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# The Fear of Pain Questionnaire (FPQ): Further psychometric examination in a non-clinical sample

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**Abstract**

The present study sought to examine psychometric properties of the Fear of Pain Questionnaire (FPQ), a measure of pain-related fear, in a sample of undergraduates. Confirmatory factor analysis confirmed the previously reported three-factor model of the FPQ (e.g. severe pain, minor pain, medical pain), but some items may be redundant. With respect to the reliability of the FPQ, both the FPQ and the subscales showed good internal consistency and test–retest stability was moderate to good. Convergent and predictive validity of the FPQ (and the subscales) were partly supported by moderate correlations with related constructs and with self-reported fear associated with three experimental pain tests. Discriminant validity of the FPQ (and the subscales) was partly supported by low correlations with unrelated self-report measures. Moreover, modest correlation coefficients were found between the FPQ and other pain-related measures. Finally, the minor pain subscale of the FPQ accounted for pain intensity scores on the ischemic pain test and the remaining subscales and the FPQ total scores accounted for pain tolerance on the electrical stimulation test and the thermal pain test. Results are discussed and directions for future research are provided.


*Keywords:* Fear of pain; FPQ; Factor structure; Reliability; Validity

## 1. Introduction

Pain-related fear has been recognized as an important determinant of chronic pain (Vlaeyen and Linton, 2000). In quantifying pain-related fear, researchers and clinicians often rely on self-report measures. Several measures of pain-related fear such as the Pain and Impairment Relationship Scale (PAIRS; Riley et al., 1988), the Fear-Avoidance Beliefs Questionnaire (FABQ; Waddell et al., 1993), the Tampa Scale for Kinesiophobia (TSK; Miller et al., 1991), and the Pain Anxiety Symptoms Scale (PASS; McCracken et al., 1992), have been developed aimed at measuring specific aspects of pain-related fear (see for a comparison of instruments McCracken et al., 1996). Although some of these measures have now been modified for use in non-clinical samples, most measures were originally designed to measure pain-related fear in (chronic) pain samples. McNeil and Rainwater (1998) developed the Fear of Pain Questionnaire (FPQ), which has been used as a self-report measure of pain-related fear in (chronic) pain syndromes as well as in non-clinical samples (e.g. McNeil and Rainwater, 1998; Osman et al., 2002; Sullivan et al., 2004). Non-clinical participants vary in the degree to which they are fearful of pain, suggesting that pain-related fear is a common experience.

Only a handful of studies have investigated psychometric properties of the FPQ. Research has indicated that the factor structure of the FPQ is problematic. McNeil and Rainwater (1998) obtained a three-factor model comprising 10 items each. Factors were labeled ‘severe pain’, ‘minor pain’, and ‘medical pain’. Although each item had a salient loading on the corresponding factor, nine items had secondary loadings. Other attempts to investigate the factor structure of the FPQ have shown inadequate fit of the original three-factor model and resulted in the creation of item-parcels, which

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involves randomly combining two items within each subscale leaving five item-parcels within each subscale. Following this procedure, a satisfactory fit of the three-factor model in which each factor consists of five item-parcels has been reported (Albaret et al., 2004; Osman et al., 2002). Despite this shortcoming, internal consistency and test–retest stability of the FPQ and the subscales are good and construct validity, predictive validity, and criterion validity of the FPQ has been supported in clinical and non-clinical samples (Albaret et al., 2004; McNeil and Rainwater, 1998; McNeil et al., 2001; Osman et al., 2002; Sperry-Clark et al., 1999).

The present study sought to examine psychometric properties of a Dutch version of the FPQ in a non-clinical sample of undergraduates. First, the goodness-of-fit of the three-factor structure of the FPQ was examined by means of confirmatory factor analysis. In the case of inadequate fit, the goodness-of-fit is subjected to a careful inspection, which has not been carried out so far. Second, internal consistency and test–retest stability of the FPQ and the subscales were estimated. Convergent and discriminant validity of the FPQ were examined by means of examining associations between the FPQ and related and unrelated self-report measures. Further, predictive validity of the FPQ in relation to self-reported fear (as a state characteristic) associated with three experimental pain tests was examined. Finally, as it is generally acknowledged that pain-related fear influences the pain experience (Asmundson et al., 2004), the relation between FPQ and self-reported pain intensity and pain tolerance for each pain test was investigated.

## 2. Methods

### 2.1. Participants

Two samples of undergraduates were used in the current study. The first sample consisted of 271 first-year college students (17% male). Mean age was 19.6 years (SD = 1.9 years). The second sample comprised 192 first-year and higher-year college students (22% male). Mean age was 21.2 years (SD = 2.5 years). As expected, mean age in sample two was significantly higher compared to mean age in sample one ($t[461] = 7.82$, $P < .001$). The FPQ was completed in both samples. Individuals in sample two completed an additional battery of questionnaires (see *measures* section). All participants completed the FPQ at one occasion. Data from both samples were pooled for confirmatory factor analysis and estimating internal consistency. A total number of 61 (unselected) undergraduates (18% male; mean age 20.9 years, SD = 2.0 years) from the second sample completed the FPQ for the second time and underwent three experimental pain tests (i.e. electrical stimulation test, thermal pain test, and ischemic pain test) 3 months after completing the FPQ for the first time. These 61 subjects who agreed to participate did not differ from those who did not participate with respect to gender, age, and mean scores on the FPQ and its subscales, suggesting that they are representative of the total sample with respect to demographic characteristics and levels of fear of pain. All participants were unfamiliar with the pain tests. Written consent was obtained from all participants before the start of the study. The Ethics Committee of the Academic Hospital Maastricht/Maastricht University approved the study protocol.

### 2.2. Self-report measures

Participants in both samples completed a Dutch version of the *Fear of Pain Questionnaire* (FPQ; McNeil and Rainwater, 1998). The FPQ is a 30-item self-report measure of pain-related fear designed to tap fear related to severe pain (e.g. 'Breaking your leg'), minor pain (e.g. 'Getting a paper-cut on your finger'), and medical pain (e.g. 'Receiving an injection in your hip/buttocks'). Items are scored on a 5-point Likert scale ranging from 1 (not at all) to 5 (extreme). The translation of the English version of the FPQ into the Dutch version was done in a state-of-the-art manner that involved back translation and retranslation. The *Pain Anxiety Symptoms Scale* (PASS; McCracken et al., 1992) is a 40-item self-report measure of pain-related fear tapping four domains: fearful appraisal of pain, cognitive anxiety, physiological anxiety, and escape/avoidance behavior. Items are rated on a 6-point Likert scale ranging from 0 (never) to 5 (always). Reliability and validity of the PASS in clinical and non-clinical populations has been well established (Larsen et al., 1997; McCracken et al., 1993; Osman et al., 1994; Roelofs et al., 2004). The trait version of the *State-Trait Anxiety Inventory* (STAI-T; Spielberger et al., 1970) is a self-report measure of trait anxiety containing 20 items rated on a 4-point scale ranging from 1 almost never) to 4 (almost always). Reliability and validity have been well documented (Kabacoff et al., 1997; Oei et al., 1990). The *Fear of Spiders Questionnaire* (FSQ; Szymanski and O'Donohue, 1995) is a 18-item self-report measure of specific anxiety related to spiders. Items are rated on a 8-point scale ranging between 0 (fully agree) to 7 (fully disagree). Reliability and validity of the FSQ are good (Muris and Merckelbach, 1996; Szymanski and O'Donohue, 1995). The *Aggression Questionnaire* (AQ; Buss and Perry, 1992; Meesters et al., 1996) comprises 29 items scored on a 5-point Likert scale ranging from 1 (extremely like me) to 5 (extremely unlike me). Reliability and validity of the AQ have been well documented (Buss and Perry, 1992; Meesters et al., 1996). The *Pain Vigilance and Awareness Questionnaire* (PVAQ; Crombez and Vlaeyen, 1998; McCracken, 1997) is a measure of pain vigilance, which consists of 16 items rated on a 6-point scale with anchors of never and always. The PVAQ is a reliable and valid measure of pain vigilance in pain-free individuals and chronic pain populations (Roelofs et al., 2002, 2003). The *Pain Catastrophizing Scale* (PCS: Crombez and Vlaeyen, 1996; Sullivan et al., 1995) is a 13-item self-report measure of pain catastrophizing. Items are rated on a 4-point scale ranging from 1 (not at all) to 4 (all the time). The PCS has been shown to be a reliable and valid measure of pain catastrophizing in pain-free individuals and chronic pain syndromes (Sullivan et al., 1995; Van Damme et al., 2002). The *Zung* (Zung, 1965) is a 20-item inventory of depression. Items are rated on a 4-point Likert scale ranging from 1 (none or a little bit of the time) to 4 (most or all of the time). The Zung is a reliable and valid measure of depression (Telerak et al., 1993; Zung, 1965). For all questionnaires, higher scores reflect higher levels of the underlying person characteristic that the questionnaire presumes to measure.

In the present study, total scores on all questionnaires (except for the FPQ) were used to assist in the validation of the FPQ.

### 2.3. Experimental pain tests

About 3 months after participants in sample two completed the measures, 61 individuals returned to our lab and underwent three experimental pain tests in a counterbalanced order. Before the start of each pain test, all participants rated the level of fear of pain they thought would be associated with the specific pain test. Fear of pain was measured on a 100-mm. visual analogue scale (VAS) with anchors 'no fear at all' to 'very fearful'. After each pain test, pain intensity was measured on a VAS with anchors 'no pain at all' to 'very painful'. Individuals were asked to rate the mean pain intensity during the pain test. Pain tolerance was also assessed for each pain test. For the *electrical stimulation test*, two electrodes (diameter 8 mm. Ag–AgCl electrodes) were applied to the non-dominant arm. Electrical stimulation was delivered at a 100 Hz train rate of square wave pulses using a constant-current stimulator (IDEE, Maastricht University), with a maximal output of 10 mA. Stimulus strength could be adjusted with a resolution of .10 mA. Stimulus intensity was increased in gradually until participants reached the pain tolerance. Participants were requested to press a button when pain tolerance was reached. The measurement of pain tolerance was repeated four times. To allow for sensitization, only the last three trials were analyzed. The *thermal pain test* was performed using a TSA 2001 (Medoc, Ramat Yishai, Israel), which operates on the Peltier principle (Reulen et al., 2003 for details). A rectangular stimulator thermode was used for cutaneous stimulation. In order to prevent thermal injury and to protect the Peltier element, the high temperature limit was 52 °C. The test was performed with a rate of temperature change of 1 °C per second. Participants were asked to push a button when pain tolerance was reached after which temperature returned to baseline immediately (32 °C). The measurement of pain tolerance (expressed in degrees Celsius) was repeated five times. To allow for sensitization, only the last four trials were analyzed. The *ischemic pain test* induces pain as a result of reduced blood flow to the muscle of the arm by wrapping the cuff of a sphygmomanometer around the (non-dominant) forearm, inflating it, and maintaining the pressure at 160 mmHg for each individual (Turk et al., 1983). While the pressure was maintained, participants performed handgrip exercises on a dynamometer, which caused a painful sensation. When participants reached the pain tolerance handgrip exercises stopped and the cuff was deflated. Pain tolerance was measured as the maximum time participants could endure the ischemic pain test. For all pain tests, participants were instructed '…to indicate at what point they were not be able to endure the painful sensation anymore…'

### 2.4. Statistical analysis

#### 2.4.1. Confirmatory factor analysis

The goodness-of-fit of the previously reported three-factor solution of the FPQ (McNeil and Rainwater, 1998; Osman et al., 2002) was examined by means of confirmatory factor analysis (LISREL version 8.30; Jöreskog and Sörbom, 1999). Each item was assumed to load only on one factor such that items of the same FPQ subscale loaded on the same factor (latent construct). Goodness-of-fit of the three-factor model was estimated while latent constructs (subscales) were allowed to correlate. A one-factor solution in which all items load on one latent construct was also examined as total scores on the FPQ are frequently reported in research papers. As the three-factor model is a special case of the one-factor model, the models can be compared with a likelihood ratio test. More specifically, under the null hypothesis that the special model fits as well as the more general one, the difference between their Chi-square values is itself Chi-square distributed with degrees of freedom equal to the difference between their degrees of freedom. The Maximum Likelihood algorithm was used to assess the fit of the models. The goodness-of-fit of the three-factor model and the one-factor model was evaluated using several descriptive criteria: (a) Root Mean Square Error of Approximation (RMSEA); (b) the Comparative Fit Index (CFI); the Non-Normed Fit Index (NNFI); and (d) the Expected Cross-Validation Index (ECVI). For the RMSEA, values below .05 or lower indicate a close fit, whereas values up to .08 represent reasonable errors of approximation. For the CFI and NNFI, values above .90 are indicative of an adequate fit whereas values above .95 are indicative of a good to very good fit. The ECVI is a relative measure to compare competing models (e.g. one-factor model vs. three-factor model): the model with the lowest value has the best fit. Data from both samples were pooled for the confirmatory factor analyses.

### 2.5. Internal consistency and test–retest stability

Internal consistency (Cronbach's alpha) and test–retest stability was examined in the FPQ total score as well as the subscales. Internal consistency was determined for both samples separately. For test–retest stability of the FPQ and the subscales, FPQ data for the 61 undergraduates who underwent the experimental pain tests were used, for which intra-class correlation coefficients (ICC) were computed.

### 2.6. Construct and predictive validity

Construct validity of the FPQ was examined in sample two only by computing Pearson correlation coefficients between scores on the FPQ (and its subscales) and scores on the PASS, STAI-T, FSQ, AQ, PCS, PVAQ, and Zung. As the FPQ and the PASS are both measures of pain-related fear, convergent validity would be supported when the correlation between the FPQ and PASS is stronger then the correlation between FPQ and STAI-T (general trait anxiety). It was also expected that the correlation between FPQ and STAI-T is stronger than the correlation between FPQ and FSQ (specific anxiety for spiders). Z-tests were used to compare the correlation coefficients. To decrease the likelihood of spurious findings due to Type I error, alpha was set to .01. Further, support for discriminant validity would be provided when there is no substantial correlation between FPQ and AQ and between FPQ and Zung. Modest correlation coefficients were expected between FPQ and other pain-related measures such as the PCS and the PVAQ. Further, predictive validity for the FPQ was examined by computing Pearson correlation coefficients between the FPQ (and the subscales) and scores on the visual analogue scales of fear associated with undergoing each pain test. Further, Pearson correlation coefficients were computed for determining the relation of the FPQ (and the subscales) with self-reported pain intensity and pain tolerance. For the electrical stimulation test and the thermal

pain test, mean pain intensity was computed by summing the pain intensity ratings over the respectively three or four trials and dividing this by the number of trials.

## 3. Results

Table 1 presents descriptive statistics of the questionnaires in both samples for males and females separately and together. In sample one, significant gender differences (alpha = .05) were found between scores on the FPQ (t[269] = 2.75; $P = .006$), the minor pain subscale (t[269] = 2.25; $P = .025$), and the medical pain subscale (t[269] = 2.61; $P = .010$). Borderline significant gender differences were found on the severe pain subscale (t[269] = 1.92; $P = .056$) in sample one. No statistically significant gender differences on the FPQ and the subscales were found in sample two. Further, significant gender differences were only found on the FSQ (t[190] = 3.25; $P = .001$).

Mean fear of pain ratings of electrical stimulation test, the thermal pain test, and the ischemic pain test were 28.5 (SD = 22.4), 26.2 (SD = 22.0), and 17.0 (SD = 18.6), respectively. Mean pain intensity ratings of the electrical stimulation test, the thermal pain test, and the ischemic pain test were 59.9 (SD = 23.2), 54.2 (SD = 25.5), and 40.3 (SD = 25.0), respectively. Mean tolerance times on the electrical stimulation test, the thermal pain test, and the ischemic pain test were 13.5 s (SD = 6.2), 49.9 °C (SD = 1.6), and 77.3 s (SD = 48.4), respectively. It should be noted that three individuals reached the maximum pain tolerance level possible (30 s) on the electrical stimulation test and eight individuals reached the maximum temperature (52 °C) for the thermal pain test. Although these individuals did not reach their pain tolerance level, they were not excluded from analyses as this may undermine the power of the study. These individuals were assigned the maximum temperature. As there was a disproportionate representation of females ($n = 50$), gender differences were not tested.

### 3.1. Confirmatory factor analysis

Table 2 depicts the goodness-of-fit indices for the three-factor model and the one-factor model as obtained by means of confirmatory factor analysis. The fit-indices for the one-factor model and the three-factor model did not meet the pre-established criteria. The three-factor solution did provide a statistically better fit compared to the one-factor model. That is, the difference between the chi-squares of the one-factor model and the three-factor model (3553–2749 = 804) was statistically significant ($\Delta df = 405–402 = 3$). Thus, it should be concluded that, although the three-factor model of the FPQ fitted better then the one-factor solution, fit of both models was poor. Inspection of the so-called 'modification-indices that are provided by LISREL showed that some items had large positive residual correlation. When items have (positive) residual correlation, it means that the correlation between these items is stronger than the correlations between the remaining items of the scale or subscale. Careful inspection of the modification indices revealed the presence of a lower order factor within the medical pain subscale. This lower order factor comprised four items related to getting an injection (items 8, 11, 14, and 17). Within this 'injection' factor, items 8 and 11 had strong residual correlation. Further, the 'injection' factor was substantially correlated with the severe pain subscale.

Table 1
Descriptive statistics of the questionnaires for both samples

| | Males ($n = 45$) | | Females ($n = 226$) | | Both ($n = 271$) | | Alpha |
|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | Mean | SD | |
| Sample 1 | | | | | | | |
| FPQ | 68.0 | 13.5 | 75.2 | 16.5 | 74.0 | 16.3 | .93 |
| FPQ severe | 30.5 | 7.1 | 32.7 | 7.0 | 32.3 | 7.1 | .88 |
| FPQ minor | 16.8 | 4.4 | 18.7 | 5.3 | 18.4 | 5.2 | .86 |
| FPQ medical | 20.8 | 5.5 | 23.8 | 7.3 | 23.3 | 7.2 | .88 |
| Sample 2 | Males ($n = 42$) | | Females ($n = 150$) | | Both ($n = 192$) | | |
| FPQ | 73.2 | 15.8 | 74.2 | 16.7 | 74.0 | 16.4 | .91 |
| FPQ severe | 31.1 | 8.6 | 32.5 | 7.9 | 32.2 | 8.0 | .89 |
| FPQ minor | 18.8 | 5.0 | 18.0 | 5.5 | 18.2 | 5.4 | .82 |
| FPQ medical | 23.3 | 6.0 | 23.7 | 7.2 | 23.6 | 6.9 | .85 |
| PASS | 52.5 | 23.7 | 52.8 | 24.6 | 52.7 | 24.4 | .93 |
| PCS | 14.1 | 7.3 | 13.7 | 7.6 | 13.8 | 7.6 | .88 |
| PVAQ | 29.2 | 12.1 | 30.3 | 11.1 | 30.0 | 11.3 | .87 |
| STAI-T | 34.7 | 7.9 | 36.3 | 9.7 | 36.0 | 9.3 | .92 |
| Zung (depression) | 34.1 | 6.0 | 34.6 | 7.1 | 34.5 | 6.8 | .82 |
| FSQ | 7.2 | 14.4 | 21.0 | 26.5 | 18.0 | 25.0 | .96 |
| AQ | 65.5 | 13.6 | 62.7 | 12.0 | 63.3 | 12.4 | .82 |

FPQ, Fear of Pain Questionnaire; PASS, Pain Anxiety Symptoms Scale; PCS, Pain Catastrophizing Scale; PVAQ, Pain Vigilance and Awareness Questionnaire; STAI-T, trait version of the State-Trait Anxiety Inventory; FSQ, Fear of Spiders Questionnaire; AQ, Aggression Questionnaire.

Table 2
Fit indices of the factor models as obtained by means of CFA ($n=465$)

| | RMSEA | | CFI | NNFI | ECVI | $\chi^2$ (df) |
|---|---|---|---|---|---|---|
| | Estimate | 90% CI | | | | |
| One-factor | .15 | .14–.16 | .53 | .50 | 10.59 | 3553 (405) |
| Three-factor model oblique | .11 | .10–.12 | .72 | .70 | 6.20 | 2749 (402) |
| Three-factor model modified | .061 | .057–.065 | .91 | .90 | 2.62 | 1029 (395) |

RMSEA, Root Mean Square Error of Approximation; CFI, Comparative Fit Index; NNFI, Non-Normed Fit Index; ECVI, Expected Cross-Validation Index.

Within the medical pain subscale, items 26 and 29 had strong residual correlation as they are uniquely related to dental fear. In addition, item 17 (e.g. 'receiving an injection in your mouth') was substantially correlated with these dental fear items. Within the severe pain subscale, items 3 and 6 had strong residual correlation as they refer to fear associated with breaking an arm or a leg, respectively. Within the minor pain subscale, items 4 and 19 had strong residual correlation as both items refer to cutting the tongue while licking an envelope or a paper-cut on your finger, respectively. When re-running the three-factor model allowing for the presence of an 'injection factor' and the above mentioned items with (strong) residual correlation to correlate, all fit indices met the predetermined criteria indicating that an adequate to good fit was obtained (see Table 2 under 'three-factor model modified'). The ECVI also clearly favored the three-factor model including the abovementioned modifications. Moreover, the improvement of fit can be tested statistically by means of the chi-square test. The difference in chi-square between the original three-factor model and the three-factor model modified (2749–1029 = 1720) was indeed statistically significant ($\Delta df = 402–395 = 7$).

### 3.2. Internal consistency and test–retest stability

Cronbach's alpha of the FPQ total score and subscales was high indicating good internal consistency (Table 1). Test–retest stability was assessed with an interval of about 3 months between both administrations. The ICC of the FPQ total score was .56 (mean = 76.0, SD = 15.2 for the first test administration [adm1] and mean = 74.8, SD = 16.1 for the second test administration [adm2]), indicating reasonable test–retest stability with an interval of 3 months. For the FPQ severe pain, FPQ minor pain, and FPQ medical pain subscales, ICC's were .45 (mean = 33.3, SD = 7.4 for adm1 and mean = 32.1, SD = 6.7 for adm2), .54 (mean = 18.7, SD = 5.4 for adm1 and mean = 19.2, SD = 5.8 for adm2), and .68 (mean = 24.0, SD = 6.6 for adm1 and mean = 23.5, SD = 6.7 for adm2), respectively indicating moderate to good test–retest stability.

Table 3
Pearson correlation coefficients of the FPQ with related and unrelated measures ($n=192$)

| | FPQ | FPQ severe | FPQ minor | FPQ medical |
|---|---|---|---|---|
| PASS | .34[a] | .21[a] | .29[a] | .32[a] |
| STAI-T | .17[b] | .04 | .22[a] | .18[b] |
| PCS | .37[a] | .27[a] | .29[a] | .32[a] |
| PVAQ | .28[a] | .15[b] | .24[a] | .30[a] |
| Zung | .14 | .01 | .19[a] | .17[b] |
| FSQ | .06 | .02 | .07 | .06 |
| AQ | .11 | −.03 | .19[b] | .13 |

FPQ, Fear of Pain Questionnaire; PASS, Pain Anxiety Symptoms Scale; STAI-T, trait version of the State-Trait Anxiety Inventory; PCS, Pain Catastrophizing Scale; PVAQ, Pain Vigilance and Awareness Questionnaire; FSQ, Fear of Spiders Questionnaire; AQ, Aggression Questionnaire.
[a] $P<.01$.
[b] $P<.05$.

### 3.3. Construct and predictive validity

With respect to the construct validity of the FPQ (Table 3), the correlation between FPQ and PASS was significantly stronger than the correlation between FPQ and STAI-T ($z=2.187$, $P=.029$). The same pattern of results was found for the FPQ severe subscale ($z=2.152$, $P=.031$), but not for FPQ minor ($z=.905$, $P=.366$) and FPQ medical ($z=1.885$, $P=.059$). Thus, convergent validity of the FPQ and its subscales was partly supported. There was no statistically significant difference between the magnitude of the correlation between FPQ and STAI-T and between FPQ and FSQ ($z=1.228$, $P=.219$), indicating no difference in the degree of association between fear of pain and trait anxiety and between fear of pain and a measure of specific fear (i.e. fear of spiders). The same pattern of results was found for the FPQ severe subscale ($z=.408$, $P=.816$), FPQ minor ($z=1.709$, $P=.087$), and FPQ medical ($z=1.304$, $P=.192$). Further, no substantial correlation was found between FPQ and AQ and between FPQ and Zung, supporting the discriminant validity of the FPQ. Although the FPQ minor subscale showed a significant association with AQ, the magnitude of this correlation was quite modest. Similarly, Zung depression scores were significantly but modestly associated with the FPQ minor and FPQ medical subscales. Modest correlation coefficients were found between the FPQ and the other-pain-related measures (PCS and PVAQ). Support for predictive validity of the FPQ and the subscales was also found on self-reported fear associated with undergoing each of the experimental pain tests (Table 4). More specifically, scores on the FPQ and the subscales were most strongly correlated with fear associated with electrical pain and least with fear associated with thermal pain. With respect to the pain intensity ratings, the minor pain subscale was most strongly associated with pain intensity measured on the ischemic pain test and to a lesser extent with pain intensity ratings from the thermal pain test. Further, FPQ total scores and scores on the other subscales

Table 4
Pearson correlation coefficients of the FPQ with fear, pain intensity, and pain tolerance measured on three experimental pain tests ($n=61$)

| | FPQ | FPQ severe | FPQ minor | FPQ medical |
|---|---|---|---|---|
| *Fear (VAS)* | | | | |
| Electrical stimulation | .53[a] | .46[a] | .35[a] | .50[a] |
| Thermal pain test | .35[a] | .27[b] | .32[b] | .30[b] |
| Ischemic pain test | .45[a] | .44[a] | .30[b] | .38[a] |
| *Pain intensity (VAS)* | | | | |
| Electrical stimulation | .10 | −.02 | .24 | .06 |
| Thermal pain test | .14 | −.01 | .25[b] | .12 |
| Ischemic pain test | .27[b] | .10 | .40[a] | .21 |
| *Pain tolerance* | | | | |
| Electrical stimulation | −.33[b] | −.28[b] | −.21 | −.32[b] |
| Thermal pain test | −.28[b] | −.28[b] | −.10 | −.32[b] |
| Ischemic pain test | −.03 | .03 | −.11 | −.02 |

FPQ, Fear of Pain Questionnaire; VAS, visual analogue scale.
[a] $P<.01$.
[b] $P<.05$.

(except for the minor pain subscale) were modestly associated with levels of pain tolerance measured on the electrical stimulation test and the thermal pain test, but not with levels of pain tolerance measured on the ischemic pain test.

## 4. Discussion

The present study sought to investigate psychometric properties of the Fear of Pain Questionnaire in a sample of undergraduates. The factor structure of the FPQ was examined by means of confirmatory factor analysis. Results showed that the previously reported three-factor model comprising the FPQ severe, FPQ minor, and FPQ medical scales, fitted substantially and significantly better compared to the one-factor model. However, within the FPQ medical subscale, a lower-order factor consisting of items referring to injection was identified. In addition, some items had strong residual correlation. When two items have residual correlation, it means that the correlation between these items is stronger than the correlations between the remaining items of the subscale. Acknowledging the lower order 'injection' factor and allowing a restricted number of items to have residual correlation, fit improved substantially and significantly. These findings are in line with previous studies that have also experienced difficulties in obtaining a clear factor structure of the FPQ. For example, McNeil and Rainwater (1998) identified the presence of either three or five factors but selected the three-factor model as the most parsimonious and interpretable one. Analysis of item-parcels has produced adequate fit of the three-factor model (Albaret et al., 2004; Osman et al., 2002) and might be useful to develop a short screening version of the FPQ. In this light, there are four items referring to 'injection' and two items to breaking a leg or an arm. It may be that some of these items are redundant and some of these items could be omitted in a shorter version of the FPQ that might tap the three FPQ factors equally well compared to the original FPQ. Albaret et al. (2004) provided a reduced 15-item version that seemed a viable alternative to the original 30-item FPQ. In a similar vein, Kennedy et al. (2001) developed a 9-item version of the FPQ from which a total score and three subscale scores (three items each) can be obtained. However, both versions contain multiple items referring to injection. This may threaten the validity, as these items may not only reflect pain-related fear but also a phobia towards blood-injection[1]. Taken together, confirmatory factor analysis provided some support for a three-factor model of the FPQ, but there are items that may be considered as redundant.

Internal consistency of the FPQ and its subscales was good. Similar values for Cronbach's alpha have previously been reported (McNeil and Rainwater, 1998; Osman et al., 2002). Test–retest stability of the FPQ and its subscales over a 3-month-period of time was moderate to good. The FPQ medical pain subscale was most stable across the 3 months and the FPQ severe pain subscale proved least stable. Only one study has addressed the test–retest stability of this measure in a comparable sample of undergraduates (McNeil and Rainwater, 1998). In that study, test–retest was assessed over three weeks and correlations ranged from .69 to .76. Consistent with our study, they found the FPQ medical pain subscale to be most stable and the FPQ severe pain subscale to be least stable. However, the present study used a substantially longer time interval compared to McNeil and Rainwater (1998). Although the FPQ is considered to be a trait measure, one cannot rule out that changes in fear of pain might have occurred due to the relative large period of time between both test administrations.

Construct validity (i.e. convergent and discriminant validity) of the FPQ was generally supported. FPQ scores were stronger associated with the PASS (Zvolensky et al., 2001), compared to trait anxiety as measured with the STAI-T. For the FPQ subscales, only the FPQ severe pain scale showed the same pattern of results. Thus, convergent validity of the FPQ was partly supported. No substantial association was found between FPQ scores and scores on a measure of aggression (AQ). Only the FPQ minor pain subscale showed a significant but modest correlation with the AQ. Thus, discriminant validity of the FPQ was fairly supported. Further, moderate correlation coefficients were found between the FPQ and other pain-related measures supporting its validity. These results extend the findings on the construct validity of the FPQ reported by McNeil and Rainwater (1998) and Osman et al. (2002). In line with their studies, FPQ total scores showed good construct validity but

[1] We assessed construct validity for the medical pain subscale without the injection items and for the scale containing the four injection items. For both scales, Pearson correlation coefficients with self-report measures and self-reported fear associated with the pain tests did not differ significantly from the original medical pain subscale.

differential support for construct validity of the subscales was found in the present study. Convergent validity of the FPQ severe pain subscale was strongest compared to the other subscales. FPQ medical pain showed the weakest discriminant validity compared to the other FPQ subscales. Importantly, the present study took the examination of predictive validity one step further by assessing the association between the FPQ (and the subscales) and fear associated with undergoing three experimental pain tests. Predictive validity of the FPQ (and the subscales) in relation to these pain tests was supported. We also examined the relation between the FPQ (and the subscales) and pain intensity and pain tolerance. The FPQ minor subscale was most strongly associated with pain intensity ratings on the ischemic pain test while the other subscales and the FPQ total score were most strongly associated with pain tolerance levels on the electrical stimulation test and the thermal pain test. In explaining these findings, it may be suggested that the FPQ minor subscale is most sensitive in assessing individual differences in fear of pain in relation to pain intensity ratings, in particular on the ischemic pain test. However, in contrast to our expectation, individual differences in fear of pain tapped with the FPQ minor subscale did not relate to pain tolerance levels, as was the case for the other FPQ subscales. We do not have a plausible explanation for this finding, which clearly warrants replication in future research. Further, individual differences in fear of pain in relation to pain tolerance levels emerged only on the electrical stimulation and thermal pain test. Both these pain tests involve repeated administration and gradually increasing stimulus intensity. Although speculative, it may be that experimental pain procedures that involve repeated administration are most suitable for measuring individual differences in pain tolerance, because on the first exposure to a novel stimulus, all individuals may be somewhat prudent. With repeated exposure to the same stimulus, fearless individuals may become bolder and tolerate the pain longer while the fearful individuals remain prudent. This would lead to significant differences in tolerance times but, at the same time, abolish the effect on pain intensity due to the inverse relationship between the length of the pain test and the final pain intensity that is reached.

The findings of the current study have several limitations. First, the generalizability of the findings is limited to non-clinical samples. Second, gender differences in relation to the FPQ and the measurement of pain intensity and pain tolerance were not assessed, as the sample was predominantly female (Jones et al., 2003). Consequently, the degree to which the results can be generalized to males is limited. Third, menstrual cycle phase was not determined and the use of oral contraceptives was not assessed. Although all women reported the absence of pain before the start of the experiment, it is possible that the hormonal status might have biased the pain experience. Finally, we did not assess the degree to which participants have previously been exposed to pain stimuli as reflected by the FPQ items. In this context, Albaret et al. found some evidence to suggest that previous exposure to pain results in a decrease of fear of pain as indexed with the FPQ. Despite these limitations, the findings of the present study indicate that the FPQ can be used as a measure of pain-related fear in pain-free undergraduates. Developing a short version of the FPQ was not central to the present study but future research should further examine the suitability of a short version of the FPQ. To ensure the validity of the medical pain scale, this scale should include one injection item at most. Further, future research of the role of (perceived) control on the pain experience by manipulating control over pain and to examine the influence on the pain experience is warranted (Janssen et al., 2004). Although there have been some attempts to examine the FPQ in non-clinical samples (McNeil and Rainwater, 1998; McNeil et al., 2001), future research could also be aimed at further addressing psychometric properties of the FPQ in clinical populations (e.g. low-back pain, fibromyalgia, whiplash). More specifically, the unique contribution of the FPQ beyond other measures of pain-related fear such as the PASS, the TSK, the PAIRS, and the FABQ should be established. In this light, Osman et al. (2002) postulate that the FPQ may make substantial contributions in studies that include specific pain-related situations as criterion variables. This future research can contribute significantly to our knowledge and understanding of pain-related fear in clinical and non-clinical samples.

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