
Acceptance	.441**
Cognitive diffusion	.427**
Self as context	.385**
Here and now	.414**
Values	.557**
Committed action	.513**

Note. ****. Correlation is significant at the <0.001 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Acceptance had a significant association with energy r = .44, p < .001. Both acceptance and its interaction with sleep disturbance were significantly correlated with energy, p = .002. Table 6 gives a summary of the significance of interactions of psychological flexibility subscales and sleep disturbance with energy. There were significant R² changes for acceptance, being present, values and committed action; indicating that the relationship between sleep disturbance and each one of those components emerged in people at all levels of acceptance, being present, values and committed action. Interaction plots showed that for high levels of those components the relationship was stronger, similar to the analysis with the overarching psychological flexibility construct (Figure 1). The detailed statistical information on moderation analyses for PF components are given in Appendix B.

Table 6

Significance of associations between Interactions of Psychological Flexibility Subscales and

Interactions with	Energy (SF-36)
Sleep Disturbance	
	t
Acceptance	-3.16**
Cognitive Defusion	-1.76 NS
Self as Context	-1.33 NS
Being Present	-2.64**
Values	-3.97***
Committed Action	-3.07**

Sleep Disturbance with Energy

Note. ****. Interaction is significant at the <0.001 level.

**. Interaction is significant at the 0.001 to 0.01 level.

*. Interaction is significant at 0.01 to 0.05 level.

NS. Interaction is not significant.

Mediating effect of sleep disturbance. Figure 3 shows the results of the mediation analysis. The standardized regression coefficient between psychological flexibility and sleep disturbance was statistically significant, as was the standardized regression coefficient between sleep disturbance and energy.

The regression analysis showed that PF was significantly associated with sleep disturbance b = -0.08, 95% CI [-0.09, -0.06], t = -9.59, p < .001. PF explained 24% of the variance in sleep disturbance. As PF increased the sleep disturbance decreased (and vice versa). Sleep disturbance also significantly predicted energy, b = -0.86, 95% CI [-1.13, -0.67], t = -7.65, p < .001. This model explained 46% of the variance in energy. As sleep disturbance increased, the energy decreased. In the model, PF significantly predicted energy even with sleep disturbance b = 0.15, 95% CI [0.11, 0.19], t = 8.06, p < .001. When sleep disturbance was not in the model, PF significantly predicted energy, b = 0.22, 95% CI [0.19, 0.26], t = 12.42, p < .001. As was the case when sleep disturbance was included in the model: PF had a positive relationship with energy.

Sobel test revealed that there was a partial mediation in the model, z = 6.19, p < .001. Sleep disturbance was a partial mediator in the relationship between PF and energy b = 0.07, 95% CI [0.05, 0.09]. Completely standardized indirect effects of PF on energy also showed that there was a partial mediation, b = 0.18, 95% BCa CI [0.13, 0.24].



Figure 3. Model of Psychological Flexibility as a Predictor of Energy, Mediated by Sleep Disturbance. The 95% confidence interval (CI) for the indirect effect is a BCa bootstrapped CI based on 5000 samples (Preacher & Hayes, 2008).

Note. BCa: the bias corrected and accelerated bootstrapped interval.

Discussion

The present study examined the associations of sleep disturbance and psychological flexibility with fatigue. The main result of this study is that psychological flexibility appears to have a buffering role in the relation between sleep disturbance and fatigue. Consistent with the current hypothesis, low PF and more sleep disturbance are associated with more fatigue. Among PF components, acceptance, being present, values and committed action were strongly associated with fatigue. There was a significant negative correlation between PF and sleep disturbance, and a positive correlation between sleep disturbance and fatigue consistent with other studies (Albayrak Gezer, et al., 2017; Bartley, Robinson, & Staud, 2007; Chen, et al., 2013; Treharne, et al., 2008). Sleep was indicated to partly mediate the association between psychological flexibility and fatigue.

The results showed that people with higher sleep disturbance report lower levels of energy compared to people with lower sleep disturbance. This shows that consistent with previous studies (Irwin, et al., 2012; Rychnovsky & Hunter, 2009) there is a positive relationship between sleep disturbance and fatigue.

While taking account of psychological flexibility, findings support our hypothesis that people with low PF and high sleep disturbance experience higher levels of fatigue compared to those with high PF and high sleep disturbance. The results even more clearly show that people with high PF and low sleep disturbance have high energy levels. Based on these outcomes, it seems that the relationship between sleep disturbance and fatigue is influenced by PF levels. Previous studies also supported the role of PF on fatigue. For instance, PF improves with ACT, throughout the treatment, individuals acquire new ways to direct their energy for functional behavior and fatigue severity decreases over time (Densham, Williams, Johnson, & Turner-Cobb, 2016); PF helps them to implement new strategies while dealing with consequences of chronic condition (Hayes, Luoma, Bond, Masuda, & Lillis, 2006).

Based on our results, people with higher psychological flexibility experience less fatigue, also after having taken sleep disturbance levels into account. This may tentatively suggest that improving psychological flexibility may have an impact on fatigue. Furthermore, for people with low PF, there was hardly a relationship between sleep disturbance and energy but for people with high PF, this association was stronger. Reflecting on these results, it is worth trying to treat sleep disturbances in addition to improving PF with ACT, because it may be more beneficial to reduce fatigue.

The current study examined the associations of the six components of psychological flexibility with fatigue. The findings confirm that people with higher scores on the six subscales of psychological flexibility report higher energy (less fatigue) than those who had low scores on those six components. The components which were the most strongly associated with fatigue were acceptance, being present, values and committed action. Our hypothesis ("acceptance" and "values-based components" will be more predictive for lower levels of fatigue) was confirmed, however, in addition to acceptance and values-based components, being present was also associated with energy in this study. Previous studies also

pointed out the importance of acceptance for fatigue: low acceptance is associated with higher fatigue (Brooks, Rimes, & Chalder, 2011) while, high acceptance is associated with better psychological well-being and lower levels of fatigue (Van Damme, Crombez, Van Houdenhove, Mariman , & Michielsen, 2006). If an individual has problems with acceptance and rather tries having control over the fatigue onset, his values and committed actions may be influenced negatively. Especially if the prevention actions are not corresponding to the values, such actions become more overwhelming (Densham, Williams, Johnson, & Turner-Cobb, 2016). By accepting, an individual can also connect with the present moment better and act in line with their values (Hayes S. , 2004).

Densham and his colleagues (2016) tried to enhance psychological flexibility and quality of life, while decreasing fatigue severity by a six-week treatment program. They observed that six months after the treatment, people experienced changes in fatigue severity. This change was associated with the change in quality of life but not with having or not having the six-week training. In that study, they did not use ACT but they rather used Cognitive Behavioral Therapy and mindfulness which in the current study found to be less associated with fatigue when considering sleep disturbance. ACT might be different than the CBT and mindfulness-based intervention that was used by Densham et al. (2016). ACT focuses more on values and committed behavior (Ciarrochi, Bilich, & Godsel, 2010) thus further research may investigate the role of ACT together with the being present component in the treatment of fatigue in the presence of sleep disturbance.

It cannot be inferred from the current correlational study that the PF directly acted to decrease sleep disturbance, which in turn increased energy level (decreased fatigue); indeed, sleep disturbance is a partial mediator of energy. The causality between those variables can only be tested in controlled studies with an intervention and repeated measurements.

Strengths and Limitations

The current study has some methodological limitations. One of them is generalizability: the number of female participants and participants with academic education were overrepresented. A similar study can be replicated with a more representative sample of the population, especially because both female gender and low education levels were found to be associated with low energy levels. On the other hand, one of the strengths of this study is that the participant group included a relatively high number of people with fatigue and sleep problems.

The second limitation are the self-report questionnaires. Even though they are high in reliability and validity, for future research less subjective scales such as polysomnography or EEG measures of sleep (Campbell, 2009) can be used to measure non-experiential aspects of sleep disturbance.

A third limitation is that there was no question about participants' medication usage. There could have been participants who were using medication for their sleep problems thus no longer experiencing sleep disturbances. In the case of using medication, experiencing less fatigue may not be attributed to psychological flexibility, and medication becomes an extraneous variable. Future studies can include an extra question for medication to include it in their analyses as a possible covariate later on.

The fourth limitation is that this study is cross-sectional. Therefore, it does not explain causal relationships between sleep disturbance, psychological flexibility and fatigue. The last limitation is that this study focuses on three specific variables, however, when we consider the Network Model (Geenen & Dures, 2019), there are a variety of variables such as pain, physical activity, and inflammation that exist in the context together with sleep and fatigue. For instance, as physical activity increases, chances of positive effects on other variables such as sleep, and energy increase (Penedo & Dahn, 2005). Thus, those systems should not be excluded from the context and the impact they have on sleep and fatigue should be taken into consideration. The real context is more complex than the reductionist model used in this study.

Practical Implications

Due to the observation that psychological flexibility is associated more with energy when the sleep disturbance is low; there should be an increased focus on the prevention and treatment of sleep disturbance. For instance, using sleep hygiene together with ACT might help people to benefit more from high levels of PF. In that sense, the conjunct treatment might be more useful, which should be examined in clinical experimental studies.

Insomnia when left untreated increases the chances of fatigue (Carey, Moul, Pilkonis, Germain, & Buyyse, 2005; Cheatle, et al., 2016) thus knowing which psychological flexibility components have a moderator effect in the relationship between sleep disturbances and fatigue will be useful in health care. This will helps people with sleeping disturbance and low PF to receive the most effective treatment, which will decrease their fatigue and sleep disturbances. Health care professionals will focus more on these specific components to provide the best and the most time efficient treatment.

This study extends previous research exploring sleep disturbance, components of PF and fatigue in the general population and provides evidence for the importance of PF in the relationship between sleep disturbance and fatigue. Future work should consider a network model of fatigue in a controlled or longitudinal study to figure out which components are most important for each individual. Treatment of one component may result in recovery of other components (Geenen & Dures, 2019).

Conclusion

This study has revealed that psychological flexibility may have a buffering role in the relationship between sleep disturbance and fatigue. The relationship between sleep and energy

The role of psychological flexibility in a multifaceted model of chronic fatigue

was stronger for people with high PF. Low acceptance, values, committed action and being present were significantly associated with fatigue in interaction with sleep disturbance. Lastly, sleep may "mediate" the relationship between PF and fatigue. Those results are important in generating effective treatments that help people with fatigue and sleep problems to develop ways to move towards their values even when they experience fatigue symptoms. Whilst these results are promising, further research is needed to enhance understanding by exploring sleep disturbance and fatigue in broader context such as the network model which also includes pain, physical activity, inflammation, anxiety and obesity.

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Appendices

Appendix A

Used Instruments

A. 1. Demographic Questions:

1. Geslacht

Kies één van de volgende antwoorden.

- a) Man
- b) Vrouw
- c) Anders
- 2. Leeftijd

Uw antwoord moet tussen 9 en 99 liggen. In dit veld mag alleen een geheel getal worden ingevoerd.

3. Wat is uw burgelijke status?

Kies één van de volgende antwoorden.

- a) Alleenstaand
- b) Gehuwd/samenwonend
- c) Gescheiden
- d) Weduwe/weduwnaar
- e) Anders
- 4. Wat is uw opleidingniveau?
 - a) Lager onderwijs (basisschool)
 - b) Lager beroepsonderwijs (LHNO/huishoudschool/LTS/VMBO-basis, VMBO-kader)
 - c) Middelbaar algemeen onderwijs (MULO/MAVO/VMBO-gemengd, VMBOtheoretisch, 3 jaar HAVO of VWO), Middelbaar beroepsonderwijs (MBO) niveau 1
 - d) Middelbaar beroepsonderwijs MBO (niveau 2, 3 of 4), MTS, MEAO, etc.
 - e) Voortgezet algemeen onderwijs (HBS/MMS/HAVO/VWO/Gymnasium/Atheneum)
 - f) Hoger beroepsonderwijs (hogeschool, HTS, HEAO, etc.)
 - g) Wetenschappelijk onderwijs (universiteir, ingenieursexamen)
 - h) Anders

Naam: Gesla	Naam: Geslacht: M / V Leeftijd:							
Burg. staat: Opleiding:	_ Dat	um	afn	ame	::			
In welke mate zijn onderstaande stellingen van toepassing op u? Omcirkel het meest passende antwoord. Sla alstublieft geen stellinger over.	ı	oneens	Helemaal				eens	Helemaal
01 Zorgen staan mijn succes in de weg.		0	1	2	3	4	5	6
02 Ik voel me vaak beperkt door alles wat ik van mezelf moet.		0	1	2	3	4	5	6
03 Ik kan negatieve gedachten over mijzelf hebben en tegelijkertijd weten dat ik oké ben.		0	1	2	3	4	5	6
04 Als ik iets wil doen, dan ga ik er voor.		0	1	2	3	4	5	6
05 Ik ben goed in staat om lange termijn doelen op te delen in korte termijn mogelijkheden.		0	1	2	3	4	5	6
06 Mijn leven is goed in balans.		0	1	2	3	4	5	6
07 Ik vind het moeilijk om doelgericht bezig te blijven.		0	1	2	3	4	5	6
08 Ik heb voldoende vrienden.		0	1	2	3	4	5	6
09 Mijn gedachten bezorgen mij ongemak of emotionele pijn.		0	1	2	3	4	5	6
10 Het is OK als ik me iets onaangenaams herinner.		0	1	2	3	4	5	6
11 Ik maak regelmatig concrete plannen voor de toekomst.		0	1	2	3	4	5	6
12 Als iets me niet lukt dan zet ik door, en probeer ik het op een and manier aan te pakken.	ere	0	1	2	3	4	5	6
13 Ik ga graag naar mijn werk.		0	1	2	3	4	5	6
14 Ik ben bereid om mijn angst volledig toe te laten.		0	1	2	3	4	5	6
15 Ik vind het moeilijk om mijn aandacht te houden bij wat er in het hier en nu gebeurt.		0	1	2	3	4	5	6
16 Ik ben snel afgeleid.		0	1	2	3	4	5	6
17 Ik vind van mezelf dat ik altijd aardig moet zijn.		0	1	2	3	4	5	6
18 Het is moeilijk voor me om de woorden te vinden die mijn gedachten beschrijven.		0	1	2	3	4	5	6
19 Ik besef dat mijn zelfbeeld niet zoveel over mij als persoon zegt.		0	1	2	3	4	5	6
20 Ik observeer mijn gevoelens zonder dat ik me erin verlies.		0	1	2	3	4	5	6
21 Als ik thuis ben voel ik me op mijn gemak.		0	1	2	3	4	5	6
22 Ik doe mijn best om geen negatieve dingen te hoeven ervaren.		0	1	2	3	4	5	6
23 Ik heb last van een negatief zelfbeeld.		0	1	2	3	4	5	6
24 Als ik iets niet goed doe, dan reken ik dat mezelf aan.		0	1	2	3	4	5	6
25 Ik besef dat ik de dingen die ik doe, zelf heb gekozen.		0	1	2	3	4	5	6

A. 2. The Flexibiliteits Index Test (FIT-60) (Batink, Jansen & de Mey, 2012)

In w Om ove	elke mate zijn onderstaande stellingen van toepassing op u? cirkel het meest passende antwoord. Sla alstublieft geen stellingen r.	oneens	Helemaal				eens	Helemaal
26 vero	Als ik pijnlijke gevoelens toelaat, dan ben ik bang dat ze niet meer Iwijnen.	0	1	2	3	4	5	6
27	Er zijn een aantal dingen die ik doe, die ik belangrijk vind.	0	1	2	3	4	5	6
28	Ik heb last van het gevoel dat ik door de bomen het bos niet meer zie.	0	1	2	3	4	5	6
29	Ik heb de neiging mijn pijn erger te maken met mijn gedachten.	0	1	2	3	4	5	6
30	Ik vind het makkelijk om mijn gedachten van een andere kant te bekijken.	0	1	2	3	4	5	6
31	Mijn pijnlijke ervaringen en herinneringen maken het me moeilijk om een waardevol leven te leiden.	0	1	2	3	4	5	6
32	Als iemand een vervelende opmerking maakt, kan ik daar nog lang last van hebben.	0	1	2	3	4	5	6
33	Ik hoef dingen niet altijd goed te doen van mezelf.	0	1	2	3	4	5	6
34	Mijn werk en / of studie speelt een belangrijke rol in mijn leven.	0	1	2	3	4	5	6
35	Gedachten die bij me opkomen moet ik onder controle houden.	0	1	2	3	4	5	6
36	Ik kan goed beschrijven wat ik voel.	0	1	2	3	4	5	6
37	Ik vind mijn leven waardevol.	0	1	2	3	4	5	6
38	Ik geloof dat sommige van mijn gedachten abnormaal of slecht zijn en dat ik niet zo zou moeten denken.	0	1	2	3	4	5	6
39	Sommige woorden kunnen mij heel hard raken.	0	1	2	3	4	5	6
40	Ik ben onderweg om mijn doelen en dromen te bereiken.	0	1	2	3	4	5	6
41	Ik besteed regelmatig tijd aan mijn hobby's.	0	1	2	3	4	5	6
42	Ik heb de neiging erg sterk te reageren op mijn eigen negatieve gedachten.	0	1	2	3	4	5	6
43	Ik keur mezelf af als ik rare gedachten heb.	0	1	2	3	4	5	6
44	Ik kan makkelijk mijn overtuigingen en meningen onder woorden brengen.	0	1	2	3	4	5	6
45	Emoties (zoals boosheid, verdriet) veroorzaken problemen in mijn leven.	0	1	2	3	4	5	6
46	Ik sta los van mijn omgeving.	0	1	2	3	4	5	6
47	Ik doe meerdere dingen die ik belangrijk vind.	0	1	2	3	4	5	6
48	Ik vind het leuk om nieuwe uitdagingen aan te gaan.	0	1	2	3	4	5	6
49	Ik kan goed beschrijven wat ik ervaar met mijn zintuigen, zoals wat ik hoor, zie en ruik.	0	1	2	3	4	5	6
50	Ik vind steun bij de mensen in mijn omgeving.	0	1	2	3	4	5	6

In w Om ove	elke mate zijn onderstaande stellingen van toepassing op u? cirkel het meest passende antwoord. Sla alstublieft geen stellingen r.	oneens	Helemaal				eens	Helemaal
51	De gedachten die ik over mijzelf heb, bepalen niet wie ik ben.	0	1	2	3	4	5	6
52	Ik schrik soms van de gedachten die ik heb.	0	1	2	3	4	5	6
53	Ik ben bang voor mijn gevoelens.	0	1	2	3	4	5	6
54	Mijn gedachten en gevoelens staan de manier waarop ik wil leven niet in de weg.	0	1	2	3	4	5	6
55	Ik vind familie en / of vrienden belangrijk.	0	1	2	3	4	5	6
56	Wanneer ik mezelf vergelijk met andere mensen, lijkt het dat de meesten onder hen hun leven beter in de hand hebben dan ik.	0	1	2	3	4	5	6
57	Het is erg moeilijk om verontrustende gedachten los te laten, zelfs wanneer ik weet dat los laten mij zou helpen.	0	1	2	3	4	5	6
58	Van sommige gedachten raak ik van streek.	0	1	2	3	4	5	6
59	Ik ben erop uit om nieuwe dingen te doen.	0	1	2	3	4	5	6
60	Ik denk dat mijn emoties soms slecht of ongepast zijn en dat ik ze niet zou moeten voelen.	0	1	2	3	4	5	6

Heeft u alle stellingen ingevuld? Hartelijk dank voor het invullen van deze lijst!

A. 3. SF-36



RAND > RAND Health Care > Surveys > RAND Medical Outcomes Study > 36-Item Short Form Survey (SF-36) >

36-Item Short Form Survey Instrument (SF-36)

RAND 36-Item Health Survey 1.0 Questionnaire Items

Choose one option for each questionnaire item.

- 1. In general, would you say your health is:
- 🔘 1 Excellent
- 🔘 2 Very good
- 🔘 3 Good
- 🔵 4 Fair
- 🔘 5 Poor

2. Compared to one year ago, how would you rate your health in general now?

- 🔘 1 Much better now than one year ago
- 🔘 2 Somewhat better now than one year ago
- 🔘 3 About the same
- 4 Somewhat worse now than one year ago
- 🔘 5 Much worse now than one year ago

36-Item Short Form Survey Instrument (SF-36) | RAND

The following items are about activities you might do during a typical day. Does **your health now limit you** in these activities? If so, how much?

	Yes, limited a lot	Yes, limited a little	No, not limited at all
3. Vigorous activities , such as running, lifting heavy objects, participating in strenuous sports	01	0 2	03
4. Moderate activities , such as moving a table, pushing a vacuum cleaner, bowling, or playing golf	01	2	3
5. Lifting or carrying groceries	01	0 2	Оз
6. Climbing several flights of stairs	01	0 2	Оз
7. Climbing one flight of stairs	01	0 2	Оз
8. Bending, kneeling, or stooping	01	0 2	Оз
9. Walking more than a mile	01	0 2	3
10. Walking several blocks	01	0 2	3
11. Walking one block	1	0 2	Оз
12. Bathing or dressing yourself	1	2	Оз

During the **past 4 weeks**, have you had any of the following problems with your work or other regular daily activities **as a result of your physical health**?

	Yes	No
13. Cut down the amount of time you spent on work or other activities	0	\bigcirc
	1	2
14. Accomplished less than you would like	0	\bigcirc
	1	2
15. Were limited in the kind of work or other activities	0	\bigcirc
	1	2
16. Had difficulty performing the work or other activities (for example, it took extra	\bigcirc	\bigcirc
effort)	1	2

36-Item Short Form Survey Instrument (SF-36) | RAND

During the **past 4 weeks**, have you had any of the following problems with your work or other regular daily activities **as a result of any emotional problems** (such as feeling depressed or anxious)?

	Yes	No
17. Cut down the amount of time you spent on work or other activities	01	0 2
18. Accomplished less than you would like	01	0 2
19. Didn't do work or other activities as carefully as usual	01	0 2

20. During the **past 4 weeks**, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?

- 🔵 1 Not at all
- 🔘 2 Slightly
- 🔘 3 Moderately
- 🔘 4 Quite a bit
- 🔘 5 Extremely

21. How much **bodily** pain have you had during the **past 4 weeks**?

- 🔘 1 None
- 🔘 2 Very mild
- 🔘 3 Mild
- 🔘 4 Moderate
- 🔘 5 Severe
- 🔘 6 Very severe

36-Item Short Form Survey Instrument (SF-36) | RAND

22. During the **past 4 weeks**, how much did **pain** interfere with your normal work (including both work outside the home and housework)?

🔵 1 - Not at all

🔘 2 - A little bit

🔘 3 - Moderately

🔘 4 - Quite a bit

🔘 5 - Extremely

These questions are about how you feel and how things have been with you **during the past 4 weeks**. For each question, please give the one answer that comes closest to the way you have been feeling.

How much of the time during the **past 4 weeks**...

	All of the time	Most of the time	A good bit of the time	Some of the time	A little of the time	None of the time
23. Did you feel full of pep?	01	2	Оз	0 4	05	0 6
24. Have you been a very nervous person?	01	0 2	3	0 4	05	0 6
25. Have you felt so down in the dumps that nothing could cheer you up?	01	0 2	3	4	05	6
26. Have you felt calm and peaceful?	01	0 2	Оз	0 4	05	0 6
27. Did you have a lot of energy?	01	2	3	0 4	05	0 6
28. Have you felt downhearted and blue?	01	0 2	3	0 4	05	06
29. Did you feel worn out?	01	0 2	Оз	0 4	05	0 6
30. Have you been a happy person?	01	0 2	Оз	0 4	05	06
31. Did you feel tired?	01	2	3	0 4	05	0 6

36-Item Short Form Survey Instrument (SF-36) | RAND

32. During the **past 4 weeks**, how much of the time has **your physical health or emotional problems** interfered with your social activities (like visiting with friends, relatives, etc.)?

- \bigcirc 1 All of the time
- 🔘 2 Most of the time
- 🔘 3 Some of the time
- 🔘 4 A little of the time
- 🔘 5 None of the time

How TRUE or FALSE is **each** of the following statements for you.

	Definitely true	Mostly true	Don't know	Mostly false	Definitely false
33. I seem to get sick a little easier than other people	01	0 2	Оз	4	05
34. I am as healthy as anybody I know	1	0 2	3	0 4	05
35. I expect my health to get worse	1	0 2	3	<u> </u>	05
36. My health is excellent	O 1	0 2	Оз	4	0 5

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 $https://www.rand.org/health-care/surveys_tools/mos/36-item-short-form/survey-instrument.html and the statement of the state$

A. 4. Insomnia Severity Index (Charles M. Morin)

The Insomnia Severity Index has seven questions. The seven answers are added up to get a total score. When you have your total score, look at the 'Guidelines for Scoring/Interpretation' below to see where your sleep difficulty fits.

For each question, please CIRCLE the number that best describes your answer.

Please rate the CURRENT (i.e. LAST 2 WEEKS) SEVERITY of your insomnia problem(s).

	Insomnia Prob	lem	None	Mild	Moderate	Severe	Very Severe
1. Difficulty falling asleep			0	1	2	3	4
2. Difficulty staying asleep			0	1	2	3	4
3. Problems w	aking up too ear	ly	0	1	2	3	4
4. How SATISFIED/DISSATISFIED are you with your CURRENT sleep pattern? Very Satisfied Satisfied Moderately Satisfied Dissatisfied V 0 1 2 3					attern? issatisfied Ve 3	ery Dissatisf 4	ied
5. How NOTIC	EABLE to other Not at all Noticeable 0	rs do you think yo A Little 1	our sleep probl Somewhat 2	em is in term Much 3	ns of impairing th Very Much I 4	ne quality of Noticeable	your life?
6. How WORRIED/DISTRESSED are you about your current sleep problem? Not at all Worried A Little Somewhat Much Very Much Worried 0 1 2 3 4							
7. To what externation fatigue, mood,	ent do you consid ability to functic Not at all Interfering 0	ler your sleep pro n at work/daily c A Little 1	blem to INTE hores, concent Somewhat 2	RFERE with ration, memo Much 3	your daily funct ory, mood, etc.) (Very Much 4	ioning (e.g. CURRENTL Interfering	daytime Y?

Guidelines for Scoring/Interpretation:

Add the scores for all seven items (questions 1 + 2 + 3 + 4 + 5 + 6 + 7) =_____ your total score

Total score categories:

0-7 = No clinically significant insomnia

8-14 = Subthreshold insomnia

15–21 = Clinical insomnia (moderate severity)

22–28 = Clinical insomnia (severe)

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Appendix B

Statistics of the Moderation Analyses for Psychological Flexibility Components

B. 1. Acceptance

	b	SE B	t	р
	[CI]			
Constant	[32.197, 57.478] 44 837	6.42	6.98	<.001
Sleep Disturbance	[-1.304, -0.822] -1.063	0.12	-8.70	<.001
Acceptance	[0.285, 0.630] 0.46	0.09	5.22	<.001
Acceptance x Sleep disturbance	[-0.048, -0.011]] -0.03	.009	-3.16	.002

Linear Regression Model predicting Energy

Note. CI= confidence interval; $R^2 = 0.43$

B. 2. Being Present

Linear Regression Model predicting Energy

	b	SE B	t	р	
	[CI]				
Constant	[35.278, 60.465]	6.40	7.48	< 001	
Constant	47.871			<.001	
Sleep	[-1.307, -0.853]	0.12	0.26	< 001	
Disturbance	-1.080	0.12	-9.30	<.001	
	[0.343, 0.706]	0.00	5 69	< 001	
Being Present	0.52	0.09	3.08	<.001	
Being Present x					
Sleep	[-0.050, -0.007]]	.011	-2.64	.009	
disturbance	-0.03				

Note. CI= confidence interval; $R^2 = 0.44$

B.3. Values

	b	SE B	t	р
	[CI]			
Constant	[37.110, 60.151]	5.85	8 31	< 001
Constant	48.630	5.05	0.51	<.001
Sleep	[-1.150, -0.725]	0.11	9 66	< 001
Disturbance	-0.937	0.11	-8.00	<.001
	[0.800, 1.209]	0.11	0.67	< 001
Values	1.004	0.11	9.07	<.001
Valara - Class	[0 072 0 025]]			
values x Sleep	[-0.073, -0.025]]	.012	-3.97	<.001
disturbance	-0.05			

Linear Regression Model predicting Energy

Note. CI= confidence interval; $R^2 = 0.53$

B.4. Committed Action

Linear Regression Model predicting Energy

	b	SE B	t	р
	[CI]			
Constant	[36.179, 60.066]	6.07	7.93	<.001
Constant	48.122			
Sleep	[-1.189, -0.755]	0.11	0 0 1	< 001
Disturbance	-0.972	0.11	-8.81	<.001
Committed Action	[0.605, 0.982] .794	0.10	8.29	<.001
Committed Action x Sleep disturbance	[-0.054, -0.012]] -0.03	.011	-3.07	.002

Note. CI= confidence interval; $R^2 = 0.49$

Appendix C.

Assumptions

Prior to analyzing the data several assumption checks were completed. First, normality test was run, based on the histogram and Q-Q Plot, the data was normally distributed. Linearity and homoscedasticity assumptions were also met. Secondly, Cook's distance and Mahalanobis distance were calculated; there were no multivariate outliers.