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Latent Class Analysis of the Short and Long Forms of the Chronic Pain Acceptance Questionnaire: Further Examination of Patient Subgroups

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Abstract: A substantial literature indicates that pain acceptance is a useful behavioral process in chronic pain rehabilitation. Pain acceptance consists of willingness to experience pain and to engage in important activities even in the presence of pain and is often measured using the Chronic Pain Acceptance Questionnaire (CPAQ). Previous traditional cluster analyses of the 20-item CPAQ identified 3 patient clusters that differed across measures of patient functioning in meaningful ways. The aims of this study were to replicate the previous study in a new sample, using the more robust method of latent class analysis (LCA), and to compare the cluster structure of the CPAQ and the shorter CPAQ-8. In total, 914 patients with chronic pain completed the CPAQ and a range of measures of psychological and physical function. Patient clusters identified via LCA were then used to compare patients across functional measures. Contrary to previous research, LCA demonstrated that a 4-cluster structure was superior to a 3-cluster structure. Consistent with previous research, cluster membership based on patterns of pain willingness and activity engagement was significantly associated with specific patterns of psychological and physical function, in line with theoretical predictions. These cluster structures were similar for both CPAQ-20 and CPAQ-8 items. These results provide further evidence of the relevance of chronic pain acceptance, and a more nuanced understanding of how the components of acceptance are related to function.

Perspective: Pain acceptance is important in chronic pain. The findings of the present study, which included 914 individuals with chronic pain, provide support for 4 discrete groups of patients based on levels of acceptance (low, medium, and high), as well as a group with a high level of activity engagement and low willingness to have pain. These groups appear statistically robust and differed in predictable ways across measures of functioning.

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Key words: Chronic Pain Acceptance Questionnaire, acceptance and commitment therapy, pain rehabilitation, latent class analysis, cluster membership, assessment.
commitment therapy (ACT),19,35 are effective in lowering psychological and physical disability and improving health, functioning, and quality of life.5,8,30,31,62

Chronic pain acceptance is typically measured via the Chronic Pain Acceptance Questionnaire (CPAQ).12,36 The CPAQ is sensitive to treatment, is psychometrically robust,45 and was developed in line with a “functional contextual” framework to reflect the particular emphasis of ACT on function and consequences of behavior. In addition to strong correlations with a number of key measures of patient functioning, the CPAQ offers an advantage of evaluating adaptive functioning, as opposed to a focus strictly on measuring maladaptive functioning (eg, pain-related distress, anxiety, catastrophizing).29,37

The CPAQ consists of 2 subscales, each assessing a different aspect of pain acceptance. The first of these, activity engagement (AE), assesses the degree to which respondents report being active with the continuing experience of pain. The second, pain willingness (PW), assesses the degree to which respondents report being open to the experience of pain without the need to engage in unsuccessful pain control efforts.

Using these 2 subscales, Vowles et al59 performed hierarchical and k-means cluster analyses to investigate whether patient subgroups could be identified. These analyses indicated the presence of 3 discrete clusters of patients: high AE and PW (high acceptance), low AE and PW (low acceptance), and a mixed cluster, high in AE and low in PW. The cluster analysis performed by Vowles et al59 has not been replicated, nor has a cluster analysis been performed using the short form of the CPAQ, the CPAQ-8.11

The objectives of the present analyses were to provide an updated analysis of the cluster structure of the CPAQ-20 in a new sample of patients using a more advanced and empirically sound cluster analytic approach (latent class analysis [LCA]) and to evaluate the cluster structure of the CPAQ-8 in comparison with the CPAQ-20. In addition, differences in self-reported measures of physical and emotional functioning based on cluster membership were evaluated to assess the usefulness of cluster membership.

**Methods**

**Participants**

Over a 25-month period, 1,391 patients were referred to the Pain and Rehabilitation Center at the University Hospital, Linköping, Sweden, and 914 (66%) patients had complete CPAQ data. The CPAQ was not a compulsory part of the assessment questionnaire battery at that time, which explains the discrepancy between total referrals and the current sample. Sociodemographic information and pain characteristics of the patients are summarized in Table 1.

These patients, compared with all the patients with chronic pain registered at the Swedish Registry of Pain Rehabilitation,53 were 6 years younger and less educated (18.0% had a university education vs 25.0% reported by the Swedish Quality Registry for Pain Rehabilitation (SQRP), and 26.4% had only elementary education vs 11.0% in the SQRP). This population was otherwise similar in educational profile to populations described in epidemiological studies and national reports.4,14,42

**Variable (No. of Completers)** | **Mean (SD) or %**
---|---
Age, y (907) | 47.5 (14.7)
Women (907) | 65.9%
Born in Sweden (907) | 82.5%
Education (877) |
Elementary school | 26.4%
High school education | 46.6%
University education | 18.0%
Other education | 5.7%
Unknown | 3.3%
Sickness benefit 100% | 13.1%
Working/studying 100% (842) | 26.9%
More than 4 medical visits in past year | 60.7%
Pain severity (min 0, max 6) (829) | 4.2 (1.1)
Pain duration, days (796) | 3,034 (3,442)
Persistent pain duration, days (652) | 2,499 (3,188)
Days since occupationally active (403) | 27,407 (3,276)
Number of pain locations (0–36) (907) | 12.5 (8.2)
Pain localizations (882) |
Head and face (52) | 5.7%
Neck (125) | 14.9%
Shoulders and upper limbs (116) | 12.8%
Chest (13) | 1.4%
Upper back (23) | 2.5%
Lower back (140) | 15.4%
Hips and lower limbs (123) | 13.5%
Abdomen and sexual organs (37) | 4.1%
Widespread pain (243)* | 26.8%

*The pain is not localized in one area; it varies around several body regions.

**Procedure**

**Data Collection**

Along with most of pain rehabilitation clinics, the Pain and Rehabilitation Center gathers data for the SQRP,53 which monitors the assessment and outcome of pain rehabilitation clinics in Sweden. The SQRP includes diagnoses as well as descriptive self-report variables of the patient’s background, pain characteristics, and other self-report measures of domains such as depression and anxiety, quality of life, and attitudes toward pain.

Before the first assessment, all patients gave their written informed consent to be registered at the SQRP in accordance with the Declaration of Helsinki. This consent includes consenting for their data to be used in research studies such as the present one. The study was granted ethical clearance by the Regional Ethics Board in Gothenburg (approval number 815-12).

**SQRP Data Used in the Present Study**

Demographic data included sex, years of education, work status, and sick leave or insurance/work situation. Pain variables included current pain severity, duration,
and frequency, as well as anatomical regions with worst pain (see Table 1).

**Measures**

The CPAQ is a 20-item questionnaire with a Likert scale (0–6), validated in Swedish. The short version with 8 items has been validated in English and in Swedish. In this article, the 8 items for CPAQ-8 were extracted from the long version (ie, items 1, 6, 9, 13, 14, 15, 17, and 18). Both versions of CPAQ are composed of 2 factors: AE (score range = 0–66 in CPAQ-20 and 0–24 in CPAQ-8) and PW (score range = 0–54 and 0–24, respectively). All items are rated on a scale from 0 (never true) to 6 (always true), with lower scores indicating lower levels of AE and/or PW. There are no existing cutoffs for the CPAQ.

The Tampa Scale for Kinesiophobia (TSK) measures fear of movement and reinjury. The 17 items are rated on a scale from 0 (strongly disagree) to 4 (strongly agree). The total score ranges from 17 to 68, and higher scores indicate more fear. The TSK appears to be a reliable and valid instrument for chronic pain assessment tool for chronic pain across different samples. It has a stable factor structure across pain diagnoses and nationalities.

Hospital Anxiety and Depression Scale (HADS) yields 2 subscales of depression and anxiety symptoms with 7 items each. Each item has 4 response categories from 0 (no problem) to 3 (severe problem). The scale covers a period of the past week. The 2 subscale scores are summed, with a score of <7 being interpreted as asymptomatic, a score of 8 to 10 indicating mild/moderate symptoms, and a score of 10 or more suggesting clinically significant symptoms. The Swedish translation has shown acceptable psychometric properties.

The Multidimensional Pain Inventory (MPI) measures pain and its impact, as well as coping. It has 61 items, with a score range of 0 to 6 (6 indicates the maximum value in each scale) and is divided into 3 sections: 1) pain impact (pain severity and interference, life control, affective distress, and support); 2) responses by significant others (negative/ignoring, solicitous, and distracting); and 3) common activities (household, outdoors, away from home, and social activities), summarized in a general activity scale. The subscales also range from 0 to 6 and a change of .6 is considered to be a clinically significant change.

**Statistical Analyses**

**Data Screening**

As the initial data analytic step, all dependent variables were evaluated for skewness and kurtosis. In addition, individual participant CPAQ subscale scores were inspected to identify statistical outliers, because outliers can substantially skew the results of the clustering approach that we used. Correlation between the various measures was performed using the Pearson correlation coefficient between all the scales.

**Cluster Analysis**

Next, LCA was used to investigate the cluster structure for both the 20-item and 8-item CPAQ using Mplus Version 7.2. LCA is a technique that assesses patterns of responses in a dataset. It determines if individuals can be grouped into categorical class membership, based on their responses to 2 or more measured variables. It begins with the assumption that only one underlying latent class exists in the dataset, and then generates a second, a third, a fourth, and so on. At each step, the probability of class membership is determined mathematically using maximum likelihood estimates. This process continues until the addition of another latent class results in a worse model fit than the previous step.

LCA is a more robust approach to cluster analysis than other methods such as hierarchical or k-means clustering. LCA determines the number of clusters and cluster membership based on probability and statistical estimates of model fit, whereas other methods of clustering rely to a large extent on researcher judgment (eg, inspection of a dendogram or agglomeration figures) and post hoc analyses to determine the appropriate number of clusters.

First, LCA allows various cluster structures to be compared with one another to aid in the determination of cluster structure. Specifically, the Vuong–Lo–Mendell–Rubin (VLMR) test and the bootstrapped likelihood ratio (BLR) test can be used to compare the differences in model fit between the hypothesized number of clusters, , and a model testing . Therefore, the hypothesized number of clusters can be tested and compared successively with alternative possible cluster structures in order to identify the structure that provides the best fit with the available data. In the Mplus statistical package, these 2 tests are the TECH11 and TECH14 options, respectively.

Second, LCA uses maximum likelihood (ML) estimates, which makes it better able to accommodate cases that have missing data, as ML estimates make use of all available data to allocate cases into different clusters. In comparison, traditional cluster analytic techniques generally require complete data or some type of replacement (eg, sample mean substitution) for missing data.

Third, LCA allows the calculation of conditional probabilities of cluster membership for all cases in the dataset. These probabilities can then be inspected to determine which individuals have strong conditional probabilities for one group only and are thus more confidently assigned to one cluster (eg, >75% probability of membership in one cluster only) in relation to individuals whose cluster membership is less clear (eg, >40% probability of membership in 2 clusters). Thus, LCA offers an advantage over the previous study examining the cluster structure of the 20-item CPAQ, which used a traditional cluster analytic approach.

**Between-Cluster Comparisons**

Between-cluster differences across measures of functioning were evaluated to examine the utility of cluster
Latent Class Analysis of the CPAQ

Concordance in Cluster Assignment for the CPAQ-20 and CPAQ-8
As the final analytic step, agreement in cluster membership was evaluated. For these analyses, percent agreement in cluster assignment when using the short and long form of the CPAQ was evaluated using an unrestricted conditional probability, as well as >25%, >50%, and >75% conditional probability.

Results
Data Screening
All dependent variables appeared normally distributed and nonkurtotic with no value in excess of 1.1. Inspection of boxplot distributions for the CPAQ total and subscale scores identified a total of 7 individuals as statistical outliers. Descriptively, these individuals had maximal scores on either subscale of the CPAQ or on its total score. The data for these individuals were excluded from further analyses, leaving a total of 907 participants.

The correlation between scales (Table 2) showed coherent relationships across included measures. The 4 activity scales of the MPI were highly correlated with the MPI general activity scale (r > .64, P < .01); HADS subscales were highly correlated with the MPI scale of affective distress and life control (r > .53, P < .01); and CPAQ AE was highly correlated with the pain interference scale of MPI (r > .64, P < .01).

CPAQ-20
LCA Analysis
For the analyses evaluating the 3-cluster structure, the best log-likelihood value was replicated across analyses with both 20 and 100 random starts (values obtained, −6,798 to −6,800). When the cluster structures were compared, both the VLMR and BLR tests were statistically significant (P < .05 and P < .001, respectively), suggesting that the 4-cluster structure was superior to the 3-cluster structure.

Finally, a 5-cluster structure was investigated. For these analyses, the best log-likelihood value was not replicated. The VLMR test was not statistically significant (P = .17), and the BLR test was therefore not performed. Given these results, the 5-cluster structure was rejected and the 4-cluster structure was retained.

As noted, individual patients were classified based on the highest conditional probability with regard to cluster membership. All 3 cluster groups indicated by Vowles et al13 were apparent in the present dataset, including a group with high scores on both the AE and PW subscales, a group with low scores on both subscales, and a mixed group with high AE and low PW scores. In contrast to previous analyses, another cluster group emerged that had scores on both subscales in a middle range. This was cluster was labeled medium.

CPAQ-20 scores were compared across the 4 groups via MANOVA, yielding a significant omnibus effect (Wilks’ Λ = .13, F_{6, 1,804} = 540.4, P < .001). Follow-up 1-way comparisons indicated significant differences across the groups for both CPAQ-20 subscales, as well as for the total score (all F > 394.2, all P < .001). Descriptive information for the clusters is given in Table 3. Pairwise comparisons indicated significant between-group differences across all analyses, with the sole exception of AE scores for the high-scoring and mixed groups. For all other comparisons, the low-scoring group had the lowest CPAQ-20 scores, followed sequentially by the medium-, mixed-, and high-scoring groups.

Cluster Comparisons on Measures of Functioning
The measures of patient functioning included self-reported levels of depression and anxiety (via the HADS), pain-related fear (via the TSK), as well as impact and responses to pain, activity, and social support, and participation level (via the MPI). A significant effect of group membership was indicated for the overall omnibus test (Wilks’ Λ = .56, F_{48, 1,841} = 8.37, P < .001) and was followed by significant results for all follow-up 1-way ANOVAs (all F > 4.01, all P < .008). The results of the pairwise comparisons were comparable with those obtained for the CPAQ-20 for the low-, medium-, and high-scoring groups, which differed significantly from one another; the low-scoring group reported the highest levels of distress and disrupted functioning, and the high-scoring group reported the lowest. The pattern of findings for the mixed group was more complicated, with a lack of significant differences indicated in comparison with the medium-scoring group on measures of anxiety, pain-related fear, pain severity, and social support or responses, as well as in comparison with the high-scoring group on measures of depression and general activity. These findings suggest that the mixed group reported better functioning than the low- and medium-scoring...
Table 2. Correlation Matrix Between Scales (HADS, TSK, MPI, and CPAQ)

|        | N  | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12  | 13  | 14  | 15  | 16  | 17  | 18  | 19  | 20  |
|--------|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1. MPI: Pain severity | 829 | 1   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 2. MPI: Pain interference | 826 | .550** | 1   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 3. MPI: Life control | 828 | .442** | -.502** | 1   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 4. MPI: Affective distress | 829 | .434** | .532** | -.622** | 1   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 5. MPI: Social support | 828 | .172** | .222** | -.027 | .093** | 1   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 6. MPI: Negative responses | 736 | .132** | .182** | -.181** | .267** | -.134** | 1   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 7. MPI: Solicitous responses | 731 | .245** | .247** | -.151** | .162** | .543** | -.105** | 1   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 8. MPI: Distracting responses | 733 | .170** | .179** | -.082* | .178** | .416** | -.067 | .620** | 1   |     |     |     |     |     |     |     |     |     |     |     |     |     |
| 9. MPI: Household chores | 833 | -.142** | -.276** | .306** | -.182** | -.182** | -.016 | -.235** | -.152** | 1   |     |     |     |     |     |     |     |     |     |     |     |     |
| 10. MPI: Outdoor activities | 831 | -.148** | -.233** | .208** | -.128** | -.154** | -.016 | -.153** | -.039 | .389** | 1   |     |     |     |     |     |     |     |     |     |     |     |
| 11. MPI: Activities away from home | 832 | -.154** | -.237** | .274** | -.199** | -.006 | -.050 | .000 | .074* | .289** | .265** | 1   |     |     |     |     |     |     |     |     |     |     |
| 12. MPI: Social activities | 833 | -.141** | -.317** | .352** | -.259** | .066 | -.118** | -.002 | .067 | .411** | .244** | .527** | 1   |     |     |     |     |     |     |     |     |     |
| 13. MPI: General activity index | 833 | -.190** | -.359** | .368** | -.256** | -.112** | -.045 | -.151** | -.034 | .723** | .662** | .637** | .669** | 1   |     |     |     |     |     |     |     |     |
| 14. HADS: Anxiety | 827 | .374** | .411** | -.526** | .689** | .052 | .247** | .172** | .194** | -.189** | -.124** | -.166** | -.222** | -.233** | 1   |     |     |     |     |     |     |
| 15. HADS: Depression | 827 | .375** | .551** | -.571** | .604** | -.019 | .287** | .089* | .060 | -.290** | -.197** | -.273** | -.406** | -.393** | .674** | 1   |     |     |     |     |     |
| 16. TSK | 731 | .365** | .368** | -.347** | .366** | .206** | .135** | .280** | .192** | -.291** | -.125** | -.185** | -.247** | -.319** | .390** | .335** | 1   |     |     |     |
| 17. CPAQ-8: AE | 907 | -.353** | -.638** | .493** | -.419** | -.122** | -.136** | -.163** | -.089* | .376** | .253** | .291** | .383** | .435** | -.358** | -.527** | -.420** | 1   |     |     |
| 18. CPAQ-8: PW | 907 | -.234** | -.343** | .251** | -.306** | -.230** | -.066 | -.236** | -.197** | .210** | .072* | .179** | .177** | .220** | -.312** | -.280** | -.490** | .363** | 1   |     |
| 19. CPAQ-20: AE | 907 | -.370** | -.597** | .493** | -.413** | -.127** | -.115** | -.158** | -.093* | .347** | .247** | .277** | .361** | .407** | -.361** | -.502** | -.445** | .930** | .394** | 1   |
| 20. CPAQ-20: PW | 907 | -.251** | -.346** | .273** | -.330** | -.185** | -.090* | -.217** | -.210** | .147** | .024 | .131** | .134** | .150** | -.323** | -.267** | -.440** | .305** | .898** | .329** | 1   |

*P<.05 and **P<.01 (2-tailed). All correlations are Pearson’s r. Those in **bold** are considered to be strong correlations (>|.5 and <.7) or very strong correlations (> .7). Section I: Pain Impact: 1, Pain severity; 2, Pain interference; 3, Life control; 4, Affective distress; 5, Support. Section II: Response by Significant Others: 6, Negative responses; 7, Solicitous responses; 8, Distracting responses. Section III: Activities: 9, Household chores; 10, Outdoor work; 11, Activities away from home; 12, Social activity; 13, General activity index.
groups, and somewhat worse compared with the high-scoring group. Significant differences across all groups were indicated for pain interference. Means and standard deviations (SDs) are displayed in Table 4.

### Comparisons Using More Stringent Conditional Probabilities

All between-group comparisons were repeated including only those individuals who showed stronger conditional probabilities. As 4 groups were indicated, required conditional probabilities of >25%, >50%, and >75% were examined sequentially.

With regard to the >25% requirement, all 907 participants had a probability exceeding that threshold. Therefore, further analyses were not done with regard to between-group differences.

With respect to the >50% requirement, a total of 54 individuals (6%) were excluded. The pattern of between-cluster differences was identical to those that included the full sample across all analyses.

In the case of the most stringent >75% requirement, a total of 372 individuals (41%) were excluded. When cluster differences were examined in the remaining 535 individuals, the pattern was identical to that obtained using the full sample for the CPAQ-8 and its subscales, as well as for all measures of functioning, with the exception of MPI pain severity and interference scales. For pain severity, a lack of significant difference between the high- and mixed-scoring groups was indicated, in addition to the lack of difference between the medium- and mixed-scoring groups, which was indicated within the full sample. For pain interference, a marginally nonsignificant ($P = .057$) difference was indicated between the high- and mixed-scoring groups. The difference in findings is detailed in the notes in Table 4.

### CPAQ-8

#### LCA Analysis

The results of the cluster analysis for the CPAQ-8 were highly consistent with those performed for the CPAQ-20. Overall, a 4-cluster structure was indicated as the most appropriate.

#### Cluster Comparisons on Measures of Functioning

In brief, the pattern of between-cluster differences for the CPAQ-8 was almost identical to the pattern for the CPAQ-20. The only difference was with regard to pain severity, for which nonsignificant differences were indicated between both the medium-scoring and mixed groups (as was the case with the CPAQ-20) and the high-scoring and mixed groups (which was not the case with the CPAQ-20). The results of all pairwise comparisons are detailed in the following paragraphs. Means and SDs are displayed in Table 4.

A significant omnibus effect of cluster membership was indicated (Wilks’ $\Lambda = .50$, $F_{20, 1,841} = 10.0$, $P < .001$), and all
1-way ANOVA comparisons were significant (all $F > 3.4$, all $P < .017$). Pairwise comparisons indicated significant differences for all comparisons for the low-, medium-, and high-scoring groups. As was the case with the CPAQ-20 comparisons, the pattern of findings for the mixed group was more irregular, with a lack of significant differences indicated compared with the medium-scoring group on measures of anxiety, movement-related fear, and pain severity, and compared with the high-scoring group on measures of depression and general activity. As noted above, the sole difference in group comparisons was with regard to the comparison of pain severity for the high- and mixed-scoring groups, which was nonsignificant for the CPAQ-8 comparisons, although the $P$ value of .07 approached significance.

### Comparisons Using More Stringent Conditional Probabilities

When the requirements for conditional probabilities of >25%, >50%, and >75% were examined sequentially, the pattern of findings was highly concordant with both the CPAQ-8 analyses, which did not require a threshold probability, and the CPAQ-20 analyses, which used the more stringent probabilities.

With regard to the >25% requirement, all 907 participants had conditional probabilities exceeding that threshold. Therefore, further analyses were not performed.

With regard to the >50% requirement, a total of 64 individuals (7%) were excluded. The patterns of between-cluster differences were identical to those included in the full sample across all analyses.

With regard to the most stringent >75% requirement, a total of 337 individuals (37%) were excluded. In the analyses including the remaining 570 individuals, the pattern of between-cluster differences in CPAQ scores was identical to the pattern using the full sample, as well as for all measures of functioning, with the sole exception of pain interference. For this latter measure, the difference between the high- and mixed-scoring groups failed to reach significance. The difference in findings is detailed in the notes for Table 4.

<table>
<thead>
<tr>
<th>Clusters from CPAQ-20</th>
<th>LOW</th>
<th>MEDIUM</th>
<th>HIGH</th>
<th>MIXED (HIGH AE/LOW PW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HADS: Depression</td>
<td>11.3 (4.4)</td>
<td>8.4 (4.1)</td>
<td>5.6 (3.8)</td>
<td>6.4 (3.5)</td>
</tr>
<tr>
<td>HADS: Anxiety</td>
<td>11.6 (5.0)</td>
<td>8.4 (4.5)</td>
<td>5.8 (4.2)</td>
<td>8.6 (4.9)</td>
</tr>
<tr>
<td>TSK: Pain-related fear</td>
<td>47.0 (9.3)</td>
<td>40.8 (8.1)</td>
<td>32.3 (6.1)</td>
<td>41.2 (8.4)</td>
</tr>
<tr>
<td>1. MPI: Pain severity</td>
<td>4.7 (.9)</td>
<td>4.1 (1.0)</td>
<td>3.6 (1.2)</td>
<td>4.0 (1.1)</td>
</tr>
<tr>
<td>2. MPI: Pain interference</td>
<td>4.7 (.8)</td>
<td>4.0 (.9)</td>
<td>2.8 (1.3)</td>
<td>3.4 (1.1)</td>
</tr>
<tr>
<td>3. MPI: Life control</td>
<td>1.5 (1.1)</td>
<td>2.4 (1.1)</td>
<td>3.1 (1.2)</td>
<td>2.8 (1.1)</td>
</tr>
<tr>
<td>4. MPI: Affective distress</td>
<td>4.0 (1.2)</td>
<td>3.1 (1.3)</td>
<td>2.2 (1.3)</td>
<td>3.0 (1.3)</td>
</tr>
<tr>
<td>5. MPI: Social support</td>
<td>4.4 (1.3)</td>
<td>3.9 (1.3)</td>
<td>3.4 (1.4)</td>
<td>4.1 (1.5)</td>
</tr>
<tr>
<td>6. MPI: Negative responses</td>
<td>1.7 (1.4)</td>
<td>1.6 (1.3)</td>
<td>1.1 (1.2)</td>
<td>1.5 (1.3)</td>
</tr>
<tr>
<td>7. MPI: Solicitous responses</td>
<td>2.9 (1.6)</td>
<td>2.4 (1.4)</td>
<td>1.8 (1.3)</td>
<td>2.8 (1.6)</td>
</tr>
<tr>
<td>8. MPI: Distracting responses</td>
<td>2.3 (1.3)</td>
<td>2.0 (1.2)</td>
<td>1.5 (1.0)</td>
<td>2.4 (1.3)</td>
</tr>
<tr>
<td>9. MPI: Household chores</td>
<td>2.2 (1.5)</td>
<td>2.8 (1.4)</td>
<td>3.5 (1.2)</td>
<td>3.3 (1.5)</td>
</tr>
<tr>
<td>10. MPI: Outdoor activities</td>
<td>2.9 (1.3)</td>
<td>1.2 (1.4)</td>
<td>1.7 (1.3)</td>
<td>2.0 (1.7)</td>
</tr>
<tr>
<td>11. MPI: Activities away from home</td>
<td>1.2 (1.1)</td>
<td>1.5 (1.0)</td>
<td>1.9 (1.1)</td>
<td>1.9 (1.2)</td>
</tr>
<tr>
<td>12. MPI: Social activities</td>
<td>1.8 (1.1)</td>
<td>2.2 (1.1)</td>
<td>2.6 (1.1)</td>
<td>2.6 (1.0)</td>
</tr>
<tr>
<td>13. MPI: General activity index</td>
<td>1.3 (1.0)</td>
<td>1.8 (9.9)</td>
<td>2.2 (8.8)</td>
<td>2.3 (1.0)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Clusters from CPAQ-8</th>
<th>LOW</th>
<th>MEDIUM</th>
<th>HIGH</th>
<th>MIXED (HIGH AE/LOW PW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HADS: Depression</td>
<td>11.6 (4.5)</td>
<td>8.7 (3.9)</td>
<td>5.6 (4.0)</td>
<td>6.3 (3.6)</td>
</tr>
<tr>
<td>HADS: Anxiety</td>
<td>11.8 (5.1)</td>
<td>8.6 (4.5)</td>
<td>6.0 (4.3)</td>
<td>7.9 (4.2)</td>
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<tr>
<td>TSK: Movement-related fear</td>
<td>48.0 (8.8)</td>
<td>40.8 (7.9)</td>
<td>32.3 (6.5)</td>
<td>40.7 (7.8)</td>
</tr>
<tr>
<td>1. MPI: Pain severity</td>
<td>4.7 (.9)</td>
<td>4.2 (1.9)</td>
<td>3.6 (1.2)</td>
<td>4.0 (1.0)</td>
</tr>
<tr>
<td>2. MPI: Pain interference</td>
<td>4.7 (.7)</td>
<td>4.1 (1.8)</td>
<td>2.9 (1.2)</td>
<td>3.3 (1.1)</td>
</tr>
<tr>
<td>3. MPI: Life control</td>
<td>1.5 (1.2)</td>
<td>2.3 (1.1)</td>
<td>1.0 (1.2)</td>
<td>2.8 (1.0)</td>
</tr>
<tr>
<td>4. MPI: Affective distress</td>
<td>4.0 (1.3)</td>
<td>3.2 (1.3)</td>
<td>2.3 (1.3)</td>
<td>2.8 (1.4)</td>
</tr>
<tr>
<td>5. MPI: Social support</td>
<td>4.3 (1.4)</td>
<td>4.0 (1.3)</td>
<td>3.5 (1.4)</td>
<td>4.0 (1.4)</td>
</tr>
<tr>
<td>6. MPI: Negative responses</td>
<td>1.7 (1.4)</td>
<td>1.6 (1.3)</td>
<td>1.1 (1.2)</td>
<td>1.6 (1.4)</td>
</tr>
<tr>
<td>7. MPI: Solicitous responses</td>
<td>2.9 (1.6)</td>
<td>2.5 (1.4)</td>
<td>1.9 (1.4)</td>
<td>2.5 (1.6)</td>
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<tr>
<td>8. MPI: Distracting responses</td>
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<td>2.1 (1.2)</td>
<td>1.6 (1.2)</td>
<td>2.2 (1.4)</td>
</tr>
<tr>
<td>9. MPI: Household chores</td>
<td>2.1 (1.5)</td>
<td>2.8 (1.4)</td>
<td>3.5 (1.4)</td>
<td>3.3 (1.4)</td>
</tr>
<tr>
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<td>.9 (1.3)</td>
<td>1.2 (1.4)</td>
<td>1.6 (1.3)</td>
<td>1.9 (1.6)</td>
</tr>
<tr>
<td>11. MPI: Activities away from home</td>
<td>1.1 (1.0)</td>
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<td>2.3 (8.8)</td>
<td>2.3 (9.0)</td>
</tr>
</tbody>
</table>

NOTE: Different subscripts indicate statistically significant differences at a Bonferroni-controlled alpha with $P < .05$.

*These domains were not significantly different when each individual was required to have a >75% conditional probability of membership in one group.
Concordance in Cluster Assignment for the CPAQ-20 and CPAQ-8

We calculated the proportion of patients assigned to the same cluster when data scores from the CPAQ-20 and CPAQ-8 were used to independently assign cluster membership. These data are displayed in Table 5. Overall concordance in cluster assignment was 80.1% for the unrestricted and >25% probabilities (these both included all 907 participants), 86.1% for the >50% probabilities, and 97.5% for the >75% probability.

Discussion

Revision and comparison of the cluster structure of the CPAQ-20 and CPAQ-8 were performed with the intention of developing a cluster membership model that would be robust across the different versions of the CPAQ, using the more robust method of clustering. LCA demonstrated that a 4-cluster structure was superior to a 3-cluster structure, in contrast to the findings of Vowles et al.59 Ideally, the derivation of such a cluster structure would allow allocation of patients to groups that distinctly differentiate their measures of functioning and therefore their potential treatment needs.

Our findings show that, similarly Vowles et al,59 the cluster with high acceptance in both PW and AE had less depression, anxiety, and fear of movement than the other clusters. Furthermore, the high-acceptance group reported less pain severity, less interference from pain, and higher levels of general activity. As expected, the cluster with low levels of PW and AE showed the opposite levels of functioning and reported high pain interference in life. Our findings also identified a mixed cluster, similar to that identified by Vowles et al.59 The mixed group showed high AE but low PW and could be characterized as low in depression, high in anxiety, and higher pain-related fear. The mixed group also reported moderate levels of pain and rated the pain as more interfering in their lives than the high-acceptance group, even though they also scored the highest level of general activity. This could reflect a “keep busy to distract from pain” kind of behavior where they display a pronounced pain anxiety-related distraction in an attention-demanding paradigm as a behavioral correlate of hypervigilance toward pain.54 This group could also be similar to the pattern identified by the avoidance-endurance model of pain, described as presenting a pattern of behaviors and thought suppression, anxious mood, and task/activity persistence behavior (distress endurance responses).15 It is not clear whether these persistent activities are based on committed actions, and this question could be the subject of a future investigation.26 Committed actions are behavioral patterns linked to values and important goals, in contrast to activities that are intended to suppress anxiety. On the contrary, committed actions are flexibly persistent in that they can incorporate failure and discomfort while remaining on track toward important personal values and goals. To incorporate such a dimension in the clusters would be of potential value to better understand what influences patient’s activity choices.26,28

Contrary to Vowles et al,59 a fourth cluster emerged in this analysis that had a medium level of acceptance. Both the medium and low clusters showed a related profile of poorer functioning, as would be predicted by the ACT model. An interesting suggestion from this finding of a medium cluster is that the benefits of higher acceptance may not be dimensional but may occur above a certain threshold of AE and PW.

Remarkably, whereas the middle and mixed groups had no significant difference in their pain severity, fear of movement, or level of social support, the mixed cluster reported significantly less pain interference and reported being able to participate to a greater extent in social activities, household chores, and outdoor and general activities than the medium cluster, even though this cluster had higher PW (see Table 4). Moreover, the mixed group was able to engage in activities to the same extent as the group with high pain acceptance. Although equally as active as the high-acceptance group, the mixed group experienced higher anxiety and fear of movement, indicating a potential need for more focus in those areas in their rehabilitation program.

The CPAQ clusters differentiate levels of function and pain impact, providing further support to the inclusion of acceptance as a functionally useful concept and potential treatment target in pain rehabilitation. The 2 functional subscales of clustering, PW and AE, describe specific behavioral treatment targets. To relate to pain with an active choice to be open, letting go of unproductive attempts to control or avoid pain, is one of the core processes and active components of the psychological flexibility model.32,35

Table 5. Proportion of Patients, n/N (%), Assigned to the Same Cluster by CPAQ-20 and CPAQ-8 Scores

<table>
<thead>
<tr>
<th>Score</th>
<th>Unrestricted and &gt;25%</th>
<th>&gt;50%</th>
<th>&gt;75%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>181/215 (84%)</td>
<td>175/199 (88%)</td>
<td>127/129 (98%)</td>
</tr>
<tr>
<td>Medium</td>
<td>358/468 (88%)</td>
<td>334/412 (81%)</td>
<td>165/172 (99%)</td>
</tr>
<tr>
<td>High</td>
<td>110/125 (77%)</td>
<td>102/112 (91%)</td>
<td>165/175 (96%)</td>
</tr>
<tr>
<td>Mixed</td>
<td>85/99 (89%)</td>
<td>74/80 (93%)</td>
<td>38/38 (100%)</td>
</tr>
<tr>
<td>Total % concordance</td>
<td>80%</td>
<td>86%</td>
<td>98%</td>
</tr>
</tbody>
</table>

Revision and comparison of the cluster structure of the CPAQ-20 and CPAQ-8

Latent Class Analysis of the CPAQ
There is now significant evidence across a wide range of disorders that lack of acceptance is associated with a broad range of symptoms and negative outcomes. Clustering patients according to acceptance further supports the transdiagnostic value of ACT and its therapeutic processes that focus on functioning rather than targeting symptoms, signs, or diagnoses. Developing transdiagnostic models of behavioral change, with closely associated strategies, allows the creation of broadly applicable interventions to treat heterogeneous clinical populations with less focus on their disease or comorbidities and more on their functional/dysfunctional behaviors.

Such a transdiagnostic model may also facilitate a pragmatic and predictive assessment approach to patients with chronic pain. Each cluster reflects different levels and expressions of psychological flexibility or inflexibility. Psychological inflexibility has been shown across diverse populations to be linked to various dysfunctional or risk behaviors, level of functioning, and dysfunction in adolescents of psychological inflexible parents. It is also possible that developing more tailored rehabilitation programs for these groups of patients that target their different behavioral styles and psychological flexibility levels could lead to improvements in treatment. Future research that tests whether these clusters of patients do respond differently to interventions is needed to further test the predictions that follow from these findings.

Furthermore, to subgroup patients according to pain acceptance supports clearer links between theory, model, and the specific intervention. This in turn generates an integrity in the process of subgrouping and predicting outcome for a specific treatment and the outcomes expected.

Limitations of the current analyses include the following. First, the measures included in the present study were all limited to self-reports, and method variance, as well as errors in completion, could have influenced study results. Furthermore, the pattern of findings, although fairly concordant with data collected from an English-speaking sample residing in the United Kingdom, may not necessarily be representative of non-Swedish-speaking individuals or samples of individuals with chronic pain who differ significantly from the sample analyzed here. More fundamentally, all studies that use self-report measures make the assumption that self-reports do at least in part measure the construct that they are intended to measure. The measures used in this study are valid and reliable by the kinds of standards expected of a self-report questionnaire. Nonetheless, future research that explores the relationships between clustering (derived from self-report measures such as the CPAQ) and more concrete outcomes such as committed action-based activities, objective physical capacity, and return to work are needed to fully establish the usefulness of clustering methods.

Second, although there was good concordance overall in the cluster structures between the short and long forms of the CPAQ, there was a degree of disagreement (up to 20% in the group with the least restrictive conditional properties), and it is unclear which classification method is the most appropriate at the present time. Furthermore, in participants with a low conditional probability (eg, <50%), it may be that classification is not appropriate. To our knowledge, there is no empirical guidance with regard to addressing these issues within LCA. These data were all cross-sectional, which means that relationships are likely bidirectional, and causality cannot be determined. For example, it is not clear whether low levels of pain acceptance contribute to high distress and disability or vice versa. Longitudinal designs are required to address such issues.

At a principle level, it is not yet clear whether forming categories of patients based on their self-reports of behavioral parameters such as acceptance will lead to strong clinical or research applications. This study is exploratory and assumes for the time being that clustering could be a useful tool clinically and is worthy of further exploration. This study expands our knowledge by comparing the capacity of the long and short CPAQs to generate similar cluster structures with a novel and more robust method of clustering (LCA), differentiating between-cluster members on a wide range of other important parameters. In addition, LCA investigates model fit in successive steps, and in this sample the best fit was arrived at with 4 clusters. This means that there is something meaningful about patterns of responding to the CPAQ that is not available if we simply treat the acceptance subscales as continuous variables. Ultimately, further research is needed to determine which clustering method is more adapted to generate clinically useful algorithms for grouping patients. In addition, the clinical and research usefulness of clustering will be determined by future research that investigates other characteristics of the patients in each cluster, such as response to treatment.

In conclusion, the 4 clusters emerging from the CPAQ appear to be potential indicators for identifying different rehabilitation needs, and the same 4 clusters could also be identified by the short version of the CPAQ, the CPAQ-8. The current study represents a further step toward a principle-focused clinical model of assessment for pain rehabilitation. This is consistent with the development of a functional contextual behavioral science in which “developing interventions are based on theoretical models, tightly linked to basic principles that are themselves constantly upgraded and evaluated.”

References


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63. Wicksell RK, Olsson GL, Melin L: The Chronic Pain Acceptance Questionnaire (CPAQ) - further validation including a confirmatory factor analysis and a comparison with the Tampa Scale of Kinesiophobia. Eur J Pain 13:760-768, 2008