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Original Reports

Assessing Psychological Flexibility and Inflexibility in Chronic Pain Using the Multidimensional Psychological Flexibility Inventory (MPFI)

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Abstract: **Psychological flexibility (PF) is a model of well-being and daily functioning that is applied to chronic pain, and is the model behind Acceptance and Commitment Therapy (ACT). However, studies of PF in chronic pain are limited by the lack of a single measure capturing all facets. The Multidimensional Psychological Flexibility Inventory (MPFI) assesses all facets of PF and psychological inflexibility (PI) and could remedy this problem. The current study employs this measure. Adult participants with chronic pain (*N* = 404) were recruited online and completed the MPFI, other validated measures of PF/PI, and measures of pain, work and social adjustment, and depression, at two time points. The reliability, factor structure, and validity of the MPFI were assessed. Confirmatory factor analysis results demonstrated a good model fit for the proposed factor-and subscale structure. Correlations between MPFI and theoretically similar measures were moderate to strong, and correlations with pain intensity, pain interference, work-and social adjustment, and depression, were small to large. In this first examination of the potential utility of the MPFI within a chronic pain population, we found it to be valid and reliable. It should be noted that the MPFI was less predictive of outcomes compared with more established measures in most cases. Despite this, results from the wide range of variables available from the MPFI highlights the potential importance of aspects of PF and PI not previously emphasized, including the greater predictive utility of the inflexibility facets. Further use and study of the MPFI is recommended.**
ClinicalTrials.gov ID: NCT05050565
Perspective: ***This article presents a comprehensive examination of a self-report measure assessing all facets of psychological flexibility and inflexibility, in a chronic pain sample. The results support the role of facets not previously emphasized. Comprehensive assessment of PF and PI appears possible and is recommended depending on research questions being asked.***

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Key Words: *Chronic pain, psychological flexibility, psychological inflexibility, psychological processes, disability.*

The role of psychological processes in chronic pain and disability is widely appreciated.[23,40] Also, it is clear that psychological treatments, primarily forms of cognitive behavior therapy (CBT), produce benefits for many people with chronic pain (eg, Gandy et al., 2022).[10] However, further research is needed to determine by which treatment methods, for whom, and under what circumstances, the best results will emerge, and how.[30,43] The question "how" pertains to what is called therapeutic mechanism, or processes of change.

Psychological flexibility (PF) is a model of well-being and successful functioning in general and in chronic pain.[20 32] PF is the model behind Acceptance and Commitment Therapy (ACT), a type of therapy within the wider family of cognitive behavioral treatments.[19] Evidence for PF and ACT in the understanding and treating

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chronic pain is growing steadily, now including several reviews and meta-analyses, suggesting that they together represent a promising approach to chronic pain.[7,11,21,33,42]

ACT seeks to help people to change their behavior to improve aspects of their daily functioning as primary outcomes.[20,32] The PF model underlying ACT consists of six interrelated processes of behavior change, or facets. These include acceptance, cognitive dfusion, present moment awareness, self-as-context, values, and committed action, and can be summarized as behavior that are "open, aware, and engaged".[18,20] Conversely, psychological inflexibility (PI) includes the opposite processes, experiential avoidance, cognitive fusion, lack of contact with the present moment, self as content, lack of contact with values, and inaction.[18]

Despite considerable progress, research into PF in chronic pain remains limited in one specific respect. Most studies focus on a small set of the facets from the model, typically acceptance and committed action.[2,32,37] The reason for this is that valid measures for some of the individual facets of PF or single instruments able to capture all of the facets, did not exist until recently.[9,44] The most recent example of the latter is the Multidimensional Psychological Flexibility Inventory.[35] Increasing our knowledge of processes of change in psychological treatments is theoretically important. It is also practically important as a means to refine and improve these treatments in the future.[16] Complete data reflecting all aspects of PF and PI would help in this regard, helping us to pinpoint the processes that appear most relevant for specific outcomes, for specific people, in specific contexts.

The purpose of this study is to examine the overall dimensions and facets of PF and PI in chronic pain by employing the most recent complete measure of all of these, the MPFI. Here we administer the MPFI in a sample of people with chronic pain. First, because we are aware of no published data from the MPFI in people with chronic pain we look at the internal consistency, temporal stability, factor structure, and construct validity of the measure, its dimensions, and its subscales. We then examine how well the dimensions and facets of PF and PI are able to correlate and explain variance in outcomes that include pain interference, work and social functioning, and depression. These three outcomes were chosen because they reflect the range of domains commonly assessed in psychological treatments for chronic pain and the aim to capture everyday functioning in social roles and emotional functioning. Finally, we compare the relative performance of the PF and PI components of the MPFI as predictors of outcomes and also compare these to a selected set of established measures of PF.

Methods

Participants and Procedure

Eligible participants were adults aged 18 or older suffering from chronic pain conditions with persisting or recurrent pain for the past 3 months or more. In addition, fluency in written Swedish was required, as well as access to an internet enabled device such as a smartphone, computer, or tablet. In order to gather test-retest data, participants were contacted on a second occasion during the study. No pain conditions were excluded. However, endometriosis, vulvodynia, persistent low back pain, and fibromyalgia were especially targeted in terms of recruitment material used in order to represent a wider range of pain conditions, including both common and less studied conditions. While low back pain and fibromyalgia are commonly included in psychological chronic pain research, endometriosis and vulvodynia represent two conditions that have not received much research attention.[27] Participants were excluded if they experienced pain less than 15 days in a month, and if their average pain intensity during the last week was less than three on a scale from zero to10.

Following informed consent, self-report measures were administered at two time points through REDCap, an online survey platform.[15] Participants who completed all measures at the first time point received an e-mail with a link to the second time point measures two weeks thereafter. Ethical approval from the Swedish Ethical Review Authority was received before data collection (DNR: 2021-02656).

A total of 700 potential participants were recruited through Facebook ads, Facebook posts in pain related groups and patient organizations between October 8, 2021 and December 17, 2021. Out of the 700 who followed the link, 669 participants provided consent. After screening out potential participants according to days in pain per month and pain intensity (n = 44), and excluding participants that dropped out before completing the MPFI (n = 221), 404 participants remained and were included in the analyses. Out of the final sample, 301 participants (74.5 %) completed measure administered at the second time point and were also included in analyses of test-retest reliability. See Table 1 for participant characteristics.

Measures

Demographics and Pain Characteristics

All participants provided demographic information regarding gender, family origin, potential identification with a minority group, relationship status, work status, educational level, and financial situation. They also provided information on pain conditions, pain sites, pain duration, number of health care visits during the last six months, medical and psychological treatments, whether a pain diagnosis had been provided by a medical doctor, and recruitment site.

The Multidimensional Psychological Flexibility Inventory (MPFI). The MPFI was created by pooling items from the 22 most widely used instruments used in ACT and mindfulness research and then selecting the items best representing each of the facets via item response theory.[35] The selected items making up the MPFI were then tested via

Table 1. Sample Demographics

	Mean (SD) or n (%)
Age	47.75 (13.02)
Gender (women)	379 (93.8 %)
Identify as part of a minority group	28 (6.9 %)
Education (highest completed)	
Elementary	24 (5.9 %)
Secondary	130 (32.3 %)
College/university	223 (55.2 %)
Work status	
Employed (full-time)	140 (34.7 %)
Employed (part-time)	52 (12.9 %)
Self-employed	19 (4.7 %)
Job seeking	22 (5.4 %)
Sick leave	78 (19.3 %)
Other (retired, student, etc.)	90 (22.2 %)
Financial situation	
Very good	41 (10.1 %)
Good	140 (34.7 %)
Sufficient	143 (35.4 %)
Bad	56 (13.9 %)
Very bad	20 (5.0 %)
Relationship status (married/in a relationship)	279 (69.1 %)
Diagnosed pain condition	367 (91.1 %)
Pain duration (> 2 years)	258 (63.9 %)
Days in pain per month	28.14 (4.05)
Pain condition	
Fibromyalgia	116 (28.7 %)
Low-back pain	85 (21.0 %)
Endometriosis	81 (20.0 %)
Other	122 (30.2 %)
Generalized pain	219 (54.2 %)
Pain sites (most frequent)	
Lower back/spine	278 (68.8 %)
Pelvic region	203 (50.2 %)
Neck region	184 (45.5 %)
Prescribed opioids	138 (34.2 %)
Health care visits due to pain	4.73 (9.19)
PHQ-9 (≥ 8 points)	280 (70.53 %)
Received psychological treatment	246 (60.9 %)
Pain	131 (32.4 %)
Mental health condition	189 (46.8 %)
Other	38 (9.4%)
Recruitment site	
Facebook ad	188 (47.5 %)
Facebook groups	149 (37.6 %)
Patient organizations	32 (8.1 %)
Other	27 (6.9 %)

Note. Pain sites were not mutually exclusive.
Abbreviations: PHQ-9, patient health questionnaire - 9.

both exploratory and then a confirmatory factor analysis. This resulted in 12 first-order factors representing all core facets of psychological flexibility and inflexibility, and two global dimensions representing the main processes of flexibility and inflexibility with an excellent fit in a large community sample.[35]

Each of the 60 items in the MPFI is scored on a six-point scale, and averages can be calculated for each facet as well as each global dimension.[35] Higher scores based on summaries of the flexibility and inflexibility items indicate higher PF and PI, respectively. Apart from an excellent model fit, the MPFI has also demonstrated good construct validity.[35] While the MPFI correlates strongly with conceptually related measures, there are consistently low correlations between the MPFI and conceptually differing measures. Looking at reliability, the full 60-item version has demonstrated excellent internal consistency across populations, with Cronbach's Alphas ranging from .96 to.97 for the flexibility dimension, and from .95 to .97 for the inflexibility dimension. The MPFI appears appropriately sensitive to change.[35]

The MPFI was originally translated into Swedish by Tabrizi and collegues.[39] Due to the recent and relatively untested nature of the translation, as well as the complexity of some of the item content, a test panel composed of a mix of four bilingual psychology researchers and three lay people was consulted prior to the current study to review the translation. Based on feedback, some items were modified slightly. This was done by renewed forward and backward translations by two of the researchers, FS and AL. These translations were in turn reviewed by MB, and the new back translations were then compared to the original English versions by LM for fidelity with the original English version. Further revisions were finally discussed by the whole research group and shared with the original translators (see appendix).

The Chronic Pain Acceptance Questionnaire, 8-item version (CPAQ-8). The CPAQ-8 is an eight-item measure of acceptance of pain, a specific from of the acceptance facet of PF. It consists of the two factors, activity engagement and pain willingness.[8,36] Items are rated on a scale from 0 to six. Maximum score for the whole scale is 48 and higher sums reflect higher levels of acceptance. The psychometric properties of the Swedish version, factor loadings are satisfactory for both subscales, although the overall model fit did not reach desired levels on all fit indices.[36] The internal consistency of the subscales has proven to be good and, convergent validity has been demonstrated, and it has been shown to be sensitive to change.[36]

The Committed Action Questionnaire, 8-item version (CAQ-8). The CAQ-8 is a measure of committed action, another facet of PF. It consists of eight items, rated on a scale of 0 to six and with a total possible score of 48. Higher sums indicate higher levels of committed action.[1,31] CFA item loadings are satisfactory in the Swedish translated version, high levels of internal consistency have been demonstrated, and convergent validity is good.[1]

The acting with awareness-subscale (AAS) of the Five Facet Mindfulness Questionnaire (FFMQ). AAS is a subscale of the FFMQ and consists of eight items that reflect acting with awareness.[3,28] It is included here to reflect the contact with the present moment facet of PF. Item ratings are made on a scale from one to five.[28] Minimum score is thus eight, while maximum score is 40. Higher scores reflect higher levels of acting with awareness. The Swedish version of the FFMQ has shown good content validity, and high internal consistency for all subscales, including the AAS.[28]

Pain intensity. Participants rated their pain intensity during the last week, as well as current pain intensity. Both items used a standard numerical rating scale (NRS) ranging from 0 (no pain) to 10 (worst pain possible).

Adjusted version of the Brief Pain Inventory (BPI). The BPI is a widely used and well validated pain measure of pain interference in daily functioning.[5] The scale includes seven domains: general activity, walking, work ability, relationships with other people, enjoyment of life, mood, and sleep. All domains are rated with one item each, on a scale of 0 (no interference) to 10 (completely interferes). All seven BPI pain interference items were adjusted to be framed within the last week. The mean of the seven items was calculated as a measure of average pain interference. The BPI interference scale has demonstrated good internal consistently and validity.[41]

The Work and Social Adjustment Scale (WSAS). The WSAS is a five-item measure that assesses how one's problems affect work, household chores, social and leisure activities, and relationships. Items are rated 0 to eight and the scale has a possible maximum score of 40.[34] Higher scores point to lower work and social adjustment. The WSAS has demonstrated good internal consistency and test-retest reliability, as well as convergent and criterion validity in a Swedish sample with insomnia.[22]

The Patient Health Questionnaire (PHQ-9). The PHQ-9 is a ten-item measure of symptoms of depression during the last two weeks.[25] Items are rated on a 0 to three-scale, thus yielding a maximum score of 27. Higher scores reflect higher levels of depression. The scale also includes an item regarding interference with everyday functioning.[25] The Swedish version has demonstrated high internal consistency and a stable one factor structure.[14]

Statistical Analyses

Three outliers were identified using a cut off score of three SD in regards to questionnaire scores and four outliers using two mean absolute deviations in the time it took to complete the survey. However, no outliers were removed, because effects on the data appeared negligible. Number of participants differ between analyses as there was some missing data in background variables, and attrition varies between the measures.

In order to assess the degree of the role of background variables and generality of the results of the validity and reliability results of the MPFI, the sample was analyzed in respect to the various subgroups that made up the full sample. A series of Pearson and point-biserial correlations were calculated with MPFI scores and continuous and recoded categorical background variables. A one-way analysis of variance was used to see whether there was a difference in global dimension scores of flexibility and inflexibility depending on primary pain condition. The global dimensions were used since no predictions that these scores would differ were made beforeh and, and because we wanted to limit the number of analyses conducted.

For reliability assessment, internal consistency was examined with Cronbach's alpha including MPFI first and second order factors (facets and dimensions), and alpha values between .7 and .95 were deemed desirable.[4] Bivariate correlations between the MPFI facets were also investigated, as was the correlation between the two global dimensions of flexibility and inflexibility. Test-retest reliability was examined by calculating the intraclass correlation coefficient (ICC) between the results from the two time points, two weeks apart using a two-way random-effect model based on absolute agreement and single ratings.[24] The test-retest reliability was interpreted using the ICCs as either poor ($< .5$), moderate ($.5 - .75$) or good ($.75 - .9$).[24]

Factorial validity was examined through structural equation modelling, using confirmatory factor analysis (CFA) to investigate whether the factor structure of the original MPFI holds up in the Swedish version as administered in a chronic pain sample. Due to multivariate non-normality, the CFA was conducted using a maximum likelihood estimation, based on the biased sample covariance matrix, with robust standard errors and Satorra-Bentler scaled test statistic. Item loadings above .32 were considered sufficient.[38] Goodness of fit was examined looking at the Chi-Square ($\chi 2$), and the criteria of $\leq .08$ for the root mean square error of approximation (RMSEA), $> .90$ for the comparative fit index (CFI), $> .90$ for the Tucker-Lewis index (TLI), and $\leq .09$ for the standardized root mean squared residual (SRMR).[29]

Convergent construct validity was investigated by looking at Pearson correlations between the MPFI global dimensions on the one hand, and the CPAQ-8, the CAQ-8, and the FFMQ-AAS on the other hand. Further, correlations were examined between particular MPFI facets and the comparison measures targeting the same facets. Specifically, the MPFI acceptance and experiential avoidance scales were examined looking at correlations to the CPAQ-8, while the MPFI committed action and inaction scales were assessed for correlations to the CAQ-8, and the MPFI present moment awareness and lack of contact with the present were examined in relation to the AAS. Correlation coefficients were deemed as small above .1, medium above .3, and strong above .5.[6]

In order to estimate magnitude of relations with key outcomes, correlations were calculated for scores from the MPFI in relation to average pain intensity, and scores from the BPI, the WSAS and the PHQ-9. The relative strength of relations with outcomes for the MPFI scores was further investigated by conducting hierarchical multiple regression analyses after verifying that the data did in fact fulfill the assumptions needed for regression analysis using guidelines from Hair and colleagues.[13] These analyses allowed us to assess which facets from the MPFI perform best as predictors and whether there is any difference between the global dimensions of the MPFI. Regression analyses were also conducted to assess how scores form the MPFI compare

with established measures of PF/PI (CPAQ-8, CAQ-8, AAS) for understanding variations in pain interference, work and social adjustment, and depression.

The CFA was conducted using the Lavaan package in R version 4.1.2, while the remaining analyses were conducted in IBM SPSS Statistics version 26.

Results

Sample Characteristics and Relations to the MPFI

The final sample included 404 participants with a mean age of 47.75 years (SD = 13.02) and was predominantly women (93.8%). They reported pain conditions included fibromyalgia (28.7%), persistent low-back pain (21.0 %), endometriosis (20.0 %), or other persistent pain conditions (54.2 %), including vulvodynia. A majority had lived with their pain condition for over two years (63.9 %) (see Table 1 for more details).

Firstly, relations between background variables and global flexibility and inflexibility were analyzed. Age had a small positive correlation with global flexibility (r = .12, P= .02), and a small negative correlation with global inflexibility (r = −.22, $P <$ .01), and having good or sufficient financial status was negatively correlated with global inflexibility (r = -.15, P=.02).

A one way analysis of variance showed that there were no significant differences between the different pain conditions, namely fibromyalgia, persistent low-back pain, endometriosis and other persistent pain conditions including vulvodynia, in the global scores of flexibility (F(3, 400) = [.18], P= .91) and inflexibility (F(3, 400) = [.67], Pi = .57). No other background variables were significantly related to the PF or PI scores.

Reliability

Internal consistency reliability for the global dimensions, as well as the individual facets, was excellent with Cronbach's alphas ranging from .81 to .96 (Table 2).

Table 2. Test-Retest Reliability Analysis.

Scale	*Intraclass Correlation [95 % CI]*
1. MPFI global psychological flexibility	.83 [.79, .86]
1a. Acceptance	.67 [.60, .73]
1b. Present moment awareness	.64 [.57, .70]
1c. Self-as-context	.70 [.63, .75]
1d. Defusion	.76 [.70, .80]
1e. Values	.74 [.69, .79]
1f. Committed action	.74 [.68, .78]
2. MPFI global psychological inflexibility	.83 [.79, .86]
2a. Experiential avoidance	.71 [.65, .76]
2b. Lack of contact with present moment	.66 [.59, .72]
2c. Self-as-content	.77 [.72, .82]
2d. Fusion	.77 [.72, .82]
2e. Lack of contact with values	.66 [.56, .73]
2f. Inaction	.72 [.67, .77]

Note. N = 301.

As seen in Table 2, intercorrelations between the global flexibility dimension and its facets were all positive and large, ranging between r = .64 − .84. Similarly, intercorrelations between the global inflexibility dimension and its facets were large and ranged between r = .51 − .84.

The correlations between the flexibility facets and the global inflexibility dimension were all negative and significant ranging from medium to strong (see Table 2). Looking at the relationships between the global flexibility dimension and the inflexibility facets, five out of six correlations were negative and significant ranging from medium to strong. The only facet not showing a significant relationship to global flexibility was experiential avoidance (r = -.06). As seen in Table 2, the same pattern is evident between experiential avoidance and the other flexibility facets, thus distinguishing it from the other inflexibility facets and their correlations to the flexibility facets showing significant negative relationships ranging from small to large (r = -.14 − -.66).

Temporal stability of the MPFI was investigated over a two-week interval. According to guidelines by Koo and Li,[24] the results showed good ICCs for both the global flexibility dimension (ICC = .83), 95 % CI [.79, .86] and the global inflexibility dimension (ICC = .83), 95 % CI [.79, .86]. The ICCs of each of the twelve facets ranged from moderate to good in all cases (see Table 2).

Confirmatory Factor Analysis

To confirm the MPFI's dimensional structure, a second-order CFA was applied to all 60 items with global Psychological Flexibility as a second-order latent variable, and with Acceptance, Present Moment Awareness, Self-as-Context, Defusion, Values, and Committed Action as first-order latent variables. Further, global Psychological Inflexibility was also used as a second-order latent variable with Avoidance, Lack of Contact with the Present, Self-as-Content, Fusion, Lack of Values, and Inaction as first-order latent variables. The second-order CFA yielded a good model fit (χ2 (1,697) = 3289.639, $P <$ .001; RMSEA = .048; CFI = .910; TLI = .906; SRMR = .083). Consistent with results in the original MPFI study, all items generated strong path coefficients to their first-order latent variable. As seen in Table 3, all first-order latent variables but one, Experiential Avoidance, generated moderate to strong path coefficients to their higher-order factor. Further, the higher-order factors, Global Flexibility and Inflexibility, had a standardized correlation coefficient of -.77, implying that the two factors share 59.6 % of the variance. This suggests that Flexibility and Inflexibility are both closely related and also two distinct processes.

Convergent Validity

Correlations with other measures of PF were calculated to determine MPFI's convergent validity. As expected, significant correlations were found between measures of acceptance (CPAQ-8), committed action (CAQ-8), present moment awareness (AAS), and their

Table 3. Second-Order Confirmatory Factor Analysis Results

First and Second order Factors and items	*B*	SE		*B*	SE
Global Flexibility			*Global Inflexibility*		
Acceptance	.552	.078	Experiential Avoidance	.265	.066
I was receptive to observing unpleasant thoughts and feelings without interfering with them	.400	.064	When I had a bad memory, I tried to distract myself to make it go away	.816	.047
I tried to make peace with my negative thoughts and feelings rather than resisting them	.605	.045	I tried to distract myself when I felt unpleasant emotions	.807	.048
I made room to fully experience negative thoughts and emotions, breathing them in rather than pushing them away	.795	.049	When unpleasant memories came to me, I tried to put them out of my mind	.902	.043
When I had an upsetting thought or emotion, I tried to give it space rather than ignoring it	.80	.049	When something upsetting came up, I tried very hard to stop thinking about it	.882	.044
I opened myself to all of my feelings, the good and the bad	.746	.044	If there was something I didn't want to think about, I would try many things to get it out of my mind	.872	.044
Present Moment Awareness	.514	.085	Lack of Contact with Present Moment	.469	.074
I was attentive and aware of my emotions	.763	.044	I did most things on "automatic" with little awareness of what I was doing.	.621	.051
I was in tune with my thoughts and feelings from moment to moment	.670	.051	I did most things mindlessly without paying much attention.	.707	.051
I paid close attention to what I was thinking and feeling	.797	.054	I went through most days on auto-pilot without paying much attention to what I was thinking or feeling	.902	.048
I was in touch with the ebb and flow of my thoughts and feelings	.879	.050	I floated through most days without paying much attention.	.945	.047
I strived to remain mindful and aware of my own thoughts and emotions	.677	.050	Most of the time I was just going through the motions without paying much attention	.944	.046
Self-as-Context	.797	.126	Self-As-Content	.662	.085
Even when I felt hurt or upset, I tried to maintain a broader perspective	.775	.034	I thought some of my emotions were bad or inappropriate and I shouldn't feel them	.772	.043
I carried myself through tough moments by seeing my life from a larger viewpoint	.864	.038	I criticized myself for having irrational or inappropriate emotions	.870	.048
I tried to keep perspective even when life knocked me down	.870	.037	I believed some of my thoughts are abnormal or bad and I shouldn't think that way	.864	.055
When I was scared or afraid, I still tried to see the larger picture	.885	.039	I told myself that I shouldn't be feeling the way I'm feeling	.934	.050
When something painful happened, I tried to take a balanced view of the situation	.852	.037	I told myself I shouldn't be thinking the way I was thinking	.931	.049
Defusion	.767	.100	Fusion	.837	.147
I was able to let negative feelings come and go without getting caught up in them	.868	.033	Negative thoughts and feelings tended to stick with me for a long time.	.876	.046
When I was upset, I was able to let those negative feelings pass through me without clinging to them	.897	.035	Distressing thoughts tended to spin around in my mind like a broken record.	.908	.046
When I was scared or afraid, I was able to gently experience those feelings, allowing them to pass	.874	.035	It was very easy to get trapped into unwanted thoughts and feelings.	.929	.048
I was able to step back and notice negative thoughts and feelings without reacting to them	.859	.036	When I had negative thoughts or feelings it was very hard to see past them.	.898	.046
In tough situations, I was able to notice my thoughts and feelings without getting overwhelmed by them	.822	.037	When something bad happened it was hard for me to stop thinking about it.	.851	.043
Values	.921	.268	Lack of Contact with Values	0.818	0.129
I was very in-touch with what is important to me and my life	.796	.036	My priorities and values often fell by the wayside in my day to day life	.804	.038
I stuck to my deeper priorities in life	.808	.040	When life got hectic, I often lost touch with the things I value	.850	.040
I tried to connect with what is truly important to me on a daily basis	.833	.040	The things that I value the most often fell off my priority list completely	.871	.038
Even when it meant making tough choices, I still tried to prioritize the things that were important to me	.762	.035	I didn't usually have time to focus on the things that are really important to me	.803	.037
My deeper values consistently gave direction to my life	.819	.037	When times got tough, it was easy to forget about what I truly value	.812	.040
Committed Action	.911	.224	Inaction	.897	.202
Even when I stumbled in my efforts, I didn't quit working toward what is important	.806	.034	Negative feelings often trapped me in inaction	.868	.041
Even when times got tough, I was still able to take steps toward what I value in life	.866	.037	Negative feelings easily stalled out my plans	.907	.040
Even when life got stressful and hectic, I still worked toward things that were important to me	.863	.038	Getting upset left me stuck and inactive	.843	.040
I didn't let set-backs slow me down in taking action toward what I really want in life	.866	.039	Negative experiences derailed me from what's really important	.879	.039
I didn't let my own fears and doubts get in the way of taking action toward my goals	.804	.038	Unpleasant thoughts and feelings easily overwhelmed my efforts to deepen my life	.796	.039

Note. Table shows standardized path coefficients. All path coefficients were significant at $P < .001$.

Table 4. Descriptives and Correlation Analyses.

Scale	N of items	M (SD)	α	1	1A	1B	1C	1D	1E	1F	2	2A	2B	2C	2D	2E	2F
3. MPFI Global Psychological Flexibility	30	3.64 (.77)	.96	–													
1a. Acceptance	5	3.24 (.91)	.81	.69**	–												
1b. Present moment awareness	5	3.58 (.91)	.87	.67**	.52**	–											
1c. Self-as-context	5	3.86 (1.02)	.93	.84**	.48**	.46**	–										
1d. Defusion	5	3.19 (1.02)	.94	.81**	.49**	.36**	.71**	–									
1e. Values	5	4.10 (1.00)	.90	.84**	.43**	.46**	.63**	.61**	–								
1f. Committed action	5	3.87 (1.03)	.92	.83**	.37**	.41**	.66**	.61**	.81**	–							
4. MPFI Global Psychological Inflexibility	30	3.02 (.80)	.95	−.58**	−.31**	−.27**	−.44**	−.52**	−.57**	−.58**	–						
2a. Experiential avoidance	5	3.59 (1.07)	.93	−.06	−.19**	−.04	.02	−.03	−.02	−.03	.51**	–					
2b. Lack of contact with present moment	5	3.02 (1.02)	.92	−.28**	−.14**	−.22**	−.23**	−.17**	−.27**	−.27**	.62**	.32**	–				
2c. Self-as-content	5	2.58 (1.18)	.94	−.42**	−.22**	−.24**	−.27**	−.42**	−.42**	−.39**	.77**	.28**	.34**	–			
2d. Fusion	5	3.25 (1.18)	.95	−.62**	−.29**	−.22**	−.54**	−.66**	−.56**	−.59**	.81**	.21**	.29**	.61**	–		
2e. Lack of contact with values	5	3.00 (1.01)	.92	−.55**	−.23**	−.23**	−.43**	−.42**	−.62**	−.63**	.77**	.19**	.39**	.48**	.61**	–	
2f. Inaction	5	2.69 (1.14)	.93	−.56**	−.25**	−.19**	−.45**	−.51**	−.58**	−.61**	.84**	.23**	.39**	.58**	.72**	.70**	–
5. Acceptance - CPAQ-8	8	22.27 (8.59)	.77	.31**	.19**	−.01	.27**	.32**	.34**	.39**	−.39**	−.15**	−.16**	−.23**	−.35**	−.42**	−.39**
6. Committed action - CAQ-8	8	28.33 (8.59)	.84	.61**	.34**	.21**	.51**	.51**	.60**	.64**	−.65**	−.14**	−.32**	−.44**	−.63**	−.59**	−.69**
7. Acting with awareness - AAS	8	25.70 (8.07)	.94	.42**	.19**	.24**	.31**	.37**	.40**	.45**	−.56**	−.14**	−.51**	−.36**	−.50**	−.43**	−.51**
8. Pain intensity	1	6.21 (1.49)	–	−.056	.011	.039	−.094	−.052	−.064	−.086	.197**	.089	.128**	.135**	.154**	.165**	.181**
9. BPI – pain interference	7	6.05 (2.10)	.84	−.22**	−.10*	−.04	−.17**	−.21**	−.24**	−.25**	.40**	.21**	.21**	.28**	.32**	.36**	.34**
10. WSAS	5	21.28 (9.52)	.87	−.16**	−.09	.01	−.12*	−.15**	−.17**	−.22**	.31**	.17**	.22**	.18**	.17**	.31**	.30**
11. PHQ-9	9	13.19 (5.84)	.83	−.41**	−.20**	−.19**	−.31**	−.38**	−.43**	−.42**	.64**	.19**	.35**	.53**	.58**	.54**	.57**

Abbreviations:. N , 396-404; α , Cronbach's Alpha; CPAQ-8 , chronic pain acceptance questionnaire – 8; CAQ-8 ,committed action questionnaire – 8; AAS , five facet mindfulness scale –acting with awareness subscale; BPI , brief pain inventory – pain interference; PHQ-9 ,patient health questionnaire – 9; WSAS , work and social adjustment scale; Pain intensity , average pain intensity during last week assessed with a 0-10 numerical scale.
*$P < .05$.
**$P < .01$.

related MPFI global and individual facet scores (see Table 4).

Acceptance measured with CPAQ-8 showed significant, medium sized, correlations with global flexibility (r = .31, P< .01) and global inflexibility (r = -.39, P < .01). Surprisingly, the correlations between CPAQ-8 and the corresponding MPFI facets of acceptance (r = .19) and experiential avoidance (r = -.15) were small, although significant (P < .01).

The relationships between CAQ-8 and global flexibility (r = .61) and inflexibility (r = -.65) were also significant (P < .01). A similar pattern was found between CAQ-8 and its related MPFI facets showing strong correlations; committed action (r = .64) and inaction (r = -.69).

Further, AAS showed a significant (P < .01) positive correlation to global flexibility (r = .42) and negative correlation to global inflexibility (r = -.56). The corresponding facets of present moment awareness and lack of present moment awareness showed a significant small-sized positive correlation (r = .24) and a strong negative correlation (r = -.51) respectively.

Taken together, these results provide support for the convergent validity of MPFI's global flexibility and inflexibility dimensions, as well as its facets. However, with the exception of experiential avoidance, the inflexibility facets of MPFI showed stronger correlations to CPAQ-8, CAQ-8, and AAS, as compared to the MPFI flexibility facets, unlike results in the original study (Table 4).[35]

Prediction of Outcomes

Small correlations with pain intensity (NRS – average for last week) were found, but only for global inflexibility and five out of six inflexibility facets (see Table 4). Further, significant small to large correlations to measures of daily functioning (BPI, WSAS) and depression (PHQ-9) were found. Once again, the global inflexibility dimension showed stronger correlations (r = .31 to .64) as compared with the global flexibility dimension (r = -.16 to-.22).

Relative Prediction in Multivariate Analyses

Hierarchical multiple regression was used to evaluate the unique relative strength of relations with outcomes for the MPFI scores. Background variables were only included if they had previously shown a significant relationship (r = .20, P < .05) with the dependent variable in the model. Background variables (model 1) were entered first followed by average pain intensity during previous week (model 2) and generalized pain (model 3) in all models.

MPFI: global flexibility and inflexibility. Firstly, with pain interference as a dependent variable the inclusion of financial situation as a background variable explained 3.9 % (P < .001) of the total variance. Pain intensity explained a further 29.4 % (P< .001) of the variance in pain interference and was the strongest predictor. Adding global flexibility and inflexibility led to a significant increase in the explained variance (ΔR^2 = .079, P > .05). But when comparing the beta coefficients of the two global dimensions, the flexibility coefficient (β = -.045, P > .05) appeared significantly smaller than the inflexibility coefficient (β = .26, P < .001).

With the WSAS score as the dependent variable once again financial situation was included in the analyses. The results of the regression analyses show that the background variables explained 6.1 % (P< .001), pain intensity explained 16.0 % (P < .001), and generalized pain explained 1.2 % (P < .05) of the variance. Further, the MPFI global dimensions added significantly to the explained variance, 4.6% (P < .001), and the inflexibility dimension (β = .20, P < .001) contributed the most, as compared with the flexibility dimension (β = -.029, P > .05).

In the equation for depression, the results of the regression analysis showed that background variables (financial situation, age) contributed 13.0 % (P < .001) while pain intensity and generalized pain contributed 8.3 % (P < .001) and 1.7 % (P < .01) respectively. Entering global flexibility and inflexibility increased the explained variance by 26.0 % (P < .001). Here flexibility had a significant beta coefficient (β = -.11, P < .05), as did inflexibility (β = .47, P < .001), which was once again the larger of the two.

MPFI: facets. To test which facets belonging to PF and PI of the MPFI contributed the most, new hierarchical multiple regressions were carried out (see Table 5). Firstly, the PF facets were tested, all entered simultaneously (model 4). No significant beta-values were found when pain interference was the dependent variable. Further, when the WSAS score was the dependent variable, acceptance, present moment awareness and committed action had significant beta values (P < .05), however, the beta-coefficient in present moment awareness was in a theoretically unexpected direction (see Table 5). Lastly, when depression was the dependent variable, this led to three facets having significant beta-coefficients; defusion (β = -.14, P < .05), values (β = -.20, P < .01), and committed action (β = -.16, P < .05).

When testing the PI facets, there was an overall increase in the number of significant beta-coefficients, and in the strength of some coefficients. When pain interference was the dependent variable, experiential avoidance had a small but significant correlation (β = .087, P < .05) as did lack of values (β = .18, P < .01). Further, in the equation for the WSAS score, three facets had significant betas, fusion (β = -.18, P < .01), lack of values (β = .19, P < .01), and inaction (β = .18, P < .01). However, fusion was not in the expected direction, meaning higher scores on the facet fusion were associated with lower WSAS scores. Lastly, three facets demonstrated significant beta coefficients when depression was the dependent variable, self as content (β = .16, p < .01), fusion (β = .21, P < .001), and lack of values (β = .16, P < .01).

Generally, the change in explained variance was about the same in the analyses of the PF facets as it had been in the previous analyses using the global dimensions: pain interference, 3.91%, WSAS, 4.9 %, depression, 16.0 %. However, including the PI facets led to a

slight increase in explained variance: pain interference, 8.7 %, WSAS, 8.4 %, depression, 27.3 %.

MPFI and comparison measures. To test whether the performance of the MPFI scores in prediction models is comparable with established, validated, single facet measures of psychological flexibility separate analyses with CPAQ-8, CAQ-8, and AAS were carried out with BPI, WSAS, and PHQ-9 as dependent variables (see Table 5).

The comparison measures had an overall higher total explained variance on all the dependent variables when comparing them with the global MPFI dimensions of flexibility and inflexibility. Due to the higher explained variance of the MPFI inflexibility facets, the numbers are more comparable with the comparison measures here, but the established measures still explain more variance for the BPI, 17.0% ($P < .001$), and the WSAS, 20.0% ($P < .001$), However, when comparing them with the PI facets in predicting depression, the total explained variance is nearly identical, PI facets, 50.3 %, comparison measures, 50.8 % (see Table 5).

In addition, to explore the limits of unique contribution of the global MPFI dimensions of flexibility and inflexibility we tested the established measures and the global MPFI dimensions within the same analyses using BPI, WSAS, and PHQ-9 as dependent variables. The global PF and PI dimensions did not lead to any additional explained variance in most of the analyses with the exception of the PI dimension when BPI ($\Delta R^2 = .01$, $P < .01$) and PHQ-9 ($\Delta R^2 = .04$, $P < .001$) were used as dependent variables.

Discussion

The current study fully examined PF and PI in chronic pain by employing the MPFI, a comprehensive measure of all facets associated with these dimensions. Since there are, to the authors knowledge, no data published using the MPFI in people with chronic pain we first looked at the psychometric properties of the instrument, then examined the relative performance in prediction of outcomes, and finally compared this with established measures of PF.

We found good evidence for the reliability and structure of the MPFI. Internal consistency was excellent and the individual facets in general correlated strongly with their main global dimensions. Temporal stability was generally satisfactory. CFA results demonstrated a good model fit when testing the second order model with Inflexibility and Flexibility as second order factors and the specific sub processes as first order factors. Path coefficients between first order factors and their second order factors were medium to strong in most cases. Further, correlations between the global factors of the MPFI and theoretically similar measures were medium to strong, supporting construct validity.

The overall dimension scores from the MPFI achieve significant correlations with important pain outcomes. The global flexibility and inflexibility scores showed significant small to large correlations with pain interference, work and social adjustment, and depression. Also, hierarchical multiple regression analyses showed that inflexibility added to the explained variance in pain interference, work and social adjustment, and depression, while global flexibility performed less well in this regard. When looking at the facets of the MPFI in separate analyses, entering both PF and PI facets significantly increased explained variance, however, once again the PI facets performed better across all dependent variables. The stronger performance in prediction by the PI scores is a new insight made available in the way the MPFI measures equally 12 facets and two overall dimensions of PF and PI.

When comparing the performance of the MPFI with established measures of acceptance, committed action, and present moment awareness, the established measures performed better across most dependent variables. An exception was the comparison including the PI facets in predicting depression, where the MPFI had a similar performance with the established measures. When the PF and PI scales were added in the last step of HMR analyses that also included the established measures of PF, the addition of the PI scale in two of the analyses led to a small significant increase in explained variance while the addition of the PF scales did not add to the explained variance. These results suggest that using the established measures may be adequate some of the time, especially since the established measures include fewer items and are thus less burdensome. A disadvantage in doing this is that the established measures do not include all facets of PF and PI, and cannot address questions about facets that are excluded. Thus, it is important to further investigate the potential benefits of the MPFI, and instruments like it, using a wider selection of outcome variables, as well as using the measure in a broader range of study designs such as interventional studies.

Some aspects of the Swedish version of the MPFI deserve further consideration. The temporal stability of the facets may at a first glance seem unsatisfactory, however, considering that PF and PI are thought to be changeable and contextually sensitive psychological processes, some fluctuations over time may be expected. An additional issue is that the MPFI first order factor Experiential Avoidance did not show a strong path coefficient to its higher order factor of PI. While this differs from the validation of the original MPFI, it is consistent with the work from Tabrizi and collegues in validating the MPFI in a general, non-pain, population.[39] Further, experiential avoidance was the only facet that failed to correlate significantly with global flexibility or with the flexibility sub processes. Again, while this is inconsistent with the original MPFI, it is in line with results from the Italian validation of the MPFI.[26,35] It might be worth considering whether the similar results relate to a general translation problem that may need to be addressed in some way. We note that some of the specific language in measures of PF such as the MPFI is frequently metaphorical in quality and perhaps this creates problems in translation.

Table 5. Hierarchical Regression Analyses.

Step	Predictor variables	Work and social adjustment				Pain interference				Depression		
		R^2	ΔR^2	β		R^2	ΔR^2	β		R^2	ΔR^2	β
MPFI												
Flexibility- and Inflexibility												
1	Financial situation	.061	.061‡	−.18‡	1	Financial situation	.039	.039‡	−.10*	1	Age	.13	.13‡	−.17‡
2	Pain intensity	.22	.16‡	.35‡	2	Pain intensity	.33	.29‡	.49‡		Financial situation			−.12†
3	Generalized pain	.23	.012*	−.10*	3	Generalized pain	.34	.006	−.070	2	Pain intensity	.21	.083‡	.19‡
4	Global flexibility	.28	.046‡	−.029	4	Global flexibility	.42	.079‡	−.045	3	Generalized pain	.23	.017†	−.10†
	Global inflexibility			.20‡		Global inflexibility			.26‡	4	Global flexibility	.49	.26‡	−.11*
											Global inflexibility			.47‡
PF facets												
4	Acceptance	.28	.049‡	−.14*	4	Acceptance	.39	.052‡	−.058	4	Acceptance	.39	.16‡	−.023
	PMA			.12*		PMA			.043		PMA			−.044
	Self as context			.083		Self as context			.089		Self as context			.11
	Defusion			−.011		Defusion			−.11		Defusion			−.15*
	Values			−.038		Values			−.11		Values			−.20†
	Committed action			−.192*		Committed action			−.086		Committed action			−.16*
PI facets												
4	Experiential avoidance	.32	.084‡	.071	4	Experiential avoidance	.43	.087‡	.087*	4	Experiential avoidance	.50	.27‡	.002
	Lack of PMA			.048		Lack of PMA			.001		Lack of PMA			.078
	Self as content			.003		Self as content			.046		Self as content			.16†
	Fusion			−.18†		Fusion			.075		Fusion			.21‡
	Lack of values			.19†		Lack of values			.18†		Lack of values			.16†
	Inaction			.18*		Inaction			.009		Inaction			.10
CPAQ-8, CAQ-8, FFMQ-AAS												
1	Financial situation	.056	.056‡	−.092*	1	Financial situation	.036	.036‡	−.035	1	Age	.14	.14‡	−.18‡
2	Pain intensity	.22	.16‡	.29‡	2	Pain intensity	.33	.29‡	.45‡		Financial situation			−.070
3	Generalized pain	.23	.012*	−.13†	3	Generalized pain	.34	.006	−.091*	2	Pain intensity	.22	.081‡	.18‡
4	CPAQ-8	.43	.20‡	−.43‡	4	CPAQ-8	.51	.17‡	−.36‡	3	Generalized pain	.23	.016†	−.11†
	CAQ-8			−.085		CAQ-8			−.094*	4	CPAQ-8	.51	.28‡	−.22‡
	FFMQ-AAS			.020		FFMQ-AAS			−.047		CAQ-8			−.29‡
											FFMQ-AAS			−.19‡

Abbreviations: R^2 , R square; ΔR^2 , R square change; β , standardized regression coefficient in last step. Background variables were included based upon if a significant relationship to the dependent variable existed ($r = .20$, $P < .05$). Beta coefficients for background variables are generally representative across analyses.
*$P < .05$.
†$P < .01$.
‡$P < .001$.

Unexpectedly, both experiential avoidance and acceptance, showed only small correlations with the CPAQ-8 that targets the same processes. In addition, the MPFI acceptance and experiential avoidance showed only small correlations to pain interference, depression, work and social adjustment, and pain intensity. This is somewhat surprising, as these processes typically correlate substantially with outcomes in chronic pain populations. In comparison, the CPAQ-8 consistently shows medium to strong correlations with measures of daily functioning, depression, and anxiety.[36] In the current study, the regression analyses further showed a relatively good performance in predicting outcomes from the CPAQ-8, CAQ-8 and AAS. As the CPAQ-8 is a measure developed specifically for people with chronic pain, and is specifically focused on pain-related acceptance, this might be a reason for it generally demonstrating higher correlations to relevant outcomes as compared to the MPFI counterpart facets. There was also an unexpected result when examining the facet fusion in predicting WSAS. This could potentially be explained by the strong naturally occurring correlations of the individual facets and could be considered a statistical anomaly. We note that fusion demonstrated a significant correlation with WSAS in the expected direction in the Pearson correlation analyses.

It is worth considering what it means that the inflexibility dimension seems to perform better than the flexibility dimension. Specifically, compared to flexibility, there were higher correlations between inflexibility and the measures used to assess convergent and criterion validity. In terms of explained variance in pain interference, work and social adjustment, and depression outcomes, adding flexibility as a predictor after inflexibility in the regression analyses generally did not increase prediction. There may be several reasons for this. First, all outcome measure used in the present study aims to measure negative constructs which likely affects the correlation to positively framed constructs such as PF. Second, the MPFI, as compared to for example the CPAQ-8, lacks the specific pain context and this may make a difference. Finally, to accurately remember and respond, general and positively framed item content might be more difficult for the respondents as compared to the negatively framed items.

While flexibility and inflexibility seem to be related and distinct processes, these results might suggest it is important to measure both PF and PI, and consider the choice to focus on one or the other, or on particular facets, depending on purpose or outcomes being investigated.

The results from this study include limitations. First, the background variable pain duration could not be measured in a satisfactory way because of a failure of the text field for this item. As such, this variable was coded using discrete categories instead. Second, the sample consisted mostly of women. Of course, some of the conditions included primarily affect women, so some of this discrepancy is expected. Further, vulvodynia was meant to be particularly targeted in order to include pain conditions often not included in chronic pain research, but in the end, there were only a small number of participants with vulvodynia included. While the lack of men as well as lack of vulvodynia participants mean the applicability to these populations may be reduced, there was a good range of pain conditions in the sample, and comparison of the conditions showed no differences on MPFI scores. The fact that pain diagnoses were most often reported as confirmed by a medical doctor, may mean the sample represents a clinically relevant chronic pain population.

The availability of a measure targeting all facets of PF is important for future chronic pain research, both theoretically and practically. In the past, it was difficult to measure all facets of PF as the existing measures typically targeted only one facet. Being able to use one single instrument for all facets provides uniformity and efficiency. This improves our ability to further study PF and PI and all related facets as potential mechanisms of pain impact and of psychological treatments for chronic pain.

To conclude, we find the MPFI to be generally valid and reliable in a chronic pain population. The wider model of PF and PI appears useful for understanding variability in pain interference, work and social adjustment, and depression. Also, the assessment of inflexibility appears somewhat more promising than flexibility for understanding pain outcomes and may have advantages in practice. Due to the length of the MPFI, further research might seek to produce a shorter version in this population. Shorter versions, have been successfully created in the English and French version of the questionnaire.[12] And, because the future of treatment development may include a greater focus on individualized processes of change and individualized approaches to treatment delivery, it is advisable that researchers consider ways to translate the breadth of content of the MPFI into an instrument or instruments more suitable for frequent assessment, such as weekly or daily.[17,30]

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Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jpain.2022.11.010.

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