UNIVERSITAT ROVIRA I VIRGILI

# THE COGNITIVE SIDE OF PAIN EXPERIENCE IN ADOLESCENTS.

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Ester Solé Pijuan

# THE COGNITIVE SIDE OF PAIN EXPERIENCE IN ADOLESCENTS

DOCTORAL THESIS

Supervised by Dr. Jordi Miró

Department of Psychology

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This is to certify that:

The present dissertation: "The cognitive side of pain experience in adolescents", presented by Ester Solé Pijuan has been supervised by Jordi Miró, Professor at the Department of Psychology of the Universitat Rovira i Virgili, in fulfillment of the requirements for the degree of Doctor of Philosophy.

29 May 2015, Tarragona

Jordi Mir

Dr. Jordi Miró

*Al Jorge i als meus pares, Josep i Mercè,*

*per la seva comprensió, paciència i suport incondicional.*

# Agraïments

El procés d'elaborar una tesi doctoral pot quedar descrit per les paraules que va mencionar Sir Winston Churchill a l'inici de la Segona Guerra Mundial: "*I have nothing to offer but blood, toil, tears and sweat*" (No us puc oferir res més que sang, esforç, llàgrimes i suor). Exceptuant la sang que de moment i afortunadament no s'ha produït, la resta d'elements sí que hi són presents. L'esforç és realment imprescindible, possiblement com en qualsevol àmbit de la vida. Les llàgrimes en algun moment sorgeixen i en relació a la suor, molts dels meus companys de seminari podran corroborar aquest fet (sobretot amb les retallades de l'aire condicionat durant la crisi). Aquesta coneguda frase va ser pronunciada en un discurs a l'inici de la guerra quan les derrotes al front eren molt elevades i és vist com un dels discursos motivadors més importants de la història que van conduir al poble britànic a una dura resistència i a l'exèrcit aliat cap a la victòria. El que he après jo durant el procés d'elaboració de la tesi és que per aconseguir la victòria necessites, a més del que diu aquesta frase, importants aliats i col·laboradors, ja que sense ells és impossible. Per tant, amb aquestes paraules vull agrair a tots aquells que han contribuït a transformar la victòria en real i han complementat la frase de Churchill amb altres elements fent que el procés fos molt més agradable.

En primer lloc vull agrair al meu director de tesi, el Dr. Jordi Miró, la seva proposta de participar en el projecte de la Marató, d'unir-me al grup d'investigació ALGOS i la seva guia durant tot el procés, la qual cosa m'ha permès desenvolupar les meves habilitats com a investigadora en el camp del dolor infantil i elaborar aquesta tesi. Vull fer una menció especial al seu THINK BIG, que m'ha ensenyat a no posar-me límits ni fronteres a priori, en tot cas ja me'ls posarà la realitat. I també que m'hagi presentat al seu bon amic i millor investigador, Dr. Mark Jensen, que m'ha donat impagables consells a l'hora d'escriure articles.

En segon lloc, vull agrair també a tots els membres del grup ALGOS que han contribuït d'alguna o altra manera a aquesta tesi a través del contacte en el dia a dia. Específicament vull agrair a l'Elena, la seva rellevant participació, ja que és co-autora de tots els articles que es presenten i durant el procés m'ha aportat un punt de calma i reflexió; a la Caterina, el seu suport incondicional i el seu "*Go on and don't give up*!" constant; a l'Eli, el seu recolzament quan les dues ens enfrontàvem al temible món de l'anàlisi factorial; i a la Rocío, per encoratjar-me a unir-me al PICH. També vull agrair a l'equip tècnic d'ALGOS, al Roman i al Pere, la seva ajuda en les crisis informàtiques que han aparegut en algun moment o altre i que sempre m'han ajudat a solucionar. Ah! i també haver-me presentat a l'Owncloud, malgrat que ha estat una relació amb un inici difícil sembla que al final ens hem convertit en bons amics. En els darrers anys, també han arribat al grup dues persones que han aportat el seu gra de sorra a aquesta tesi, l'Anna, que m'ha ajudat en temes de comunicació en les xarxes socials i en molts altres aspectes gràcies a la seva capacitat empàtica innata i al Santi, que ha aportat el seu bon humor en l'etapa final més estressant. No voldria oblidar-me d'un antic membre d'ALGOS, l'Anna Huguet, que va co-dirigir el meu treball de Màster, em va ajudar en els meus inicis i em va transmetre la seva passió per la investigació; ni tampoc de totes i tots els becaris/es de col·laboració del grup ALGOS que ens han ajudat enormement en el procés de recollida de la mostra.

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em vull oblidar de l'Aroa que m'ha mostrat el camí i que entén perfectament del que parlo.

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Tots aquests aliats han fet no només que la victòria fos possible, sinó que a més a més, realment valgués la pena.

MOLTÍSSIMES GRÀCIES A TOTS!

# INDEX

# PREFACE

# Preface

This Dissertation has been conducted within the framework of the ALGOS research group, which provided me with the opportunity to study pain in children and adolescents, learn about this field, and develop my skills as a researcher. Focusing on the cognitive dimension of pain as experienced by adolescents, it is divided into six parts: Introduction, Objectives, Methods, Results, General Discussion and Conclusions.

The Introduction defines pain and provides an overview of the main theories that explain how pain is experienced. It then briefly explains the evolution of the field and describes how pain in children and adolescents has been treated over the past thirty years. Later it focuses on the main topics of this dissertation: the cognitive factors involved in pain (pain catastrophizing, pain beliefs, and cognitive fusion). At the end of the introduction, a subsection on pain assessment describes the main questionnaires that are used to measure these cognitive factors as well as the suitable psychometric properties of a scale.

The next section presents the main objectives of the studies and summarizes the methods used. The results section presents the four articles included in this Dissertation: studies III and IV have been published in the *European Journal of Psychological Assessment* and the *Clinical Journal of Pain*, respectively. Studies I and II are at the submission and review stages. The final part of the Dissertation provides a general discussion that relates the results of these four studies, mentions the main limitations and suggests future avenues for research in this area. The end of the discussion section provides a brief overview of the conclusions drawn from this Dissertation. To finish the preface, we want to point out an issue about the terminology used to refer to the recruited sample. The words “adolescents” and “young people” are used interchangeably throughout this Dissertation; however, “young people” usually refers to a wide range of age from children to young adults (below 26 years of age).

# 1. INTRODUCTION

## 1.1. What is pain?

Pain is defined by the International Association for the Study of Pain (IASP) as "*an unpleasant sensory and emotional experience associated with actual or potential damage, or described in terms of such damage*" (Merskey & Bogduk, 1994). To discern the main elements that characterize this definition, we would like to highlight several issues with it. First, as pain is *an unpleasant experience*, it depends on personal or subjective experience. Second, pain is *a sensory and emotional experience* that involves our sensory system and carries some form of emotional charge (pain activates emotional responses such as rage, sadness and anxiety that are related to psychological distress). Third, the damage related to pain *can be actual or potential, or described in terms of such damage*. This means that although pain may not be related to tissue damage, it will be accepted as such regardless of tissue damage provided it is reported in the same way as the pain that *is* associated with tissue damage (Merskey & Bogduk, 1994). From this definition we may deduce that pain has at least biological and emotional (psychological) components.

Two of the main researchers to have highlighted the importance of pain's psychological factors are a psychologist, Ronald Melzack (Montreal, 1929), and a physiologist, Patrick David Wall (Nottingham, 1925–London, 2001), who in 1965 formulated the Gate Control Theory of pain. This theory suggests that there is a gate in the spinal cord (in the *substantia gelatinosa*) that modulates the information about pain from the peripheral nervous system before it reaches the T-cells and finally the brain (Melzack & Wall, 1965). This gate is influenced by large and small sensory fibers since the balance between the activation of these fibers opens or closes it: when the large fibers are activated, the gate closes and when the small fibers are activated, the gate opens. Therefore, when the gate is open, the perception of pain is greater than when the gate is closed. This modulation explains why people with the same injury experience different intensities of pain. The above authors also described the influence of efferent information from the cortex into the control gate. This explains, for example, how psychological factors such as anxiety or negative thoughts can open the gate whereas relaxation techniques or distraction (diverting attention away from the experience of pain) can help to close it. In 1968, Melzack and Casey expanded this theory and, with physiological evidence, described the sensory-discriminative, motivational-affective and cognitive-evaluative components of pain that interact and are responsible for experiencing it (Melzack & Casey, 1968).

In a development of the above theory, Melzack (1990) proposed the Neuromatrix theory initially to provide an explanation for phantom limb pain. This theory suggests that the activation of a brain neural network – the body-self neuromatrix – is the mechanism responsible for pain (Melzack, 2001). This brain neural network, whose neurons are distributed throughout the thalamus, the cortex and the limbic system, generates a pattern of impulses that may be activated by a noxious stimulus or be activated independently of it. The neuromatrix is genetically determined but it may also be modified by sensory experience (Melzack, 2005). This theory complements the control gate theory by adding a promising explanation for pain not being triggered by a noxious stimulus.

Other studies supporting the importance of psychological factors in the experience of pain are those by Wilbert Fordyce (Sunnyside, 1923–Seattle, 2009). A study by Fordyce and colleagues (Fordyce, Fowler, Lehmann, & DeLateur, 1968) demonstrated the effects of operant conditioning on pain behavior. For example, behaviors such as complaining about pain or rest can be positively reinforced through the attention of family and friends, making such behaviors become repeated over time and negatively influencing recovery from pain. Another author who showed the importance of psychological factors was Dennis C. Turk, who highlighted the fundamental importance of cognitions in the experience of pain and suggested that certain beliefs (for example, about the meaning of pain or the ability to control pain) influence physical and psychosocial functioning (Turk, Genest, & Meichenbaum, 1983; Turk & Okifuji, 2002).

All the above studies emphasized the importance of biological and psychological factors on pain experience and led to the formulation of the next step in explanations of the elements involved in pain experience: the biopsychosocial model of pain. This model suggests that an interaction exists between the three main components of pain: the biological/physical, the psychological, and the social. It has proved quite useful and has had a huge influence on explanations of chronic pain (Gatchel, Peng, Peters, Fuchs, & Turk, 2007). The biological component includes genetics, the nervous system and the nociception; the psychological component includes emotional (e.g. depression, anxiety or stress) and cognitive factors (e.g. thoughts and beliefs about pain or selective attention to pain); and the social component involves the social and cultural context (e.g. relationships with family and friends, and cultural beliefs).

## 1.2. Acute pain versus chronic pain

Two main kinds of pain have been described in accordance with a time criterion: acute pain and chronic pain. Acute pain has a shorter or more limited duration than chronic pain but also has different properties and purposes. Acute pain has a biological purpose; it works as an alert system for our organism, informing us that something is happening to our body and that we should react to reduce or eliminate the cause of pain. When it disappears, the pain subsides (Miró, 2003). Chronic pain, on the other hand, has lost its biological value and persists beyond normal tissue healing. Although several years ago 6 months was considered, it is now usually agreed that three months is needed before we can begin to talk about chronic pain (Merskey & Bogduk, 1994).

## 1.3. Pain in children and adolescents

Children and adolescents experience both acute and chronic pain. Approaches to the study and treatment of pain in children and adolescents have changed greatly during the last thirty years, from the idea that babies and young children are unable to experience pain due to the immaturity of their central nervous system (McGrath, 2011; Reinoso, 2000) to the increase in recent publications on pediatric pain (Fernández-Baena et al., 2000; Reinoso, 2000). Knowledge about pain in children and adolescents is greater than it was thirty years ago. Acute pain and postsurgical pain are taken into account by most health professionals, and techniques to better measure and manage them have been implemented (Brasher et al., 2014). For example, some non-pharmacological methods, such as non-nutritive sucking, swaddling, facilitated tucking, sucrose administration, kangaroo care and breastfeeding, are successfully used in neonates to reduce procedural pain (Campbell-Yeo, Fernandes, & Johnston, 2011; Cignacco et al., 2007; Fernandes, Campbell-Yeo, & Johnston, 2011). Also, in children, pharmacological methods have been found to be efficacious for relieving acute and postsurgical pain (Tobias, 2014a, 2014b).

With regard to chronic pain, the changes over the last thirty years have been dramatic. In contrast to the old belief that chronic pain was unusual among children and adolescents, it is now known that this type of pain is an important health problem among these populations. Epidemiological studies show that between 11 and 38% of children and adolescents suffer chronic pain (Bandell-Hoekstra et al., 2001; Brattberg, 1994; King et al., 2011; Perquin et al., 2000). The only epidemiological study conducted with schoolchildren in Spain reported that 37.3% of children and adolescents aged between 8 and 16 years old described having some form of chronic pain, the most common types of which were lower extremity pain, back pain, and abdominal pain (Huguet & Miró, 2008).

Chronic pain impacts the overall health of children and their families. Studies show that children with chronic pain have difficulties in performing their daily activities (Hunfeld et al., 2001; Roth-Isigkeit, Thyen, Stöven, Schwarzenberger, & Schmucker, 2005), have poorer sleep quality (de la Vega & Miró, 2013), experience psychological distress (anxiety and depression) (Kashikar-Zuck et al., 2012; Kashikar-Zuck, Vaught, Goldschneider, Graham, & Miller, 2002; Rosseau-Salvador et al., 2014; Simons, Sieberg, & Claar, 2012), have problems at school (absenteeism and school functioning) (Dick & Riddell, 2010; Logan, Simons, Stein, & Chastain, 2008); and have difficulties in social relationships (Forgeron et al., 2010). Families of children with chronic pain also experience difficulties, including restrictions in social life and problems coping with their children's pain (Hunfeld et al., 2001), significant emotional distress (including anxiety, depression and parenting stress) (Eccleston, Crombez, Scotford, Clinch, & Connell, 2004; Jordan, Eccleston, & Osborn, 2007), and a worse family functioning (Lewandowski, Palermo, Stinson, Handley, & Chambers, 2010). Studies show that these families also endure a large economic burden, with work absenteeism averaging four days out of the last six (Hechler et al., 2014) or three (Ho et al., 2008) months and seven days per year (Groenewald, Essner, Wright, Fesinmeyer, & Palermo, 2014).

Some studies have estimated the total costs per year of a child with chronic pain (including direct and indirect costs) to be £8,027 (pounds sterling) (Sleed, Eccleston, Beecham, Knapp, & Jordan, 2005) or $11,787 (American dollars) (Groenewald et al., 2014).

Effective therapies such as pharmacological or psychological treatments have been introduced to manage the problem of pediatric chronic pain (Eccleston et al., 2014; Fisher et al., 2014). In fact, the interdisciplinary treatment of pain (based on the biopsychosocial model) has emerged as the most effective way of treating children and adolescents with chronic pain. This includes a team of health professionals from several disciplines (e.g. medicine, psychology, physical therapy, occupational therapy, nursing, and psychiatry) working collaboratively and sharing treatment objectives (e.g. improving patient functioning) (Odell & Logan, 2013). Some of these interdisciplinary treatments have demonstrated significant positive effects in improving functioning, psychological well-being and school attendance and reducing pain scores and disability in children and adolescents (de Blécourt, Schiphorst Preuper, Van Der Schans, Groothoff, & Reneman, 2008; Gauntlett-Gilbert, Connell, Clinch, & Mccracken, 2013; Hechler et al., 2009; Logan, Conroy, Sieberg, & Simons, 2012).

## 1.4. Cognitive factors involved in the pain experience

Psychological factors, including the behavioral, emotional and cognitive (Gatchel et al., 2007; Miró, 2003), are important interrelated elements of pain experience. In this section we concentrate on cognitive factors, since these are the main topic of this Dissertation. Specifically, we will focus on the role played by thoughts and beliefs in the experience of pain. Other cognitive factors, such as attention to pain, also have a function in the experience of pain but will not be analyzed here.

While thoughts (or cognitions) and beliefs are related, they are also different. Cognitions are automatic self-statements or images that are specific responses to an event and appear suddenly in the mind. Beliefs, on the other hand, are stable, global views about self, the world and the future (Winterowd, Gruener, & Beck, 2003). Some cognitions and beliefs are related to pain. For example, people with chronic pain usually have automatic thoughts about pain such as: "The pain has taken my life away" or "My doctor can't help me relieve my pain". Beneath these thoughts there usually lies a pain belief, i.e. a global view of pain and the effects pain has on people's lives (Winterowd et al., 2003). Thoughts and beliefs influence the way we behave and the emotions we feel, which in turn can determine the pain we experience. However, it is no less true that the emotions we feel and the behaviors we enact also influence the thoughts we have. The fear-avoidance model of pain (Vlaeyen & Linton, 2000) attempted to provide an explanation for these interactions. This model suggested that when a person suffers pain, two main reactions may be experienced. In the first one, pain is not interpreted as something threatening, does not generate pain-related fear, and leads to a confrontation with daily activities that is likely to produce a recovery.

However, pain can also be interpreted as something threatening (catastrophizing beliefs). Here, pain-related fear is activated. This in turn activates avoidance behaviors and a hypervigilance to body sensations that generate disability, depression and disuse (physical and psychological effects of inactivity, such as muscle weakness), which can increase pain experience. Figure 1 shows a schema of this model, which is supported by much evidence from studies of patients with chronic pain, studies of patients with acute pain, and studies that used structural equation models to examine associations among the constructs of the fear-avoidance model (Leeuw et al., 2007; Pincus, Smeets, Simmonds, & Sullivan, 2010; Vlaeyen & Linton, 2012). Two recent revisions of this model emphasized the importance of incorporating the idea that pain-related fear develops in the context of a person's multiple personal goals, of which pain avoidance is just one (Crombez, Eccleston, Van Damme, Vlaeyen, & Karoly, 2012; Vlaeyen & Linton, 2012).

**Figure 1. The fear avoidance model of pain**, taken from Vlaeyen and Linton, 2000, Copyright 2000 Wolters Kluwer Health, Inc. Reprinted with permission.

### 1.4.1. Pain catastrophizing

One of the main pain beliefs is catastrophizing. This has been conceptualized as "*an exaggerated 'mental set' brought to bear during actual or anticipated pain experience*" (Sullivan, Thorn, et al., 2001; p.53) or as "*the tendency to focus on pain and negatively evaluate one's ability to deal with pain*" (Keefe, Rumble, Scipio, Giordano, & Perri, 2004; p.196). In the last ten years, catastrophizing has become a major focus of interest among pain clinicians and researchers. It has been studied in the literature on adult pain, where it is found to be significantly related to the patient's experience of pain, to psychological and physical adjustment, and to response to treatments (Boothby, Thorn, Overduin, & Ward, 2004; Geisser, Robinson, Miller, & Bade, 2003; Jensen, Turner, & Romano, 2007; Keefe et al., 2004; Sullivan, Martel, Tripp, Savard, & Crombez, 2006; Sullivan, Rodgers, & Kirsch, 2001; Sullivan, Thorn, et al., 2001; Turner, Holtzman, & Mancl, 2007; Vowles, McCracken, & Eccleston, 2007).

Pain catastrophizing has also been widely studied in the field of pediatric pain. Studies with experimentally induced pain showed that catastrophizing has been positively related to pain intensity (Verhoeven, Goubert, Jaaniste, Van Ryckeghem, & Crombez, 2012; Vervoort et al., 2011), and negatively related to pain tolerance (Piira, Taplin, Goodenough, & von Baeyer, 2002), i.e. young people who reported higher catastrophizing beliefs tended to feel more pain and have less tolerance to it. Catastrophizing has also been found to moderate the association between pain intensity and facial pain expressions. For example, an experimental study showed that young people with no catastrophizing thoughts who took part in a cold pressure test showed higher pain facial expressions when reporting stronger pain intensity. However, this association did not appear in people with many catastrophizing beliefs, who showed higher facial pain expressions regardless of pain intensity compared to those with fewer such beliefs (Vervoort, Goubert, & Crombez, 2009). With regard to studies of children and adolescents with chronic pain, catastrophizing was mainly positively related to pain intensity, disability, depression and anxiety and negatively related to quality of life (Lynch-Jordan, Kashikar-Zuck, & Goldschneider, 2010; Simons & Kaczynski, 2012; Thastum, Herlin, & Zachariae, 2005). These studies demonstrate the importance of including pain catastrophizing as a key construct in the assessment of young people with chronic pain and this is critical when evaluating the efficacy of chronic pain treatments.

### 1.4.2. Other pain beliefs

Apart from pain catastrophizing, other pain beliefs have also been described and are reported to be related to changes in the experience of pain. These include beliefs that others should be solicitous in response to pain, that one is disabled when one has pain, and that one has control over pain. Some of these beliefs are adaptive and improve physical and psychological functioning (such as the belief that one is in control over pain and the belief that there is a medical cure for one’s pain problem). Others (such as catastrophic or disability beliefs) are maladaptive and maintain or worsen functioning (Jensen, Turner, & Romano, 2001).

There is much evidence that adult patients with high levels of pain-related disability believe that others should be solicitous in response to their pain (Jensen, Romano, Turner, Good, & Wald, 1999; Jensen, Turner, Romano, & Lawler, 1994; Wong, Jensen, Mak, & Fielding, 2011), that pain signals harm (Jensen et al., 1999, 1994; Jensen, Turner, & Romano, 2000; Wong et al., 2011), that pain means disability (Jensen et al., 1999, 1994; Jensen et al., 2000; Wong et al., 2011), and that they are unable to control pain (Jensen et al., 2000; Wong et al., 2011).

In the pediatric pain arena, however, there is less evidence of the association between pain beliefs and other pain-related constructs. Only a handful of studies show that pain intensity and disability are positively related to the harm belief (i.e. pain signals harm) and negatively related to the pain-control belief (Thastum et al., 2005). Indeed, low levels of pain control beliefs were found to predict high levels of schoolchildren's pain intensity after one year (Miró, Huguet, & Jensen, 2014). Children and adolescents with chronic pain who showed disability beliefs (beliefs that one is disabled when in pain) presented high levels of pain-related disability (Engel, Jensen, Ciol, & Bolen, 2012). The belief that emotions influence pain was found to predict whether a child has chronic pain (Miró et al., 2014) and was positively related to disability and pain intensity (Engel et al., 2012).

### 1.4.3. Cognitive fusion

Cognitive fusion is a cognitive concept that derives from Acceptance and Commitment Therapy (ACT), one of the "third wave" cognitive-behavioral therapies. The first wave included behavioral therapies and focused on behavioral change by modifying contingences; the second wave considered cognitive aspects as the main factors of behavior and included cognitive-behavioral therapies; the third wave, which includes therapies such as ACT, Dialectical Behavior Therapy, Mindfulness-Based Cognitive Therapy and Functional Analytic Psychotherapy, is more focused on changing the function of the symptoms by changing the context in which they appear rather than on reducing symptoms (Hayes, 2004). ACT aims to promote psychological flexibility, a global construct that includes six core processes (contact with the present moment, acceptance, cognitive defusion, self as a context, committed action, and values), which are viewed as adaptive psychological skills and are taught and encouraged in ACT. Figure 2 shows a model of these processes. According to the ACT model of psychopathology, psychological suffering is described as a psychological inflexibility that emerges through the interaction of six processes (dominance of the conceptualized past and future; experiential avoidance; cognitive fusion; attachment to the conceptualized self; lack of values/clarity; and inaction, impulsivity, or avoidant persistence) (Fletcher & Hayes, 2005; Hayes, Luoma, Bond, Masuda, & Lillis, 2006; Luoma, Hayes, & Walser, 2007). Figure 3 illustrates the ACT model of Psychopathology.

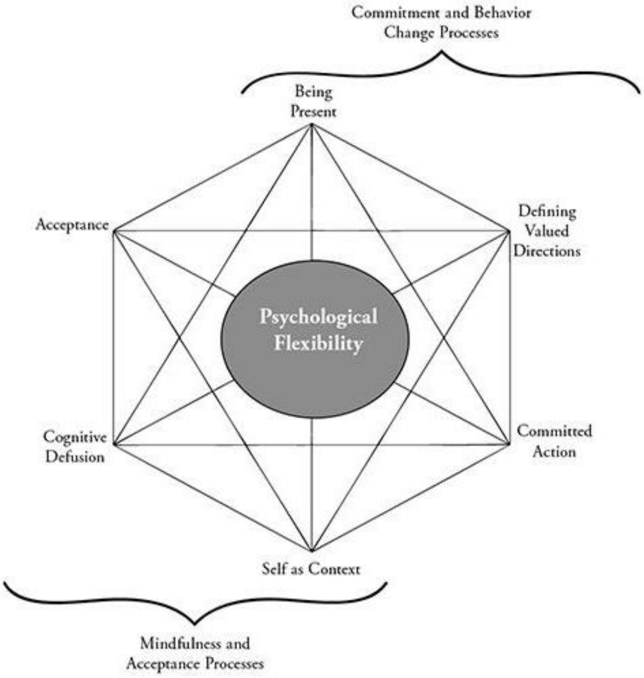

**Figure 2. Core processes of ACT**, taken from Hayes et al., 2006. Copyright 2006 Elsevier. Reprinted with permission.

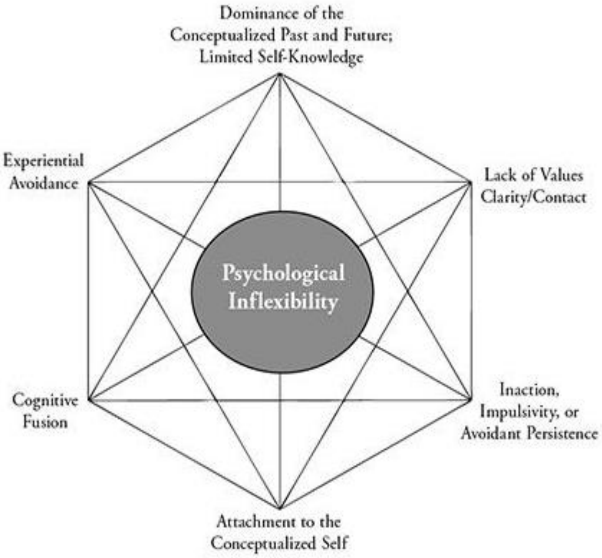

**Figure 3. ACT model of Psychopathology**, taken from Hayes et al. 2006, Copyright 2006 Elsevier. Reprinted with permission.

As we can deduce, each core ACT process counteracts one psychopathological process. Cognitive defusion (McCracken, DaSilva, Skillicorn, & Doherty, 2014) counteracts the cognitive fusion psychopathological process, which has been defined as "*. . . the tendency of human beings to be caught up in the content of what they are thinking so that it dominates over other useful sources of behavioral regulation*" (Luoma et al., 2007). A person who is cognitively fused with his/her thoughts is trapped by the meaning ascribed to cognitive events (e.g. thoughts, and images) and is more likely to react according to the content of his/her thoughts. On the other hand, a person who is defused with his/her thoughts is less likely to react under their influence.

Cognitive fusion has recently been studied in pediatric and adult populations. It is believed to play a role in pain experience and to be related to pain intensity and disability. These associations have been confirmed by studies of adult populations with chronic pain (Wicksell, Lekander, Sorjonen, & Olsson, 2010; Wicksell, Olsson, & Hayes, 2010; Wicksell, Renöfält, Olsson, Bond, & Melin, 2008) but have not yet been examined in children and adolescents with chronic pain.

## 1.5. Assessment of pain experience in children and adolescents

### 1.5.1. General assumptions

The biopsychosocial model of pain proposes to conduct an overall assessment of pain experience that includes biological, psychological and social factors (Gatchel et al., 2007). Miró (1994, 2003) suggested a multicontextual and multimethodological evaluation of patients with chronic pain that included multiple levels and units of analysis. The units of analysis are the individual, the dyad and the context. The *individual* includes characteristics of a person when evaluated as a unique subject (e.g. individual characteristics of a child in pain). The *dyad* is a macro unit of analysis based on the relationship between two individual units (e.g. the child and a person who is close to the child, such as his or her mother or a sibling). The *context* is a molar unit of analysis in which the individual, in interaction with one or more actors (additional units of analysis), is analyzed (e.g. the school or the hospital). The various levels of analysis are the *physical*, the *cognitive*, the *behavioral* and the *emotional*. The *physical* level includes variables such as pain intensity, pain location, and pain quality (e.g. pulsing, sharping, freezing or burning). The *behavioral* level involves, for example, evaluating disability (difficulties in performing certain activities) or coping strategies for dealing with pain. The *emotional* level includes assessment of anxiety or depression. The *cognitive* level evaluates aspects such as pain beliefs and attention to pain. As the central topic of this Dissertation concerns the cognitive factors involved in pain experience, I will concentrate on the assessment of the cognitive level of analysis (specifically, pain catastrophizing, pain beliefs and cognitive fusion).

### 1.5.2. Assessing pain catastrophizing, pain beliefs and cognitive fusion

- **Pain catastrophizing**

The tool most used to evaluate catastrophic thinking about pain is the **Pain Catastrophizing Scale for Children** (PCS-C; Crombez et al., 2003). This 13-item questionnaire asks respondents the extent to which they have catastrophic beliefs when they have pain using a Likert scale ranging from 0="Not at all" to 4="Extremely". The PCS-C assesses three kinds of catastrophizing beliefs: Rumination, Magnification and Helplessness. Rumination may be defined as constant worry about pain and repeated pain-related thoughts that are difficult to inhibit, such as "*I can't keep it out of my mind*" or "*I keep thinking about how much I want the pain to stop*". Magnification is the tendency to amplify the unpleasantness of pain experience and to expect negative results. Good examples of these beliefs are "*I'm afraid the pain will get worse*" or "I *wonder whether something serious may happen*". Helplessness is a negative evaluation of the ability to cope with pain (i.e. "*There is nothing I can do to reduce pain*" and "*I feel I can't go on*") (Sullivan, Bishop, & Pivik, 1995). The PCS-C scores have shown excellent reliability: Cronbach's Alpha for the total scale ranges from 0.85 to 0.90 (Crombez et al., 2003; Kröner-Herwig & Maas, 2013; Parkerson et al., 2013; Tremblay et al., 2008); and test-retest reliability is between 0.71 and 0.73 (Kröner-Herwig & Maas, 2013; Tremblay et al., 2008). Validity properties of PCS-C include significant positive associations of PCS-C reports with the following criteria: pain intensity and disability (Crombez et al., 2003; Kröner-Herwig & Maas, 2013; Pielech et al., 2014) and anxiety ratings (Pielech et al., 2014; Tremblay et al., 2008); and negative associations with cognitive and behavioral distraction coping strategies (Verhoeven et al., 2012). The PCS-C has been translated into languages such as French and German (Kröner-Herwig & Maas, 2013; Tremblay et al., 2008).

Three other tools that have been used to assess pain catastrophizing in children and adolescents are the **Pain Coping Questionnaire** (PCQ; Reid, Gilbert, & McGrath, 1998), the **Coping Strategies Questionnaire for Children** (CSQ-C; Gil, Williams, Thompson, & Kinney, 1991) and the **Pain Response Inventory** (PRI; Walker, Smith, Garber, & Van Slyke, 1997). Each measures particular pain-coping strategies but all of them include a subscale that assesses pain catastrophizing.

The **Pain Coping Questionnaire** is a 39-item self-report measure that assesses how often (1=Never, 2=Hardly ever, 3=Sometimes, 4=Often, 5=Very often) different coping strategies are used. Its factorial analysis specifies a three-factor solution (Approach, Problem-focused avoidance, and Emotional-focused avoidance) and eight subscales (Information Seeking, Problem Solving, Seeking Social Support, Positive Self-Statements, Cognitive Distraction, Behavioral Distraction, Externalizing, and Internalizing/Catastrophizing). Specifically, internalizing/ catastrophizing is a component of the emotional-focused avoidance factor and comprises five items: “Worry that I will always be in pain”, “Keep thinking about how much it hurts”, “Think that nothing helps”, “Think that the pain will never stop” and “Worry too much about it”. The PCQ can be administered to children as young as eight years old (Reid et al., 1998) and has been translated into languages such as Danish (Thastum, Zachariae, Schøler, & Herlin, 1999), Catalan (Huguet, Miró, & Nieto, 2009), and German. The German version is an abbreviated version of the PCQ, that is called the Pain-Related Cognitions Questionnaire, which includes just three subscales: Catastrophizing, Positive Self-Statements, and Problem-Solving (Hermann, Hohmeister, Zohsel, Ebinger, & Flor, 2007). The PCQ has shown excellent psychometric properties (good internal consistency and good construct and criterion validity) (Hermann et al., 2007; Huguet, Miró, et al., 2009; Reid et al., 1998; Thastum et al., 1999).

The **Coping Strategies Questionnaire for Children** (CSQ-C; Gil et al., 1993; Gil, Williams, Thompson, & Kinney, 1991; Schanberg, Keefe, Lefebvre, Kredich, & Gil, 1996; Schanberg, Lefebvre, Keefe, Kredich, & Gil, 1997) has been adapted from an adult self-report measure, the Coping Strategies Questionnaire (Rosenstiel & Keefe, 1983). It is used to measure the patient's use of different pain-coping strategies and their perception of these strategies as an effective way to control and decrease pain. The CSQ-C has 44 items and 7 subscales (6 cognitive strategies: Diverting Attention, Reinterpreting Pain Sensations, Ignoring Pain Sensations, Calming Self-Statements, Praying or Hoping, and Catastrophizing; and one behavioral strategy: Increasing Activity Level). Each item assesses how often patients use a strategy to cope with pain on a 7-point scale (0=Never, 1=Almost never, 2=Once a while, 3=Sometimes, 4=A lot of times, 5=Almost always, 6=Always). Respondents also rate the efficacy of their coping strategies, indicating: 1) how much control they have over pain (0=no control, 1=almost no control, 2= little control, 3=some control, 4=a lot of control, 5=almost complete control, 6= complete control), and 2) how much they are able to decrease pain (0= can't decrease it at all, 1=can't decrease it much, 2= can decrease it a little, 3= can decrease it somewhat, 4= can decrease it a lot, 5= can decrease it almost completely, 6= can decrease it completely). The reliability and validity of the scores for the children's version are documented in patients with pain and sickle cell disease (Gil et al., 1993, 1991), juvenile primary fibromyalgia syndrome (Schanberg et al., 1996), and juvenile chronic arthritis (Schanberg et al., 1997).

Finally, the **Pain Response Inventory** (PRI; Walker, Smith, Garber, & Van Slyke, 1997) is a 60-item scale for assessing children's coping responses to recurrent pain. A factor analysis identified 13 subscales: 1) Problem Solving, 2) Social Support, 3) Rest, 4) Massage/Guard, 5) condition-specific, 6) Catastrophizing, 7) Self-isolation, 8) Disengagement, 9) Stoicism, 10) Acceptance, 11) Minimizing Pain, 12) Self-encouragement, 13) Distract/Ignore. These are included in three higher-order factors (active, passive, and accommodative coping). Study of the psychometric properties showed that the scores obtained with this measure are reliable and valid for schoolchildren and chronic abdominal patients (Claar, Baber, Simons, Logan, & Walker, 2008; Walker et al., 1997).

- **Other pain beliefs**

One of the most important measures for assessing a variety of pain beliefs is the **Survey of Pain Attitudes** (SOPA) (Jensen, Karoly, & Huger, 1987). A pediatric version of this measure has been developed: the Pediatric Survey of Pain Attitudes (Peds-SOPA) (Engel et al., 2012). This questionnaire assesses seven pain-related beliefs: Control (the belief that one has control over pain); Medical Cure (the belief that a medical cure for the pain problem is feasible /possible); Solicitude (the belief that others should be solicitous when one is in pain); Medication (the belief that medication is an important treatment for pain); Emotion (the belief that emotions impact on pain); Exercise (the belief that physical exercise is good for pain); and Disability (the belief that one is disabled when one has pain). The scores obtained with this scale has been shown to be reliable and valid for assessing young people's pain beliefs (Engel et al., 2012). Children were asked to respond to the questionnaire items by indicating how much they agreed with the belief statements on a three-point Likert scale (0 = I do not agree with this, 1 = I am not sure, 2 = I agree with this). To obtain a score for each Peds-SOPA scale, the ratings of the items within each scale were averaged after reversing the score of a few items. A high score on a scale means a high level of pain belief.

The Peds-SOPA has been validated for use with young Catalan-speaking patients (Miró et al., 2014). The Catalan version showed good results in terms of, for example, the satisfactory internal consistency indices of most scales and the replication of the factor structure of the original Peds-SOPA. However, it also showed several weaknesses: for example, the low reliability coefficients of two scales (Control and Disability), which fell below the standard cut-off deemed necessary for adequate internal consistency (0.70) (Nunnally, 1994). Another weakness is that previous factor analyses of the measure did not consider that the item responses using three-point scales should have been treated as categorical data for analyses (Brown, 2006).

- **Cognitive fusion**

Few measures have been developed to assess cognitive fusion. In fact, we found only one questionnaire specifically for adolescents: the **Avoidance and Fusion Questionnaire for Youth** (AFQ-Y). AFQ-Y is a 17-item questionnaire that evaluates psychological inflexibility and asks respondents to rate how true each item is for them on a five-point scale (from 0=Not at all true to 4= Very true). A short form of the AFQ-Y (AFQ-Y8), with eight items, also exists. Both forms have shown suitable psychometric properties (e.g. reliability, construct and convergent validity) (Greco, Lambert, & Baer, 2008). However, this questionnaire includes items about both constructs (behavioral avoidance and cognitive fusion), which makes it difficult to measure either of them separately. If we look at the adult alternatives for measuring cognitive fusion, several options emerge:

the **Cognitive Fusion Questionnaire** (CFQ; Gillanders et al., 2014); the **Drexel Defusion Scale** (DDS; Forman et al., 2012); the **Psychological Inflexibility in Pain Scale** (PIPS, Cognitive Fusion Subscale; Wicksell, Lekander, Sorjonen, & Olsson, 2010; Wicksell, Renöfält, Olsson, Bond, & Melin, 2008); and the **Believability of Anxious Feelings and Thoughts Questionnaire** (BAFT; Herzberg et al., 2012). However, these measures have several limitations: the DDS evaluates cognitive defusion, which is the opposite process to cognitive fusion; the PIPS includes two subscales (avoidance and cognitive fusion) and is therefore not a measure of fusion alone; and the BAFT was constructed especially for people with anxiety disorders. The CFQ therefore emerged as a good alternative since its items are clear and comprehensive and it evaluates only cognitive fusion. It is a seven-item scale created to evaluate the level of cognitive fusion with a 1–7 Likert scale (1 = Never true to 7 = Always true) in adult populations. Higher scores indicate higher levels of cognitive fusion. Possible scores range from 7 to 49. Several studies in adult populations support its reliability and validity, including an internal consistency coefficient (Cronbach's Alfa) ranging from .88 to .93, a 1-month test-retest stability of .80, and significant associations with measures of related constructs (Gillanders et al., 2014).

### 1.5.3. Desirable psychometric properties of a questionnaire

As this Dissertation explores the psychometric properties of three questionnaires, we would like to make a brief introduction with regard to these properties. A questionnaire must have certain psychometric properties in order for it to be accepted as a sound measure of a construct. According to the Standards of the American Educational Research Association, the American Psychological Association, and the National Council of Measurement in Education (AERA, APA, & NCME, 2014), the scores of a scale must be reliable and valid. **Reliability** means that the measurements of individuals in different situations (e.g. different observers or different occasions) produce the same results. There are several ways of assessing reliability, the most common of which involve exploring **internal consistency** or **stability**. When **internal consistency** is examined**,** the correlations of the scores of all scale items are averaged. To obtain these correlations, methods such as Cronbach's Alpha, Kuder-Richardson and Split Halves may be used. Obtaining the **stability** of a scale involves assessing the degree of replicability of a measure used on different occasions. Methods that can be used for this include inter-observer reliability (the degree of agreement between different observers), intra-observer reliability (the agreement of the observations made by the same observer on two different occasions), and test-retest reliability (the agreement of observations on the same persons on two different occasions, e.g. one in February and the other in April) (Streiner, 2008). The reliability coefficients range from 0 to 1, where 0 signifies no precision of the scale and 1 signifies maximum precision. A cutoff point of 0.70 is established to consider that a scale is precise enough (Cronbach, 1990).

Validity implies that the scale measures what it is supposed to measure. Three of the main indicators of validity described by the

Standards (AERA et al., 2014) are based on: 1) **test content**, 2) **internal structure**, and 3) **relations to other variables**. Evidence based on **test content** involves comparing the content of the test and the construct it is intended to measure. One example of this is expert judgments, whereby a panel of experts in the construct assesses the accuracy of the items of a scale assessing this construct on a scale from 0 to 10. Evidence based on **internal structure** involves exploring associations between the test items and investigates whether these items can be grouped by components that are relevant for the construct that is intended to be studied. Evidence based on **relations with other variables** involves examining the correlation of one scale to another scale that assesses the same as that which we intend to measure (convergent validity) or a related construct (criterion validity). The correlation between two scales may not exist or may be weak. This would indicate that the scales measure different constructs and would be an indicator of discriminant validity.

# 2. OBJECTIVES

In this Dissertation we study specific cognitive aspects related to pain: pain catastrophizing, pain-related beliefs, and cognitive fusion.

**Objective 1.**

To study the psychometric properties of the Pain Catastrophizing Scale. Specifically, to explore the factor model of the questionnaire, its internal consistency, and its convergent, discriminant and criterion-related validity.

**Objective 2.**

To explore the psychometric characteristics of a revised version of the Pediatric Survey of Pain Attitudes.

**Objective 3.**

To evaluate the psychometric properties of the Cognitive Fusion Questionnaire when used with adolescents.

**Objective 4.**

To study the relationship between cognitive fusion and pain intensity, disability and catastrophizing, and to evaluate the role of cognitive fusion as a mediator between catastrophizing and disability.

# 3. METHODS

This Dissertation includes four articles, three of which examine the psychometric properties of three questionnaires (Study I: PCS-C, Study II: Peds-SOPA-R, and Study III: CFQ), and one of which (Study IV) explores the relationship between cognitive fusion and certain pain-related variables. Each article contains a detailed description of the methods used in these studies. This section provides a summary of those methods.

### 3.1. Participants

The participants in the studies contained in this Dissertation were recruited from 11 secondary schools from the province of Tarragona in the south–east of Catalonia, Spain. All the participants were aged between 11 and 20. In study I, the properties of PCS-C were examined in a sample of 316 adolescents with a mean age of 14.5 years (SD=1.57), 58% of whom were girls/young women. Study II comprised 308 adolescents with an average age of 14.35 (SD=1.62), 59% of whom were girls/young women. Study III, which evaluated the psychometric characteristics of the CFQ, included 308 adolescents with a mean age of 14.42 years (SD=1.66), 59% of whom were girls/young women. Finally, Study IV, which explored the association between cognitive fusion and specific pain-related variables, comprised 281 adolescents with an average age of 14.44 (SD=1.69), most of whom were girls/young women (61%).

To be included in these studies, potential participants had to be: 1) able to read, write and speak in Catalan; and 2) aged between 11 and 20 years old. They were excluded if they had any intellectual disability that prevented them from performing the tasks involved in the study.

### 3.2. Procedure

The same procedure was followed to collect the samples for all these studies. First, 21 secondary schools were invited to participate. Ten of these declined the invitation either because they were involved in another study at the time or were too busy to participate. Second, letters with information about the studies were delivered to the children and their parents to ask them to participate. Third, one of the parents provided informed consent to allow their child to participate or the adolescents consented themselves if they were 18 years of age or over. Fourth, candidates who agreed to take part in each study completed an assessment form during school time.

In Studies I-III, the following psychometric properties of the three questionnaires were analyzed: internal consistency, internal structure (using confirmatory factor analysis), and criteria-related validity. In Study I, we also explored the convergent and discriminant value of the questionnaire scores. Since two of these questionnaires were only available in English (PCS-C and CFQ, in studies I and III, respectively), a back-translation procedure as described by Miró (1997) was conducted to translate these two questionnaires into Catalan in order to preserve the denotation and connotation of the item content. This procedure comprised three steps: 1) two bilingual individuals (Catalan and English) translated the questionnaire into Catalan; 2) a professional translator back-translated the Catalan versions into English; 3) those back-translated versions were sent to one of the original developers of the scales to obtain their feedback (i.e. whether the items were faithful to the meaning of the original items). The Peds-SOPA-R (Study II) is a modified version of the Peds-SOPA, which had already been translated and validated into Catalan by Miró and colleagues (Miró et al., 2014). A complete description of the procedure used to develop the Peds-SOPA-R and the modifications implemented is provided in the article included in this dissertation (see Study III).

Study IV explored the associations between cognitive fusion and pain intensity, disability and catastrophizing using correlation coefficients and tested the role of cognitive function as a mediator between catastrophizing and disability using a series of multiple regression analyses.

### 3.3. Measures

All these measures have been described in the introduction to this Dissertation or are detailed in the Method section of each paper. For this reason, they are mentioned only briefly in this section.

Several socio-demographic measures (age, sex and school grade) were collected in all studies. The cognitive factors related to pain were measured using the following questionnaires: pain catastrophizing assessed by the PCS-C (Crombez et al., 2003); pain beliefs assessed by the Peds-SOPA (Engel et al., 2012); and cognitive fusion assessed by the CFQ (Gillanders et al., 2014).

Pain-related domains were assessed as follows. The most frequent pain in the previous three months was recorded (assessed by the question: "*Which is the most frequent pain of those that you have experienced during the last 3 months*?"). Pain intensity was assessed using a Numerical Rating Scale (NRS-11; Miró, Castarlenas, & Huguet, 2009). Pain location was recorded using a pain drawing that divided the body into 21 areas (von Baeyer, Lin, Seidman, Tsao, & Zeltzer, 2011). Other pain–related variables were also included. For example, disability was evaluated by the Functional Disability Inventory (FDI; Walker & Greene, 1991), and pain-coping strategies were evaluated by the Pain Coping Questionnaire (PCQ; Reid, Gilbert, & McGrath, 1998).

Anxiety sensitivity was measured by the Childhood Anxiety Sensitivity Index (CASI; Silverman, 1999), while acceptance was assessed by the Mindful Acceptance scale of the Philadelphia Mindfulness Scale (PHMS; Cardaciotto, Herbert, Forman, Moitra, & Farrow, 2008). Table 1 shows a schema of the measures included in each study.

**Table 1. Summary of measures included in each study.**

| | Study I | Study II | Study III | Study IV |
|---|---|---|---|---|
| **Socio-demographic variables** | Sex, age and school grade | | | |
| **Cognitive factors** | PCS-C | Peds-SOPA | CFQ | PCS-C<br>CFQ |
| **Pain domains** | NRS-11<br>Pain drawing | NRS-11<br>Pain drawing | | NRS-11<br>Pain drawing |
| **Pain-related variables** | FDI<br>PCQ | FDI | | FDI |
| **Other variables** | CASI | | CASI<br>Mindful Acceptance scale of the PHMS | |

# 4. RESULTS

- **Study I**

  Solé, E., Castarlenas, E. & Miró, J. Cross cultural adaptation and validation of the Pain Catastrophizing Scale for Children. *Under review.*

- **Study II**

  Miró, J., Solé, E., Castarlenas, E., &. Jensen M.P. The Survey of Pain Attitudes: a revised version of its pediatric form. *Under review.*

- **Study III**

  Solé, E., Racine, M., Castarlenas, E., de la Vega, R., Tomé-Pires, C., Jensen, M.P., & Miró, J. (2015). The psychometric properties of the Cognitive Fusion Questionnaire in adolescents. *European Journal of Psychological Assessment.*

- **Study IV**

  Solé, E., Tomé-Pires C., de la Vega R., Racine M., Castarlenas E., Jensen M.P. & Miró J. (2015). Cognitive Fusion and Pain Experience in Young People. *Clinical Journal of Pain.*

# 4.1. Study I

# Cross Cultural Adaptation and Validation of the Pain Catastrophizing Scale for Children

# Cross cultural adaptation and validation of the Pain Catastrophizing Scale for Children

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**Running head:** The Pain Catastrophizing Scale for children

**Category:** Research on Translations of Tests

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**Conflicts of interest:** nothing to be reported

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## Author contributions

All authors reviewed and provided comments on drafts and subsequent revisions of this article, and approved the final version for submission and publication. ES and JM participated in the design of the procedure and analyses. ES conducted the statistical analyses. ES prepared the first draft of the manuscript. All authors provided input into the data analysis plan and feedback on multiple drafts of the manuscript.

## ABSTRACT

Pain catastrophizing is a key factor in modern conceptualizations of pain. The development of the Pain catastrophizing Scale for Children (PCS-C) has greatly contributed to the interest shown by pediatric pain specialists. The purpose of this work was to study the factor structure of the Pain Catastrophizing Scale (PCS), and analyze its reliability and convergent, discriminant, and criteria related validity.

Three hundred and sixteen adolescents (12–19 years) completed the Catalan version of the PCS-C and provided information about pain intensity. A subgroup of 136 participants also completed measures of disability, anxiety sensitivity and pain coping strategies. The results confirmed the 3-factor model solution for the PCS-C, and demonstrated good internal consistency for the total Catastrophizing scale (0.89) and for the Rumination (0.80) and Helplessness (0.82) subscales. Internal consistency for the Magnification subscale, however, was not quite as good (0.63).This 3-factor model could be improved by removing item 8 and developing additional items for the Rumination subscale. The results also provide evidence of the convergent, discriminant and criterion-related validity of the PCS-C scores when used with Catalan-speaking adolescents. Our data demonstrate that the PCS-C is a psychometrically sound questionnaire that provides valid and reliable scores when used to assess pain catastrophizing in adolescents.

**Keywords:** pain catastrophizing; PCS-C; assessment; adolescents

## INTRODUCTION

In the past ten years, catastrophizing has become a major focus of interest in the study and treatment of pain. Pain catastrophizing has been conceptualized *as "an exaggerated negative 'mental set' brought to bear during actual or anticipated pain experience"* (Sullivan et al., 2001 a; p.53). It has been found to be a key factor in current models on the functioning of people with chronic pain (e.g., fear avoidance model; (Leeuw et al., 2007)) and an important outcome for chronic pain programs (Wertli et al., 2014).This interest in pain catastrophizing has also been taken up in the arena of pediatric pain, and the number of studies published on the subject has increased steadily since the development of a pediatric version of one of the most used scales for measuring catastrophic thinking about pain, the Pain Catastrophizing Scale (Sullivan et al., 1995).

The Pain Catastrophizing Scale for children (PCS-C; Crombez et al., 2003) has shown excellent psychometric properties. For example, the PCS-C has shown good-to-excellent reliability coefficients, Cronbach's Alpha for the total scale ranges from 0.85 to 0.90 (Crombez et al., 2003; Kröner-Herwig & Maas, 2013; Parkerson et al., 2013; Tremblay et al., 2008), and test-retest reliability properties are between 0.71 and 0.73 (Kröner-Herwig & Maas, 2013; Tremblay et al., 2008). Criterion validity has been supported by significant positive associations of PCS-C reports with pain intensity and disability (Crombez et al., 2003; Kröner-Herwig & Maas, 2013; Pielech et al., 2014), and anxiety ratings (Pielech et al., 2014; Tremblay et al., 2008).Significant negative associations have also been reported between catastrophizing, and cognitive and behavioral distraction coping strategies (Verhoeven, Goubert, Jaaniste, Van Ryckeghem, & Crombez, 2012). Nevertheless, the debate is still on about what the best structure of the PCS-C is. Although a first-order factor (Catastrophizing) with 3 second-order factors (Rumination, Magnification, Helplessness) was described in the original study (Crombez et al., 2003), recent studies have suggested an alternative, better fit for just one factor (Kröner-Herwig & Maas, 2013; Pielech et al., 2014). The best item content is also under scrutiny, and recent suggestions have been made to delete certain items to improve the questionnaire's goodness of fit (Parkerson et al., 2013; Pielech et al., 2014).

The main purpose of this study was to test the PCS-C's factor model, its internal consistency, and its convergent, discriminant and criterion-related validity. If it is reliable, we hypothesized that the PCS-C total scale and its subscale scores would show a Cronbach's Alpha of at least 0.70 (Cronbach, 1990). Further, if it is valid, we anticipated that the scores on the PCS-C would be positively associated with pain intensity, disability and anxiety sensitivity, and negatively with cognitive and behavioral distraction pain coping strategies (criterion validity).We hypothesized that seeking social support and positive self-statements would be different constructs from catastrophizing and would support discriminant validity, whereas the internalizing/catastrophizing coping strategy would measure the same construct as PCS-C and positive associations would be evidence of convergent validity.

## METHODS

### Participants

The study used a convenience sample recruited from five secondary schools in the province of Tarragona, a region in the south-east of Catalonia. The following criteria were applied for students to be included in the study: (1) they had to be able to read, write and speak Catalan, and (2) they had to be between 12 and 19years old. Participants were excluded if they had an intellectual disability that interfered with their participation in the study procedures.

## Measures

### Socio-demographic/descriptive information

All participants were requested to provide information about their age, sex and school grade. They also provided information about the most frequent pain during the previous three months, specifically about its location, frequency and intensity.

### Pain catastrophizing

Pain catastrophizing was assessed with the child version of the 13-item Pain Catastrophizing Scale (PCS-C) (Crombez et al., 2003) which requires respondents to indicate the extent to which they have catastrophic beliefs when they are in pain on a 0 = “Not at all” to 4 = “Extremely” scale. The PCS-C assesses three catastrophizing domains: rumination (i.e. *“I cannot keep it out of my mind”)*, magnification (i.e.*“I am afraid that pain will get worse”)* and helplessness (i.e.*“There is nothing I can do to reduce pain”*) (Parkerson et al., 2013). Higher scores indicate more frequent catastrophic pain beliefs (scores range from 0 to 52). The English version of the PCS-C has proved to be reliable and valid in community and clinical samples of children and adolescents (Crombez et al., 2003; Parkerson et al., 2013).

### Language translation

The PCS-C was translated into Catalan using the back-translation procedure described by Miró (1997). Two bilingual psychologists (Catalan and English) translated the PCS-C items into Catalan. The instructions were modified and respondents were asked for the frequency of their beliefs not their intensity because frequency was more understandable in Catalan (i.e., 0= “Never”, 1= “Rarely”, 2= “Sometimes”, 3= “Often”, and 4=“Always”). Next, a professional translator, who was not familiar with the original version of the PCS-C, back-translated the Catalan version into English. In the third step, the English back-translated version was sent to one of the scale developers to determine if the items were faithful to the meaning of the original items. This procedure has been described in detail elsewhere (see Huguet et al., 2009; Miró et al., 2008).

### Pain intensity

Participants were asked to rate the most intense pain they could remember in the previous three months for their most frequent pain problem using the 0 – 10 Numerical Rating Scale (NRS-11) where 0 means “No Pain” and 10 “Very much pain”. This scale has proved its reliability and validity when used to report pain intensity in children as young as 6 years old (Castarlenas, Miró and Sánchez-Rodríguez, 2013; Miró, Castarlenas and Huguet, 2009; Sánchez-Rodríguez, Miró and Castarlenas, 2012). Pain was conceptualized as chronic if it had lasted for at least three months (Elliott, Smith, Penny, Smith, & Chambers, 1999; Perquin et al., 2000) and appeared at least once a month. This procedure has been successfully used in previous studies (e.g., Huguet and Miró, 2008; Mikkelsson, Salminen and Kautiainen, 1997).

**Disability**

The 15-item Functional Disability Inventory (FDI) (Walker & Greene, 1991) was used to assess the impact of illness on children's everyday physical and psychosocial functioning over the previous two weeks. The FDI informs whether respondents have trouble with15 activities on a 0 = "No trouble" to 4 = "Impossible" Likert scale. Higher scores indicate greater disability (range 0 to 60) (Claar & Walker, 2006; Walker & Greene, 1991). Its psychometric properties (reliability, validity and clinical utility) were found to be suitable when it was used by young people (Claar & Walker, 2006; Kashikar-Zuck et al., 2011; Walker & Greene, 1991) and it has been used with a wide range of chronic pain-related conditions such as back pain, fatigue syndrome, fibromyalgia and arthritis (Garralda & Rangel, 2004; Kashikar-Zuck, Vaught, Goldschneider, Graham, & Miller, 2002; Lynch, Kashikar-Zuck, Goldschneider, & Jones, 2006; Peterson & Palermo, 2004; Graham J Reid, McGrath, & Lang, 2005). The Catalan version of the FDI has also shown good psychometric properties (Solé, Huguet, & Miró, 2010). Moreover, the reports provided with the questionnaire in this study showed excellent reliability (Cronbach's alpha = 0.89).

**Anxiety sensitivity**

Anxiety sensitivity was assessed by the 18-item Childhood Anxiety Sensitivity Index (CASI) (Silverman, Fleisig, Rabian and Peterson, 1991). Respondents indicate the extent to which they agree with each item using a 3-point Likert scale with 1 = "None" and 3 = "A lot". The total score ranges from 18 to 54 and higher scores indicate a greater fear of experiencing anxiety symptoms. There is a considerable amount of evidence to suggest that CASI is both reliable and valid (e.g., Chorpita and Daleiden, 2000; Sandín, Chorot, Santed and Valiente, 2002; Silverman, 1999). We used the Catalan version of the CASI (C-CASI; Fullana et al., 2003), but adapted it to better reflect our participants use of Catalan. The original version was available only in a dialectal form (i.e., Majorcan) so it had to be adapted so that it could be properly understood by our participants. The C-CASI has also shown good psychometric properties (Fullana et al., 2003). In the current sample, Cronbach's coefficient alpha for C-CASI is 0.81.

## Pain coping strategies

The 39-item Pain Coping Questionnaire (PCQ) (G J Reid, Gilbert, & McGrath, 1998) was used to measure pain coping strategies in our sample. Respondents indicate the frequency with which they use each coping response on a 1 ("Never") to 5 ("Very often") Likert scale. A higher score indicates more frequent use of a strategy. We used the Catalan version of the PCQ (Huguet et al., 2009), which has 36 items. And for the purposes of this study, we used the Internalizing/Catastrophizing, Positive Self-Statements, Seeking Social Support, Behavioral Distraction and Cognitive Distraction PCQ subscales. Both the original and the Catalan versions have proved to provide reliable (good internal consistency) and valid (construct and criterion validity) scores (Huguet et al., 2009; G J Reid et al., 1998) in samples of children and adolescents. In our sample, the reliability of the PCQ scales scores ranged from good to excellent (Cronbach's alphas = 0.78 to 0.93).

## Procedure

Six hundred and thirty-three letters were delivered to the children and parents of the five participating schools requesting their participation in the study. Either one of the parents could provide consent to allow his/her child to participate. In 33% of cases (n=210) the informed consent was not returned and 11% (n=69) declined to participate. Participants who were 18 years old or older provided their own informed consent. Three hundred and fifty-four adolescents whose parents had agreed that they could participate or who consented by themselves to participate completed the assessment forms in one hour during school time following the instructions provided by research staff. Of these, 316 answered the PCS-C and provided demographic and pain information. Responses to all questionnaires are only available from 136 participants because two of the participating schools had less time available than initially thought and the assessment form had to be reduced to fit their schedule.

## Statistical analyses

Cronbach's Alpha coefficient was computed to evaluate the internal consistency of the questionnaire and a confirmatory factor analysis (CFA) was performed to evaluate the PCS-C's factor structure. We also tested whether the data could be factorized by examining the skewness and kurtosis of each item's distribution and using the Kaiser-Meyer-Olkin test (KMO)(Kaiser, 1970) and Bartlett's statistic (Bartlett, 1950). The factor extraction method selected was Maximum likelihood (ML) (Brown, 2006) and the Chi-square ( $\chi^2$ ), Comparative Fit Index (CFI), Root-Mean-Square Error of Approximation (RMSEA), and Standardized Root Mean Residual (SRMR) were used to evaluate the goodness of fit of the solution. As described in the guidelines published by the *European Journal of Psychological Assessment* (Schweizer, 2010), CFI values should range from 0.95 to 1.00 if the model of fit is good, and between 0.90 and0.95 if the level of fit is acceptable. RMSEA values below 0.05 show a good model of fit and below 0.08 an acceptable model of fit. SRMR should be kept below 0.10. Then, we compared the $\chi^2$ of each two pairs of models because the models explored were nested. We also evaluated the validity of the PCS-C by assessing the convergent, discriminant and criterion validity. As far as the convergent validity was concerned, a correlation between PCS-C and the Catastrophizing/Internalizing subscale of the PCQ was performed and this correlation had to be equal to or greater than 0.3 - 0.5 (Streiner & Norman, 2005).The discriminant validity was examined by using Fisher's z-transformation to compare the magnitude of the correlation coefficient between scores on the PCS-C and the PCQ catastrophizing/internalizing subscale with the magnitude of the correlation coefficient between scores on the PCS-C and the PCQ Positive Self Statements subscale and also between the PCS-C scores and the PCQ Seeking Social Support subscale scores. Finally, we evaluated the PCS-C's concurrent criterion validity by computing Pearson's correlations between the scores on the PCS-C scale, and the scores on measures of anxiety sensitivity, maximum pain intensity and disability. All analyses were computed using SPSS 17.0 (IBM, http://www-01.ibm.com/software/analytics/spss/) apart from skewness, kurtosis, KMO and Bartlett's statistics, which were evaluated using Factor 8.1. (http://psico.fcep.urv.es/utilitats/factor/), and CFA, which was evaluated using Mplus 5.1. (http://www.statmodel.com/).

## RESULTS

### Sample characteristics

Participants had an average age of 14.50 years (SD = 1.57, range = 12 to 19 years) and 58% were girls/young women. The most frequent pain locations were head (26%), abdomen (15%) and knee (15%). Ninety per cent of the sample had experienced pain in the previous3 months and, of these, 32% fulfilled criteria for chronic pain. Table 1 provides the relevant information about the participating sample.

## Table 1. Sample characteristics (N=316)

| | | |
|---|---|---|
| Sex (N, %) | | |
| Girls/Young women | 184 | 58 |
| Age[a] (Mean, SD) | 14.50 | 1.57 |
| Pain problems in the previous 3 months (N, %) | 287 | 91 |
| 287 experienced pain in the previous 3 months | | |
| Chronic pain (N, %) | 102 | 32 |
| Maximum intensity of the most frequent pain[b] (N=282) (Mean, SD) | 7.32 | 1.79 |
| Localization of the most frequent pain[c] (N=274) (N, %) | | |
| Head (exclude face) | 74 | 26 |
| Abdomen | 43 | 15 |
| Knee | 33 | 12 |
| Mid-back | 19 | 7 |
| Shoulder | 15 | 5 |
| Foot | 15 | 5 |
| Throat/neck | 11 | 4 |
| Ankle | 11 | 4 |
| Calf | 8 | 3 |
| Upper Back | 8 | 3 |
| Thigh | 7 | 2 |
| Wrist | 5 | 2 |
| Hand | 5 | 2 |
| Hip | 5 | 2 |
| Chest | 4 | 1 |
| Groin/pubic area | 4 | 1 |
| Low back | 4 | 1 |
| Face/jaw/temple | 2 | 1 |
| Elbow | 1 | 0 |
| Forearm | 0 | 0 |
| Upper arm | 0 | 0 |

[a] Information missing in 1 case
[b] Information missing in 5 cases of the 287 who experienced pain in the previous 3 months.
[c] Information missing in 13 cases of the 287 who experienced pain in the previous 3 months.

### Factor structure

Histograms and measures of skewness and kurtosis showed that the distributions of the 13 PCS-C items were normal (skewness from -0.56 to 1.13 and kurtosis from -1.27 to 0.32). Data was suitable for factor analysis since the KMO was 0.90 and the significant Bartlett's test of sphericity was $\chi^2$ =1558.3, df = 78, p <0.0001.

Four models reported in previous studies were examined: 1) the 13-item oblique 3-factor model suggested by the original authors of the PCS-C (Crombez et al., 2003); 2) the 11-item oblique 3-factor model suggested by (Parkerson et al., 2013); 3) the 11-item 1-factor model; 4) the 13-item 2-factor model proposed by (Pielech et al., 2014). A new additional fifth model was also explored: the 12-item oblique 3-factor model (without item 8).This model was the same as model 1 but without item 8, and we decided to test it after previous studies (Parkerson et al., 2013; Pielech et al., 2014) had recommended deleting item 8.

Models 1, 2 and 5 showed an acceptable data fit (see Table 2 for a detailed description of the results from the CFAs). Factor loadings for models 1, 2 and 5 are presented in Table 3. When we compared these three nested models we found that Model 2 ($\Delta\chi^2(21)=59.18$, $p<0.001$) and Model 5 ($\Delta\chi^2(11)=35.63$, $p<0.001$) show a significantly better fit to the data than Model 1. However, there were no significant differences between Models 2 and 5 ($\Delta\chi^2(10)=23.55$, $p>0.001$).

## Table 2. Results of CFAs

| Model | $X^2$ (df) | CFI | RMSEA | RMSEA CI | SRMR |
|---|---|---|---|---|---|
| 1. Original 13-item oblique 3-factor model | 186.91(62) | 0.92 | 0.080 | 0.067- 0.093 | 0.045 |
| 2. Oblique 3-factor model (without items 8 and 12) | 127.73(41) | 0.93 | 0.082 | 0.066 - 0.098 | 0.042 |
| 3. 1-factor model (without items 7 and 8) | 197.63(44) | 0.88 | 0.105 | 0.090 - 0.120 | 0.052 |
| 4.Oblique 2-factor model | 221.66(64) | 0.90 | 0.088 | 0.076 - 0.101 | 0.050 |
| 5. Oblique 3-factor model (without item 8) | 151.28(51) | 0.93 | 0.079 | 0.065 - 0.094 | 0.043 |

## Table 3. Factor loadings for Model 1, 2 and 5

| | 1) Original 13-item oblique 3-factor model | | | 2) Oblique 3-factor model (without items 8 and 12) | | | 5) Oblique 3-factor model (without item 8) | | |
|---|---|---|---|---|---|---|---|---|---|
| Items | Rum | Mag | Help | Rum | Mag | Help | Rum | Mag | Help |
| 8 | 0.65 | | | | | | | | |
| 9 | 0.70 | | | 0.73 | | | 0.72 | | |
| 10 | 0.73 | | | 0.77 | | | 0.77 | | |
| 11 | 0.75 | | | 0.71 | | | 0.71 | | |
| 6 | | 0.77 | | | 0.77 | | | 0.76 | |
| 7 | | 0.43 | | | 0.43 | | | 0.43 | |
| 13 | | 0.61 | | | 0.62 | | | 0.63 | |
| 1 | | | 0.59 | | | 0.60 | | | 0.59 |
| 2 | | | 0.63 | | | 0.64 | | | 0.63 |
| 3 | | | 0.69 | | | 0.69 | | | 0.69 |
| 4 | | | 0.72 | | | 0.71 | | | 0.72 |
| 5 | | | 0.77 | | | 0.77 | | | 0.76 |
| 12 | | | 0.56 | | | | | | 0.56 |

Rum = Rumination, Mag = Magnification, Help =Helplessness

### Reliability: internal consistency

When the analyses were conducted using the factor structure suggested by the original authors of the questionnaire, the results for internal consistency were similar; namely, a Cronbach’s Alpha of 0.89 for the total Catastrophizing scale, with 0.80 and 0.82 for the Rumination and the Helplessness subscales, respectively. However, the Magnification subscale is much lower and has a Cronbach’s Alpha of 0.63. When item 8 is removed from the analysis, Cronbach’s Alpha for both the total scale (0.88) and the Rumination subscale (0.77) decreases slightly in comparison to the original version. Similarly, if item 12 is removed, then Cronbach’s Alpha for the total scale (0.88) and the Helplessness subscale (0.81) also decrease somewhat. Finally, when items 8 and 12 are removed from the analysis, the reliability of the total scale is 0.87, which again is a little bit lower than when all items are included.

### Validity (includes a subgroup of the sample N=136)

Validity analyses were conducted on the information provided by a subgroup of 136 participants (see above). The PCS-C total score was positively correlated with the score on the Internalizing/Catastrophizing coping scale (r=0.76) indicating a good level of convergent validity.

The discriminant validity of the PCS-C scores was demonstrated since the magnitude of the correlation coefficient between ratings on the PCS-C total scores and the internalizing/catastrophizing coping strategy scores was greater than the magnitude of two correlation coefficients: 1) the correlation of the PCS-C total score with the scores on the positive self-statements coping ($r = 0.14$, $p > 0.05$)($z = 6.31$, $p < 0.0001$), and 2) the correlation of the PCS-C total score with the score on the seeking social support coping($r= 0.26$, $p<0.01$) ($z = 5.61$, $p < 0.001$).

As hypothesized, criterion validity was supported by significant positive correlations between scores on the PCS-C and anxiety sensitivity ($r=0.59$ $p<0.001$), disability ($r=0.40$, $p<0.001$) and pain intensity ($r=0.33$, $p<0.001$), and also, by significant negative correlations between scores on the PCS-C and behavioral distraction coping ($r=-0.37$, $p<0.001$) and cognitive distraction coping ($r=-0.47$, $p<0.001$). The correlations with the PCS-C subscales followed the same pattern as for the total PCS-C total scale (see Table 4).

### Table 4. Convergent, discriminant and criterion validity (N=136)

| | | |
|---|---|---|
| Convergent validity (correlation between scores on the PCS-C and a variable that assesses the same construct) | | |
| Internalizing/Catastrophizing pain coping strategy (N=108) | r=0.76** | |
| Discriminant validity r (PCS-C x catastrophizing/internalizing coping) in comparison with r (positive self-statements x PCS-C) and r (PCS-C x seeking social support) | | |
| Positive self-statements (N=108) | r=0.14 | z = 6.31** |
| Seeking social support (N=108) | r=0.26* | z=5.61** |
| Criterion validity (correlations between scores on the PCS-C and criterion variables) | | |
| Maximum intensity of the most frequent pain(N=124) | r=0.33** | |
| Disability (N=119) | r=0.40** | |
| Anxiety sensitivity(N=114) | r=0.59** | |
| Cognitive distraction(N=108) | r=-0.47** | |
| Behavioral distraction (N=108) | r=-0.37** | |

** p<0.001
* p<0.01

## DISCUSSION

The aim of this study was to analyze the factor structure of the Pain Catastrophizing Scale for children (PCS-C) by comparing the proposals put forward by previous studies. We also analyzed the internal consistency, and the convergent, discriminant and criterion-related validity of the PCS-C when used with Catalan-speaking adolescents. Our hypotheses were supported and the results not only confirmed the good psychometric characteristics of the questionnaire but also provided important new information on the properties of the questionnaire.

The results of our study confirmed the original 3-factor model structure of the PCS-C (Crombez et al., 2003) and supported Parkerson’s (Parkerson et al., 2013) and Pielech’s (Pielech et al., 2014) suggestion to delete certain items from the questionnaire. Specifically, the models that got the best fit in our study were the 11-item oblique 3-factor model without items 8 and 12 as suggested by Parkerson (Parkerson et al., 2013); and the 12-item oblique 3-factor model without item 8. On the basis of our results and those from previous studies, it seems appropriate to recommend removing item 8 (i.e., "*When I am in pain, I want the pain go away*") for two relevant reasons. First, because it contributes to a poor overall model fit (as our results show, the best models are those that excluded item 8), and, second, because it lacked significant variability and this led to a ceiling effect. As was also reported in the studies by Parkerson et al. (2013) and Pielech et al. (2014), it was scored highly by most participants. It is important to note that although the RMSEA index was slightly above 0.08, the other indices showed an appropriate fit. Besides, as previous studies have demonstrated, RMSEA might be highly influenced by the size of the sample, and for small samples, a value of 0.08 may mean that the model is still acceptable (see Hu and Bentler, 1999).

Second, the reliability of the PCS-C total scores, and the scores of the subscales Rumination and Helplessness were good. However, the reliability of the Magnification subscale scores was below 0.70, the standardized acceptable criteria (Cronbach, 1990). Previous studies have also shown that the reliability of these subscale scores is lower: 0.68 in the original study by Crombez and colleagues (Crombez et al., 2003) and 0.66 in the study by Tremblay and colleagues (Tremblay et al., 2008). These results might be a consequence of the subscale only having a few items (i.e., three), which might be not enough for an acceptable level of reliability to be reached. Future research should examine whether the reliability of the subscale could be improved by adding new items. In the meantime, studies relying on this subscale should proceed with caution.

Third, criterion validity was supported by positive correlations between PCS-C and pain intensity and disability scores, as has also been reported in previous studies (Crombez et al., 2003; Kröner-Herwig & Maas, 2013; Pielech et al., 2014; Tremblay et al., 2008), and also between PCS-C and anxiety sensitivity scores (Tsao et al., 2009). In accordance with suggestions made by previous studies, the negative associations between PCS-C and behavioral and cognitive distraction pain coping strategies were another source of support for criteria validity (Lynch, Kashikar-Zuck, Goldschneider, & Jones, 2007; Verhoeven et al., 2012).

Finally, our study provides important new information on the psychometric properties of PCS-C. Namely, it shows convergent and discriminant validity for the PCS-C. The convergent validity was supported by a strong relationship between scores on the PCS-C and scores on the Internalizing/Catastrophizing scale of the Pain Coping Questionnaire, which is considered to assess the same construct as the PCS-C. A previous study found a correlation between both constructs of 0.68 in a sample of schoolchildren (Huguet et al., 2009). Our study also demonstrates the discriminant validity properties of the PCS-C by showing that the coping strategies seeking social support and positive self-statements were clearly different constructs from pain catastrophizing, since the magnitude of the correlation between the PCS-C total scores and the internalizing/catastrophizing coping strategy scores was significantly greater than the magnitude of these other two correlation coefficients: the PCS-C total score x the positive self-statements coping scores and the PCS-C total score x seeking social support coping scores.

Some limitations of this study should be considered when interpreting the results. First, we used a convenience community sample of adolescents so additional studies should be carried out with chronic pain samples so that the psychometric properties of the PCS-C scores can be evaluated, as was done for the English and German versions (Kröner-Herwig & Maas, 2013; Pielech et al., 2014). Second, the participants were between 12 and 19 years old, and the findings may or may not generalize to children of younger ages. Future studies should explore whether these results replicate in children between 8 and 11 years old (see Crombez et al., 2003; Kröner-Herwig and Maas, 2013; Parkerson et al., 2013) or even younger.

Future research should also examine other psychometric properties of the PCS-C that still remain unexplored: for example, its clinical utility or feasibility. Similarly, additional work should be carried out to explore whether this questionnaire behaves in other languages and cultural contexts as it does in the languages in which it has been studied to date. Moreover, a validated questionnaire for assessing children's and adolescent's pain catastrophizing in different languages would enable us to determine whether this construct is understood by different cultures at these early ages, and can be instrumental in tailoring treatments for young people with pain.

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# 4.2. Study II

# The Survey of Pain Attitudes: a Revised Version of its Pediatric Form

# The Survey of Pain Attitudes: a revised version of its pediatric form

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## ABSTRACT

Valid and reliable measures of pain beliefs are needed by clinicians and researchers to better understand the efficacy and mechanisms of pain treatments. The objective of this work was to address this need by further developing the pediatric version of the Survey of Pain Attitudes (Peds-SOPA).

A convenience sample of 307 adolescents (mean age= 14.35; SD=1.62; 59% girls) participated in the study. They rated the intensity of their worst pain experienced in the 3 months prior to the assessment and completed the Functional Disability Inventory and a revised version of the Peds-SOPA.

Factor analyses confirmed a seven-factor solution of the questionnaire, and the revised version demonstrated improvements in the internal consistency of several of the scales (values ranged between adequate and good: 0.71 to 0.87), except for the Medical Cure scale which showed an internal consistency value of 0.65. The results support the validity of the Peds-SOPA-R scale scores by showing, as predicted, positive relationships between beliefs thought to be maladaptive (e.g., the belief that one is unable to function because of pain) and pain intensity and disability, and negative relationships with beliefs thought to be adaptive (e.g., the belief that exercise is beneficial for pain management) and criterion variables.

**Key words:** Chronic Pain; Pain beliefs; Children, Survey of Pain Attitudes; Peds-SOPA

## INTRODUCTION

Pain beliefs, defined as the attributions individuals make about pain and its impact (Williams & Thorn, 1989), have been shown to influence adjustment to pain, as well as to treatment adherence and treatment outcome in adults (DeGood, 2011). Pain beliefs have also been hypothesized to play a key role in understanding pediatric pain (e.g., Palermo, 1997; Thastum, Herlin, & Zachariae, 2005). However, while there has been a fair amount of research demonstrating the importance of catastrophizing in adjustment to pain among young people (e.g., Crombez et al., 2003; Eccleston, Fisher, & Vervoort, 2012), there is as yet relatively little research studying the role that other pain-related beliefs, such as those that have been demonstrated to be important in adults (e.g., Jensen, Turner, Romano, & Lawler, 1994; Jensen, Romano, Turner, Good,, & Wald, 1999), may play in pediatric populations.

Recently, Engel, Jensen, Ciol and Bolen (2012) introduced the pediatric version of the Survey of Pain Attitudes (Peds-SOPA), a measure of pain beliefs based on one of the most commonly used measures of such beliefs that had been developed for use in adults with chronic pain (Jensen, Turner, Romano, & Lawler, 1994). The Peds-SOPA assesses seven different pain-related belief domains, and has been shown to be reliable and valid for assessing young people’s pain beliefs (Engel et al., 2012; Miró, Huguet, & Jensen, 2014). For example, Engel et al. (2012) reported a negative association between pain intensity and the belief that one can control pain, and the Peds-SOPA measure of this pain belief was subsequently shown to prospectively predict pain intensity one year later in a longitudinal study (Miró et al., 2014). Thus, the Peds-SOPA could be instrumental for advancing our knowledge regarding the role that pain beliefs play in adjustment to pediatric pain, as it assesses a number of pain beliefs and attitudes that have been demonstrated to have important relationships with key pain outcomes (e.g., pain intensity, disability) and adherence to treatment in adults (e.g., Jensen, Turner, & Romano, 2001).

Nevertheless, a number of findings suggest that additional work could make the Peds-SOPA scales even more reliable and valid. First, although the same factor structure of the measure has emerged in both American and Catalan samples (Engel et al., 2012; Miró et al., 2014), these studies treated the SOPA items as continuous. However, since the Peds-SOPA items are rated using three-point Likert-type scales, the item responses do not likely have ratio qualities, and would therefore best be treated as ranked or even categorical data for analyses (Brown, 2006). Second, there are differences in the number of items per scale in the Peds-SOPA, ranging from two (for the Medication scale) to six (for the

Control scale). Because a larger number of items that assesses the same domain tends to result in measures with more reliability, it is likely that the reliability of the Peds-SOPA scales with fewer items could be improved by adding more items, which could then improve their overall validity. Related to this issue, the internal consistency of some scales is less than ideal, with several falling below the standard cutoff deemed necessary for adequate internal consistency (0.70) in some samples (Nunnally, 1978). Finally, the Peds-SOPA contains some items that are very similar (Miró et al., 2014). While asking the same question in slightly different ways can result in greater measurement precision and reliability, it can also result in increased subject burden with relatively little additional information gained. For this reason, highly redundant items could be replaced by less redundant items in order to increase construct validity (i.e., allow for the assessment of a wider perspective of the domain of interest).

The overall aim of this study was to further develop the Peds-SOPA in order to address some of the issues described above. Specifically, our goals were to (1) increase the internal consistency of several of the scales; (2) create scales with a more balanced number of items per scale by developing new items; and (3) replace some of the redundant items in order to reduce subject burden and increase content validity. We planned to evaluate the factorial structure, reliability and criteria validity of the resulting measure. We hypothesized that the original seven-factor solution would be confirmed in the revised version, and that more of the scales would evidence at least adequate internal consistency coefficients (i.e., alpha coefficients = 0.70 or greater). If valid, we hypothesized that the beliefs thought to be adaptive which have demonstrated significant associations with measures of pain intensity and disability in previous adult and pediatric samples (i.e., the scales measuring Pain Control and Exercise beliefs; (Jensen et al., 1994; Miró et al., 2009; Nieto, Raichle, Jensen, & Miró, 2012) would evidence negative associations with measures of pain intensity and pain-related disability. Similarly, we hypothesized that pain beliefs thought to be maladaptive and that have demonstrated significant associations with measures of pain and disability in previous research (i.e., the scales measuring Disability, Harm, Medical Cure, and Solicitude beliefs; (Engel et al., 2012; Jensen et al., 1994, 2001; Miró et al., 2014; Nieto et al., 2012; Turner et al., 2000) would evidence significant positive associations with measures of pain and disability.

## METHODS

### Participants

The sample consisted of 307 adolescents (aged 12 to 20 years; mean age=14.35, SD= 1.62; 59% girls). This convenience sample was recruited from 8 secondary schools in the province of Tarragona, a city in the southeast of Catalonia. Study inclusion criteria included (1) being able to read, write, and speak in Catalan and (2) being between 12 and 20 years old. Participants were excluded if they had an intellectual disability that interfered with participation in the study procedures. A total of 495 adolescents were enrolled into the study. Complete Peds-SOPA data were obtained from 307 participants (62%).

### Procedure

Eighteen secondary schools were invited to participate and 8 of them accepted. A total of 668 letters were delivered to the children and parents of those schools and 495 agreed to participate. Either one of the parents could provide consent to allow his/her child to participate and adolescents older than 17 years old provided their own informed consent. Participants answered to the questionnaires during one hour within school time following the instructions provided by research staff. Three hundred and seven of these provided complete data for the revised form of the Peds-SOPA (Peds-SOPA-R).

## The development of the Peds-SOPA-R

Like the original SOPA, the Peds-SOPA assesses seven pain-related belief domains: *Control* (which measures the extent to which the child believes she/he can control the pain), *Medical Cure* (the extent to which the child believes in a medical cure for the pain problem), *Solicitude* (the extent to which the child believes that others should be solicitous in response to their experience of pain), *Medication* (the extent to which the child believes that medication is an appropriate treatment for pain), *Emotion* (the extent to which the child believes that their emotions impact their pain), *Exercise* (the extent to which the child believes that exercise is beneficial for pain management), and *Disability* (the extent to which the child believes that one is unable to function because of pain). However, there are some important differences between the Peds-SOPA and the original SOPA. First, the Peds-SOPA has about half the number of items as the adult version: 29 *vs*. 57. Second, the “Harm scale” in the adult version was renamed as the “Exercise scale” in the Peds-SOPA (Engel et al., 2012), to reflect the changes in the content of the items after the adaptation for their use with young people.

Following the analysis of the items included in the Peds-SOPA two groups of very similar items were identified (one with three and two with two items), belonging to the Medical Cure, Control and Solicitude scales, respectively. With the aim of replacing some and adding new items, we developed a pool of 49 new items, resembling those included in the original version of the questionnaire developed by Engel et al (Engel et al., 2012). Twenty-four items of the original Peds-SOPA were preserved, 4 discarded because they had the same meaning than other items in the original Peds-SOPA, and 1 because previous work by Miró et al. (2014) found a very low item-scale correlation. Thus we started with a set of 73 items (24 from the original questionnaire and 49 newly created). In order to select items for the final scales, we followed the two criteria that had been used by Engel et al (2012) and Jensen et al (2000): (1) the item had to be correlated at .30 or greater with its parent scale (minus that item); and (2) there had to be a minimum difference of .10 between the item-parent scale correlation and the correlation between the item and each of the other scales. Given that just two items remained in the Medical Cure scale after applying these criterion in the Peds-SOPA development study (Engel et al., 2012), three additional items for that scale that met the first criterion were selected as long as the item-parent scale correlation was stronger than the correlation between the item and each of the other scales. Using these criteria, a pool of 35 items (5 for each scale) was used for the analyses.

## Measures

### Pain beliefs

Pediatric pain beliefs were assessed using the Peds-SOPA-R, described in the previous section. Children were asked to respond to the questionnaire items by indicating how much they agree with the belief statements on a 3-point Likert scale (0 = I do not agree with this, 1 = I am not sure, 2 = I agree with this). To obtain a score for each Peds-SOPA scale, the ratings of the items within each scale were averaged, after reversing the score of a few items. Examples of items are as follows: “I have learned I can control my pain” (Control scale); “The right doctor will know how to make me hurt less” (Medical Cure scale); “When I hurt, I want my family to treat me better” (Solicitude scale); “Medicine helps my pain” (Medication scale); “Bad feelings can make my pain worse” (Emotion scale); “Physical exercise can help to improve my pain” (Exercise scale); “Being in pain means that you cannot do what other people do” (Disability scale).

### Pain intensity

Participants were asked to rate the intensity of the pain they had experienced during the three months before the assessment. Specifically, they were asked to rate their recalled worst pain intensity in the past three months for the most frequent pain problem using a 0 – 10 Numerical Rating Scale (NRS-11), where 0 means ‘‘No pain” and 10, ‘‘Very much pain”. The NRS-11 has been shown to provide a valid and reliable measure of pain intensity when used with adolescents and children as young as 6 years old (Castarlenas, Miró, & Sánchez-Rodríguez, 2013; Miró, Castarlenas, & Huguet, 2009; Sánchez-Rodríguez, Miró, & Castarlenas, 2012).

### Disability

The 15-item Functional Disability Inventory (FDI; Walker & Greene, 1991) was used to assess disability associated with the impact of illness on children’s physical and psychosocial everyday functioning over the last 2 weeks. The level of difficulty that respondents have developing each activity item was assessed using a 5-point Likert scale (0 = “No trouble” to 4 = “Impossible”). Higher scores indicate more disability (possible range, 0 to 60) (Claar & Walker, 2006; Walker & Greene, 1991). The FDI has been shown to be a reliable and valid measure of disability in youths as young as 8 years old (Kashikar-Zuck et al., 2011). The measure has also been used to assess disability in pediatric samples presenting with a wide range of chronic pain-related conditions such as back pain, fatigue, fibromyalgia and arthritis (Kashikar-Zuck, Vaught, Goldschneider, Graham, & Miller, 2002). The Catalan version of the FDI has also demonstrated good psychometric properties (Solé, Huguet & Miró, 2010), and its internal consistency was shown to be very good (Cronbach's alpha = 0.89) in the current sample.

## Data analyses

We first computed descriptive statistics to describe the sample. Second, we performed a confirmatory factor analysis (CFA) to evaluate the Peds-SOPA-R factor structure, and then computed the Cronbach's alpha coefficients to evaluate the internal consistency of the different scales. Before performing the CFA, we examined the Skewness and Kurtosis of each item's distribution, and tested whether the data were suitable to factorize using Kaiser-Meyer-Olkin test (KMO; Kaiser, 1970) and Bartlett's statistic (Bartlett, 1950). Weighted Least Square estimator using a diagonal weight matrix and with mean and variance -adjusted Chi-square- statistic (WLSMV; Brown, 2006) was used as the factor extraction method since the items of the Peds-SOPA-R were considered ranked variables given that that questionnaire has just 3 possible answers. We also computed Chi-square ($\chi^2$), Comparative Fit Index (CFI), Root-Mean-Square Error of Approximation (RMSEA), and Standardized Root Mean Residual (SRMR) to help evaluate the goodness of fit of the solution. Finally, we evaluated the Peds-SOPA-R's concurrent criteria validity by computing Pearson's correlations between scores on the Peds-SOPA-R scale scores and the validity criterion (pain intensity, pain related disability). All analyses were performed using SPSS 17.0 (IBM, http://www-01.ibm.com/software/analytics/spss/) apart from Skewness, Kurtosis, KMO and Bartlett's statistics that were evaluated using Factor 8.1. (http://psico.fcep.urv.es/utilitats/factor/), and CFA using Mplus 5.1. (http://www.statmodel.com/).

## RESULTS

### Participant characteristics

Three-hundred and seven young people aged 12 to 20 years participated in this study (40% boys and 60% girls). A total of 286 (93%) of them reported that they had experienced pain somewhere in their body in the last three months, and 74 (26%) of these reported that they had chronic pain. Pain was labeled as chronic if it had lasted for three months or more (Elliott, Smith, Penny, Smith, & Chambers, 1999). In addition, those indicating that they had intermittent pain (i.e., had at least some pain-free periods) had to report a minimum of one pain episode each month in the previous three months in order to be deemed to have chronic pain. These criteria for defining chronic pain have also been used in other studies (e.g., Huguet & Miró, 2008; Mikkelsson, Salminen, & Kautiainen, 1997). Table 1 provides descriptive information about the sample and the most frequent pain locations reported by the study participants.

**Table 1. Characteristics of the sample (n=307)**

| | |
|---|---|
| **Sex** (N, %) | |
| Boys | 125 (40%) |
| Girls | 182 (59%) |
| **Age** (Mean, SD) | 14.35 (1.62) |
| **Pain in the last 3 months** (N, %) | |
| Yes | 286 (93%) |
| No | 21 (7%) |
| 286 that experienced pain in the last 3 months (74 (26%) had chronic pain) | |
| **Pain beliefs** (Peds-SOPA-R; Mean; SD) | |
| Control | 1.10 (0.54) |
| Medical Cure | 1.27 (0.47) |
| Solicitude | 1.34 (0.60) |
| Medication | 1.23 (0.61) |
| Emotion | 1.16 (0.69) |
| Exercise | 0.99 (0.58) |
| Disability | 0.73 (0.55) |
| **Maximum intensity of the most frequent pain**[b] (N=281) (Mean, SD) | 7.87 (1.75) |
| **Localization of the most frequent pain**[c] (N=279) (N, %) | |
| Head (exclude face) | 63 (22%) |
| Face/jaw/temple | 5 (2%) |
| Throat/neck | 14 (5%) |
| Shoulder | 10 (4%) |
| Chest | 5 (2%) |
| Upper arm | 0 (0%) |
| Elbow | 1 (0%) |
| Forearm | 0 (0%) |
| Wrist | 10 (4%) |
| Hand | 3 (1%) |
| Abdomen | 49 (17%) |
| Hip | 4 (1%) |
| Groin/pubic area | 10 (4%) |
| Thigh | 14 (5%) |
| Knee | 26 (9%) |
| Calf | 9 (3%) |
| Ankle | 13 (5%) |
| Foot | 7 (3%) |
| Upper back | 11 (4%) |
| Mid back | 17 (6%) |
| Low back | 8 (3%) |
| **Disability**[d] (N=291) (Mean, SD) | 11.45 (10.07 |

[a] Information missing in 54 cases of 286 that experienced pain in the last 3 months (there were 54 cases because this question was introduced after some students had completed some assessment forms, so 50 of 286 cases were not asked about that question, the other 4 cases did not answered to that question). Chronic pain is defined as pain lasting for more than 3 months.

[b] Information missing in 5 cases of 286 that experienced pain in the last 3 months.

[c] Information missing in 7 cases of 286 that experienced pain in the last 3 months.

[d] Information missing in 16 cases of 307 participants.

## Factor Structure

Histograms and measures of Skewness and Kurtosis indicated that the distributions of the 35 Peds-SOPA-R items had acceptable levels of Skewness from -1.08 to 0.95, whereas the levels of Kurtosis (from -1.71 to -0.27) showed a platykurtic (flat) distribution for some of the item responses, a bit far from the normal distribution. The factor structure of the Peds-SOPA-R was evaluated using CFA, specifically, using the WLSMV method that can deal with non-normal and non-ratio data. A KMO of 0.84 and a significant Bartlett's test of sphericity ($\chi^2$ = 4047.4, df = 595, p < 0.001) indicated that data were suitable for factor analyses. Individual item-scale correlations are shown in Table 2. Factor analyses confirmed the seven-factor solution described in the original Peds-SOPA with an excellent goodness of fit ($\chi^2$ (126)=225.71, p<0.001; CFI=0.96; TLI=0.97; RMSEA=0.05). The factor loadings for each scale were: Control (0.50 - 0.75); Medical Cure (0.39-0.83); Solicitude (0.45-0.91); Medication (0.69-0.90); Emotion (0.70-0.91); Exercise (0.67-0.91); Disability (0.61-0.73) (see Table 2).

## Table 2. Factor loadings of the seven-factor structure of the Peds-SOPA-R

| | Control | Medical Cure | Solicitude | Medication | Emotion | Exercise | Disability |
|---|---|---|---|---|---|---|---|
| **13** | 0.74 | | | | | | |
| **18** | 0.68 | | | | | | |
| **27** | 0.75 | | | | | | |
| **32** | 0.73 | | | | | | |
| **34** | 0.50 | | | | | | |
| **1** | | 0.39 | | | | | |
| **8** | | 0.54 | | | | | |
| **25** | | 0.65 | | | | | |
| **28** | | 0.63 | | | | | |
| **31** | | 0.83 | | | | | |
| **7** | | | 0.45 | | | | |
| **19** | | | 0.91 | | | | |
| **21** | | | 0.86 | | | | |
| **24** | | | 0.85 | | | | |
| **35** | | | 0.90 | | | | |
| **5** | | | | 0.69 | | | |
| **12** | | | | 0.86 | | | |
| **14** | | | | 0.77 | | | |
| **17** | | | | 0.84 | | | |
| **20** | | | | 0.90 | | | |
| **6** | | | | | 0.70 | | |
| **15** | | | | | 0.91 | | |
| **23** | | | | | 0.89 | | |
| **26** | | | | | 0.87 | | |
| **30** | | | | | 0.88 | | |
| **3** | | | | | | 0.67 | |
| **16** | | | | | | 0.87 | |
| **22** | | | | | | 0.91 | |
| **29** | | | | | | 0.74 | |
| **33** | | | | | | 0.67 | |
| **2** | | | | | | | 0.69 |
| **4** | | | | | | | 0.62 |
| **9** | | | | | | | 0.61 |
| **10** | | | | | | | 0.68 |
| **11** | | | | | | | 0.73 |

## Reliability: Internal Consistency

All the scales, except Medical Cure (Cronbach's alpha = 0.65), evidenced adequate to good internal consistency reliability indices, Control: 0.73; Solicitude: 0.83; Medication: 0.83; Emotion: 0.87; Exercise: 0.83 and Disability: 0.71.

## Criterion validity

Table 3 presents the correlation coefficients between the Peds-SOPA-R scales and the measures of pain intensity and disability. As can be seen, the pattern of associations is as hypothesized (i.e., pain beliefs thought to be adaptive are negatively associated with pain intensity and disability, and pain beliefs thought to be maladaptive are positively associated with pain beliefs and disability), and all significant associations are in the hypothesized directions.

**Table 3. Pearson's correlations between Peds-SOPA-R subescales and criteria variables.**

| | C | MC | S | M | E | EX | D |
|---|---|---|---|---|---|---|---|
| **Pain Intensity Max** | -0.13* | 0.03 | 0.02 | 0.04 | -0.04 | -0.12* | 0.23** |
| **FDI** | -0.23** | 0.01 | 0.13* | 0.10 | 0.08 | -0.23** | 0.31** |

**p<0.01
*p<0.05

Pain attitudes, Peds-SOPA-R scales
C=Control, MC=Medical Cure, S= Solicitude, M= Medication, E= Emotion, EX= Exercise, D= Disability

## DISCUSSION

The primary aim of this study was to develop and test a revised version of the pediatric version of the Survey of Pediatric Pain Attitudes that would yield improvements in the psychometric properties of the scales. The findings confirmed the original factor structure of the seven scales of the Peds-SOPA. The changes in the content of the scales, that is to say, the deletion of some similar items and the addition of new ones, resulted in an increase of the internal consistency properties for all of the scales except for the Medical Cure scale. Moreover, the changes resulted in an improvement of the factor fit and the factor loadings.

In support of the criteria validity of the Peds-SOPA-R, the pain beliefs measured by the revised questionnaire demonstrated the predicted pattern of associations with pain intensity and disability. As it has been shown in previous studies with clinical (e.g., Engel et al., 2012; Thastum et al., 2005) and schoolchildren samples (e.g., Huguet, Eccleston, Miró, & Gauntlett-Gilbert, 2009; Miró et a., 2008, 2014) what has been conceptualized as negative pain beliefs and attitudes (e.g., the belief that one is unable to function because of pain) was positively related with pain intensity and disability, and negatively with positive pain beliefs (e.g., the belief that exercise is beneficial for pain management).

The study has a number of limitations that should be considered when interpreting the results. First, the study sample represented a sample of convenience. Thus, we do not know how representative they are of children in general. Additional studies using other samples are needed to evaluate the reliability and generalizability of our findings. Relatedly, the sample came from a population of children who were attending school, and so were for the most part generally healthy. It is therefore not clear how well the Peds-SOPA-R items would perform in samples of children with clinical pain problems, such as chronic headache or abdominal pain. In addition, all of the data were obtained via self-report. It would be useful to determine the associations between the Peds-SOPA-R scales and objective measures of functioning, such as those that might be obtained from parent, teacher, or clinician reports. Also, all of the measures were obtained at a single assessment. It would be useful to examine the sensitivity of the Peds-SOPA-R scales to change over time and/or with treatment in longitudinal and experimental studies. Finally, in this scale development study, we eliminated items that appeared very similar to one another to both reduce assessment burden (by not asking respondents the same question multiple times) and to allow for a greater breadth of assessment of the different aspects of each belief domain. In hindsight, however, the elimination of items that appeared similar might have reduced our ability to assess in greater depth some of the key aspects of the domains, and also resulted in less internal consistency than could have otherwise been achieved. Therefore, future development of the Peds-SOPA might involve a re-introduction of some of the items that were eliminated in this version due to similarity, in order to increase the Medical Cure scale precision and reliability further.

Despite the study's limitations, the results provide critical psychometric information about a revised version of one of the most used questionnaires to assess pain beliefs and attitudes. The evidence presented here will be helpful to researchers who wish to study the role that pain beliefs play in adjustment to chronic pain in young people. Such a measure could also help clinicians and researchers to identify and monitor changes in beliefs important for modification of treatment, acceptance of interventions and influencing a young person's capacity to adapt to pain. The Peds-SOPA-R could be also useful for identifying the pain treatments that are most effective, based on their impact on the pain beliefs of the young person with pain; for example, to determine if cognitive restructuring is more effective for young people with high levels of maladaptive beliefs (or low levels of adaptive beliefs) than young people who evidence the opposite pattern before treatment.

Such research using the Peds-SOPA-R could ultimately help clinicians select the best treatment for each patient.

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# 4.3. Study III

# The Psychometric Properties of the Cognitive Fusion Questionnaire in Adolescents

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Original Article

# The Psychometric Properties of the Cognitive Fusion Questionnaire in Adolescents

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**Abstract.** Cognitive fusion can be defined as the inability to view thoughts as just thoughts, which is hypothesized to increase the impact of those thoughts on behavior. Cognitive fusion is a core concept of Acceptance and Commitment Therapy, a therapeutic approach that is being increasingly studied as a treatment for a plethora of chronic health problems. The objective of this study was to evaluate the psychometric properties of the Cognitive Fusion Questionnaire (CFQ) in a sample of adolescents. Three hundred eight adolescents (11–20 years) completed the Catalan version of the questionnaire (CFQ-C) as well as measures assessing anxiety sensitivity and acceptance. The results supported a one-factor solution for the CFQ-C, and indicated an adequate level of internal consistency (Cronbach's $\alpha = 0.79$). The validity of the CFQ-C was supported by a significant positive association between the CFQ-C total score and the measure of anxiety sensitivity and by a significant negative association with the measure of acceptance. The findings support the psychometric properties of the CFQ to study the role that cognitive fusion may play in functioning among adolescents.

**Keywords:** cognitive fusion, adolescents, assessment, Acceptance and Commitment Therapy

In the last decade a number of so-called "third wave" cognitive-behavioral therapies have demonstrated efficacy for improving the management of various psychological and medical conditions in children and adolescents, such as chronic pain (Gauntlett-Gilbert, Connell, Clinch, & McCracken, 2013), diabetes (Gregg, Callaghan, Hayes, & Glenn-Lawson, 2007), obsessive-compulsive disorder (Armstrong, Morrison, & Twohig, 2013), depression (Hayes, Boyd, & Sewell, 2011), posttraumatic stress disorder (Woidneck, Morrison, & Twohig, 2013), and Tourette's syndrome (Franklin, Best, Wilson, Loew, & Compton, 2011). One of the most popular of these therapies is Acceptance and Commitment Therapy (ACT) which aims to promote psychological flexibility and encourages a focus on the client's most valued life goals instead of symptom reduction (Fletcher & Hayes, 2005).

Psychological flexibility is a global construct consisting of six core processes (contact with the present moment, acceptance, cognitive defusion, self-as a context, committed action, and values), which are viewed as adaptive psychological skills and are taught and encouraged in ACT (Luoma, Hayes, & Walser, 2007). One of these processes – *cognitive defusion* (McCracken, Dasilva, Skillicorn, & Doherty, 2013) – is taught to counteract the cognitive fusion process. Cognitive fusion has been defined as

> "...the tendency of human beings to be caught up in the content of what they are thinking so that it dominates over other useful sources of behavioural regulation" (Luoma et al., 2007) (see section "The ACT Model of Psychopathology," subsection "Cognitive Fusion").

Based on ACT principles, people who are more fused to their thoughts are more likely to have their behavioral and emotional reactions influenced by those thoughts. On the other hand, individuals who employ cognitive defusion processes are better able to view their thoughts for what they are – combinations of words in a sentence that reflect certain events and ideas, rather than absolute truths. For example, when a 14-year-old teenager with chronic pain and high cognitive fusion has a thought such as, "Nobody believes I have pain!," that teenager would be more likely to experience anxiety and less likely to socialize with friends when he or she has this thought. On the other hand, a teenager with high cognitive defusion would be less likely to react to the thought when it occurs. In support of this idea, measures of cognitive fusion have been shown to be related positively to anxiety both in adults (Gillanders et al., 2014; Herzberg et al., 2012; Wicksell, Lekander, Sorjonen, & Olsson, 2010) and in adolescents (Greco, Lambert, & Baer, 2008). One measure of cognitive defusion has been also found positively associated with anxiety in adults (Forman et al., 2012). Anxiety is a construct related to anxiety sensitivity among children and adolescents, although they are also distinct domains (Bilgiç et al., 2013; Muris, Schmidt, Merckelbach, & Schouten,

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2001; Payne, Seidman, Lung, Zeltzer, & Tsao, 2013). Anxiety sensitivity can be defined as the tendency to be afraid of anxiety-related symptoms (Taylor, 1995) and has been found to prospectively predict the development of anxiety symptoms and disorders among adolescents (Schmidt et al., 2010). Considering the role of anxiety sensitivity and the efficacy of the ACT in adults with anxiety disorders (Swain, Hancock, Hainsworth, & Bowman, 2013), it seems reasonable to expect a negative relationship between anxiety sensitivity and cognitive fusion, a nuclear process in the psychopathological model of ACT (Luoma et al., 2007).

Acceptance, another ACT core process, can be defined as a process of embracing one's own thoughts, feelings, and sensations without making efforts to change their frequency or form. It is the opposite of experiential avoidance and one of its goals is to facilitate a focus on values-based actions (Hayes, Luoma, Bond, Masuda, & Lillis, 2006). Previous research has supported a negative relationship between measures of cognitive fusion and acceptance in adults (McCracken et al., 2013) and adolescents (Greco et al., 2008), as well as a positive relationship with cognitive defusion in adults (Forman et al., 2012). In addition, some studies have found a positive relationship between cognitive fusion measures and experiential avoidance, the other end of the continuum acceptance – experiential avoidance (Gillanders et al., 2014; Herzberg et al., 2012; Palladino et al., 2013), which is consistent with what ACT proposes.

In order to determine if ACT (or other) treatments influence cognitive fusion, and if changes in cognitive fusion explain the benefits of ACT as hypothesized, a valid and reliable measure of this key construct is needed. One measure has been developed for use with adolescents: the Evaluation of the Avoidance and Fusion Questionnaire for Youth (AFQ-Y; Greco et al., 2008). However, this measure contains some items that confound both behavioral avoidance and cognitive fusion, limiting the ability to measure these as distinct constructs. Other measures of cognitive fusion have been developed to assess this construct in adults: the Cognitive Fusion Questionnaire (CFQ; Gillanders et al., 2014), the Drexel Defusion Scale (DDS; Forman et al., 2012); the Psychological Inflexibility in Pain Scale (PIPS, Cognitive Fusion Subscale; Wicksell et al., 2010; Wicksell, Renöfält, Olsson, Bond, & Melin, 2008) and the Believability of Anxious Feelings and Thoughts Questionnaire (BAFT; Herzberg et al., 2012). Nevertheless, most of these measures have limitations as well. For example, the PIPS is not a unique measure of cognitive fusion, since it was designed to measure psychological inflexibility using two subscales (avoidance and cognitive fusion) in people with pain; the BAFT was specifically created to be used with people with anxiety disorders; and the DDS assesses cognitive defusion, as opposed to cognitive fusion. The CFQ, however, appears to be an appropriate choice as a measure of cognitive fusion. This questionnaire assesses only cognitive fusion, and the items are clearly written and therefore easily understandable to adolescents.

The main objective of the current study was to assess the psychometric properties of a translated version of the Cognitive Fusion Questionnaire for use by Catalan-speaking adolescents. We hypothesized that (1) the translated CFQ would be internally consistent (Cronbach's $\alpha \geq .70$; Cronbach, 1990), (2) a confirmatory factor analysis would support the one-factor solution suggested by the CFQ developers, and (3) if valid, the CFQ scale score would be positively associated with a measure of anxiety sensitivity and negatively associated with a measure of acceptance.

## Materials and Methods

### Participants

The study sample was one of convenience recruited from five secondary schools located in Tarragona, a city in the south-east of Catalonia. Study inclusion criteria included (1) being able to read, write, and speak in Catalan and (2) being between 11 and 20 years old. Participants were excluded if they had an intellectual disability that interfered with participation in the study procedures. A total of 344 adolescents and young adults were enrolled into the study. Complete CFQ data were obtained from 308 of these participants. The average age of the participants was 14.42 years (*SD* = 1.66, range = 11–20 years) and 59% were girls/young women.

### Procedure

Seven secondary schools were invited to participate in this study, but two of them declined participation; one because they were already involved in another study and the other because the school administrators reported they were "too busy" to participate. Four hundred fifty-six letters were delivered to the children and parents of the five participating schools, and either one of the parents could provide consent to allow his/her child to participate. Of those, 20% (*n* = 112) did not return the informed consent and 5% (*n* = 23) declined to participate. Adolescents older than 17 years provided their own informed consent. Adolescents whose parents agreed to participate or who consented by themselves to participate completed the assessment form during 1-hr within school time following the instructions provided by research staff.

### Measures

#### Socio-Demographic/Descriptive Information

All participants were asked to provide information related to their age, sex, and school grade.

#### Cognitive Fusion

The Cognitive Fusion Questionnaire (CFQ) is a seven-item measure that is designed to assess the single construct of cognitive fusion (Gillanders et al., 2014). Respondents rate each item that reflects an aspect of cognitive fusion on a 1–7 Likert scale, with 1 = *never true* and 7 = *always true*. A higher score indicates higher levels of cognitive fusion; the possible score range is 7–49. The CFQ has evidence supporting its reliability and validity in adults, including an internal consistency coefficient (Cronbach's α) ranging from .88 to .93, a 1-month test-retest stability of .80, and significant associations with measures of related constructs (Gillanders et al., 2014). Prior to the most recent 2013 version of the CFQ, the scale authors had developed a 13-item version that had the same instructions and response options as the 2013 version. Given that this study started before the 2013 version was published, we administered the original 13-item version of the CFQ that the measure developers had provided to us. However, the current analyses were performed using only the seven items included in the most recent adult version, because (1) it is the most up-to-date (adult) version of the measure and (2) a preliminary factor analyses of both the 7- and 13-item version in our sample yielded a better factorial solution for the seven-item version.

Linguistic translation of the CFQ into Catalan was performed using a back-translation procedure as described by Miró (1997). Two Catalan psychologists who also spoke English translated the CFQ items into Catalan. Next, a professional translator, who was not familiar with the original version of the CFQ, back-translated the Catalan version into English. In a third step, the English back-translated version was sent to one of the scale developers (David T. Gillanders) to determine if the items were faithful to the meaning of the original items. The scale developer indicated that the back-translated version was faithful to the original. No developmental adjustment to the wording was deemed necessary, given that the adult version appeared clear, understandable, and suitable for adolescents.

### Anxiety Sensitivity

Anxiety sensitivity, defined as the fear of having a variety of anxiety symptoms, was assessed by the 18-item Childhood Anxiety Sensitivity Index (CASI; Silverman, Fleisig, Rabian, & Peterson, 1991). On the CASI, respondents indicate the extent to which they agree with each item using a 3-point Likert scale with 1 = *none* and 3 = *a lot*. The total possible score ranges from 18 to 54 (higher scores indicate higher anxiety sensitivity). We used the Catalan version (C-CASI) of the CASI (Fullana, Servera, Weems, Tortella-Feliu, & Caseras, 2003), but adapted it somewhat to better reflect our participants use of Catalan language, since the original version was available in a dialect form of Catalan (i.e., Majorcan) so that it could be properly understood by our participants. The CASI has strong evidence supporting its reliability and validity (Chorpita & Daleiden, 2000; Sandín, Chorot, Santed, & Valiente, 2002; Silverman, 1999). Moreover, the C-CASI has shown to be a reliable and valid instrument (Fullana et al., 2003); and the Cronbach's coefficient alpha for C-CASI was .82 in this sample.

### Acceptance

The Mindful Acceptance scale of the Philadelphia Mindfulness Scale (PHMS; Cardaciotto, Herbert, Forman, Moitra, & Farrow, 2008) was used to assess acceptance. Although it was developed to be used with adults, it is easy readable and understandable by adolescents. The PHMS has just a few items and is therefore very useful for research purposes. Moreover, the only other validated inventory for adolescents – the Chronic Pain Acceptance Questionnaire (McCracken, Gauntlett-Gilbert, & Eccleston, 2010) – assesses *chronic pain acceptance*, not acceptance in general, and we were interested in measuring this general concept of acceptance in the current study. Evidence supports the reliability and validity of the English version of the PHMS in adults (Cardaciotto et al., 2008). We translated the PHMS items into Catalan, using the same back-translation procedures as for the CFQ-C, described above. No changes in the translated version were deemed necessary, since the original author of the PHMS verified that the back-translation was faithful to the original. We found that the two-factor solution of the PHMS that has been demonstrated in adults (Cardaciotto et al., 2008) was only partially confirmed in our adolescent sample ($\chi^2(169) = 388.56$; RMSEA = 0.07 with 90% CI 0.06–0.07; SRMR = 0.07; CFI = 0.82). The CFI was below our a priori cutoff (0.90) for establishing adequacy of the fit, and the main source of misfit was the low internal consistency of the whole scale (Cronbach's coefficient α was .53) due to the low correlation between the items pertaining to different factors. Therefore, we performed a one-dimensional analysis including just the items of the acceptance subscale (i.e., the subscale used in our study), showing the following fit indices ($\chi^2(35) = 108.59$, $p < .01$; RMSEA = 0.08 with 90% CI 0.07–0.1; SRMR = 0.06; CFI = 0.88). Finally, in order to further improve the fit, we also allowed two errors of the one-dimensional model to be correlated (item 10 with 4); and the model improved in all indices ($\chi^2(34) = 92.49$, $p < .01$; RMSEA = 0.07 with 90% CI 0.06–0.09; SRMR = 0.05; CFI = 0.90). The Cronbach's coefficient α for the acceptance subscale was adequate (.79) in our sample, providing additional support for its reliability.

## Statistical Analyses

We performed a confirmatory factor analysis (CFA) to evaluate the CFQ-C's factor structure, and then computed the Cronbach's alpha coefficient to evaluate the internal consistency of the measure. Before performing the CFA, we examined the Skewness and Kurtosis of each item's distribution, and tested whether the data were suitable to factorize using Kaiser-Meyer-Olkin (KMO) test (Kaiser, 1970) and Bartlett's statistic (Bartlett, 1950). Maximum likelihood (ML; Brown, 2006) was used as the factor extraction method and we computed chi-square ($\chi^2$), Comparative Fit Index (CFI), Root-Mean-Square Error of Approximation (RMSEA), and Standardized Root Mean

Residual (SRMR) to help evaluate the goodness of fit of the solution. As described in the guidelines published by the European Journal of Psychological Assessment (Schweizer, 2010), CFI values should range from 0.95 to 1.00 to indicate a good model of fit, and between 0.90 and 0.95 to show an acceptable level of fit; RMSEA values less than 0.05 show a good model of fit and less than 0.08 an acceptable model of fit; SRMR should be kept below 0.10. Finally, we evaluated the CFQ's concurrent criterion validity by computing Pearson's correlations between scores on the CFQ scale score and the validity criterion assessing anxiety sensitivity and acceptance. All analyses were performed using SPSS 17.0 (SPSS Inc., 2008) apart from Skewness, Kurtosis, KMO, and Bartlett's statistics that were evaluated using Factor 8.1 (Lorenzo-Seva & Ferrando, 2013) and CFA using Mplus 5.1 (Muthén & Muthén, 2008).

## Results

### Factor Structure

Histograms and measures of Skewness and Kurtosis indicated that the distributions of the seven CFQ items were normal (Skewness, from −0.29 to 0.80 and Kurtosis, from −1.22 to −0.42). The factor structure of the CFQ-C was evaluated using CFA. A KMO of 0.85 and a significant Bartlett's test of sphericity ($\chi^2 = 495.0$, $df = 21$, $p < .0001$) indicated that data was suitable for factor analyses. CFA revealed a one-factor solution and the goodness of fit of the model was $\chi^2(14) = 30.81$; $p < .01$; CFI = 0.97; RMSEA = 0.06 with 90% CI 0.03–0.09; SRMR = 0.03. The factor loadings ranged from 0.48 to 0.70 (see Table 1).

### Reliability: Internal Consistency

CFQ-C showed a good internal consistency with a Cronbach's $\alpha$ of .79 for the total Fusion scale. The mean of the total scale was 24.06 and the *SD* was 8.63 (girls/young women: mean = 25.81 and *SD* = 8.63; and boys/young men: mean = 21.50 and *SD* = 8.00).

### Criterion Validity

Criterion validity of the CFQ-C was supported, as hypothesized, by significant correlations between scores on the CFQ-C and the criteria variables: anxiety sensitivity ($r = 0.45$, $p < .001$) and acceptance ($r$(PHLMS_Acceptance) = −0.44, $p < .001$).

## Discussion

The findings support the psychometric properties of the CFQ-C as a measure of cognitive fusion in adolescents from 11 to 20 years. The results support a one-factor solution of the CFQ-C items, consistent with the factor solution found by the scale developers (Gillanders et al., 2014). Support for the psychometric strengths of the measure was also found in its significant associations with measures of both anxiety sensitivity and acceptance, both constructs hypothesized to be influenced by cognitive fusion (the former positively and the latter negatively), and which have also been shown to be associated with cognitive fusion in a sample of adults (Gillanders et al., 2014; McCracken et al., 2013) and adolescents (Greco et al., 2008). Also consistent with previous results, cognitive defusion, the opposite of fusion, has demonstrated a negative association with anxiety and a positive association with acceptance (Forman et al., 2012). In addition, a factor considered to be the opposite of acceptance – experiential avoidance – has been shown to be related positively with cognitive fusion (Gillanders et al., 2014; Herzberg et al., 2012; Palladino et al., 2013).

The CFQ has a number of advantages over other existing measures of cognitive fusion, such as the AFQ-Y (Greco et al., 2008), the DDS (Forman et al., 2012), the PIPS (Wicksell et al., 2010), and the BAFT (Herzberg et al., 2012). These advantages include (1) its brevity and simplicity, (2) that it assesses cognitive fusion in general,

*Table 1*. Descriptive information of items in the Cognitive Fusion Questionnaire and factor loadings resulting from CFA

| | Fusion factor | | | | | |
|---|---|---|---|---|---|---|
| Items | Factor loadings | Mean | *SD* | Range | Skewness | Kurtosis |
| 1. My thoughts cause me distress or emotional pain. | 0.69 | 3.19 | 1.64 | 1–7 | 0.46 | −0.56 |
| 2. I get so caught up in my thoughts that I am unable to do the things that I most want to do. | 0.70 | 2.69 | 1.68 | 1–7 | 0.80 | −0.42 |
| 3. I overanalyse situations to the point where it's unhelpful to me. | 0.61 | 3.38 | 1.84 | 1–7 | 0.36 | −0.94 |
| 4. I struggle with my thoughts. | 0.48 | 3.72 | 1.87 | 1–7 | 0.07 | −1.07 |
| 5. I get upset with myself for having certain thoughts. | 0.53 | 3.31 | 1.91 | 1–7 | 0.36 | −1.06 |
| 6. I tend to get very entangled in my thoughts. | 0.59 | 3.34 | 1.96 | 1–7 | 0.36 | −1.15 |
| 7. It is such a struggle to let go of upsetting thoughts even when I know that letting go would be helpful. | 0.58 | 4.45 | 2.05 | 1–7 | −0.29 | −1.22 |
| Total scale | – | 24.06 | 8.63 | 7–46 | 0.17 | −0.57 |

*Notes*. *SD* = Standard deviation; CFA = Confirmatory Factor Analysis.

rather than cognitive fusion associated with a specific illness or a health condition, (3) it measures the construct of cognitive fusion only, and does not include items that assess other constructs such as experiential avoidance, and (4) its factorial structure has been tested and confirmed in seven different samples (six of adults and one – the current one – of adolescents). These advantages support the measure as a good choice for assessing cognitive fusion in adolescents. Despite these promising findings, however, future research should look at additional psychometric properties of the CFQ that have been studied in adult samples (Gillanders et al., 2014) but not yet in adolescents. These include sensitivity to treatment, test-retest reliability, incremental and divergent validity. Additional psychometric properties that have not yet been studied in either adolescents or adults deserve attention as well, such as the measure's predictive validity and overall utility.

This study has some important limitations that should be considered when interpreting the results. First, the study sample represented a convenience sample of adolescents from the general population. It would be useful to evaluate the psychometric properties of the measure in different clinical samples such as adolescents seeking assistance for specific conditions, for example depression or chronic pain. Second, our study is based on correlational analyses of self-reported measures, a common weakness in the evaluation of psychometric properties of questionnaires (Borsboom, Mellenbergh, & van Heerden, 2004). Future research should consider introducing behavioral measures of cognitive fusion when possible (e.g., Hesser, Westin, Hayes, & Andersson, 2009) or using an experimental design to examine whether a defusion exercise is able to modify CFQ-C scores as it has been observed in the believability and discomfort of thoughts in adult studies (Masuda, Hayes, Sackett, & Twohig, 2004). More research is also needed to evaluate how changes in the CFQ predict subsequent changes in the components hypothesized by ACT and other models to be influenced by cognitive fusion.

Despite the study limitations, however, the findings provide information in support of the psychometric properties of CFQ in adolescents. Its brevity and simplicity make it an excellent choice for researchers to evaluate the role that cognitive fusion may play in treatment outcome for adolescents involved in clinical trials of treatment changes across a variety of psychological and physical health conditions.

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# 4.4. Study IV

# Cognitive Fusion and Pain Experience in Young People

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# Cognitive fusion and pain experience in young people

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## Disclosure

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## ABSTRACT

**Objectives:** Acceptance and Commitment Therapy (ACT) has been shown to be an effective treatment for chronic pain in young people. Cognitive fusion is a key concept of ACT that is hypothesized to contribute to distress and suffering. In this study, we sought to: (1) test hypothesized associations between cognitive fusion and pain intensity, disability, and catastrophizing; and (2) examine the function of cognitive fusion as a possible mediator between catastrophizing and disability.

**Methods:** A community sample of 281 young people (11-20 years) completed measures assessing cognitive fusion, pain intensity, disability and pain catastrophizing.

**Results:** Cognitive fusion was positively related to pain intensity ($r = 0.24$, $p < 0.01$), disability ($r = 0.32$, $p < 0.001$) and pain catastrophizing ($r = 0.47$, $p < 0.001$). Moreover, cognitive fusion was found to mediate the association between pain catastrophizing and disability ($\beta=0.01$, CI= 0.002 to 0.024 at 95% confidence level, 5000 bootstrap resamples).

**Discussion:** The findings indicate that cognitive fusion is moderately to strongly associated with pain-related outcomes, which support the need for further research to (1) better understand the relationship between cognitive fusion and adjustment to chronic pain, and (2) determine whether the benefits of treatments such as ACT are mediated, at least in part, by reductions in cognitive fusion.

**Keywords**: cognitive fusion, young people, chronic pain, Acceptance and Commitment Therapy

## INTRODUCTION

Chronic pain is a significant problem for many children and adolescents [1,2] that can significantly contribute to their disability [3,4] and negatively impact their quality of life [1,4–6]. Recently, Acceptance and Commitment Therapy (ACT) has demonstrated efficacy for addressing the problem of chronic pain in young people [7,8]. ACT aims to promote psychological flexibility and increase the client’s focus on his or her most valued life goals instead of only or primarily pain reduction [9]. Psychological flexibility is defined as consisting of six core processes (i.e., contact with the present moment, acceptance, cognitive defusion, self-as a context, committed action and values) that are viewed as adaptive psychological skills and are enhanced through ACT [10].

One of these processes – cognitive defusion [11] – is taught and encouraged as a way to counteract the negative effects of cognitive fusion, which itself is a process that involves being trapped by the meaning ascribed to cognitive events (e.g., thoughts, emotions, and images) and which can then limit the use of adaptive methods of behavioral and emotional regulation [10]. Cognitive defusion involves viewing thoughts, emotions, and images as what they are – merely cognitive events– rather than “reality”. It reflects an expansion of attention and awareness of one’s ongoing experience, and is thought to result in being more detached from one's ongoing thoughts, including worries and thoughts that may be difficult for the person. For example, an adolescent with a headache might have a thought that pain is a sign of a brain tumor, even though tests have not established this as fact. To the extent that the adolescent is fused to this thought, and therefore experiences the thought as reflecting reality, the adolescent would likely experience anxiety and distress when he or she experiences pain. On the other hand, if the adolescent is defused from thoughts, and views it as merely one (of many thoughts), he or she would likely experience less anxiety. ACT promotes cognitive defusion by teaching and encouraging the use of a number of strategies, such as learning to view thoughts as "just thoughts" and not necessarily as representing reality [12]. Consistent with the ACT model, research supports the beneficial effects of defusion training on the emotional distress associated with negative statements [13,14]. Research also shown improvements in pain tolerance [15] and pain thresholds [16] during a cold pressor task after defusion instructions.

ACT theory hypothesizes that cognitive fusion is positively associated with negative outcomes, such as pain intensity and disability, in chronic pain populations. Although some support for this hypothesis has been found in studies with adults (e.g. [17–19]), to our knowledge, the associations between cognitive fusion and outcomes in young people with chronic pain have not yet been examined.

Pain catastrophizing is another pain-related domain that could potentially be significant positively related to cognitive fusion. Catastrophizing is an exaggerated way of negative thinking that can occur during a current or anticipated pain experience [20]. Catastrophizing can be distinguished from cognitive fusion in that the former specifically includes thought content (i.e., *what* one thinks, in this case, negative thoughts about pain), whereas the latter reflects thought processes (i.e., *what one does* with one's thoughts, in this case, fuse with them and view them as reflecting reality). Although catastrophizing and cognitive fusion are distinct, they could potentially interact and influence each other. For example, catastrophic thoughts could potentially facilitate and enhance cognitive fusion. Thoughts such as, "I can't stand this pain anymore", "I wonder whether something serious may happen" or "I become afraid that the pain will get worse", could potentially make it difficult to step back and calmly experience the situation in a defused kind of way; that is, avoiding automatic adoption of the thought as reflecting reality and/or by not taking the context into consideration in order to choose the most appropriate response. This raises the possibility that pain catastrophizing could contribute to reacting in a fused way among individuals with chronic pain.

A consideration of the three components of pain catastrophizing (rumination, magnification and helplessness) [21] also supports this idea. Rumination involves persistent and constant worry, which is also present in cognitive fusion. Consistent with this idea, depressive rumination in adults has been found associated with cognitive fusion [22], and magnification and helplessness are examples of exaggerated thinking. Other preliminary evidence consistent with the idea that catastrophizing might enhance cognitive fusion comes from research showing that (1) catastrophizing is associated with depression, including in children [23–27] and (2) depression is associated with cognitive fusion in adults [11,17,22]; thus, it would be reasonable to hypothesize a significant positive association between cognitive fusion and pain catastrophizing in young people.

Given these considerations, the objectives of this work were (1) to test the hypothesized associations between cognitive fusion and three pain-related variables (pain intensity, disability and pain catastrophizing) and (2) to test a model of cognitive fusion functioning as a mediator between catastrophizing and disability. We predicted that cognitive fusion would be associated with higher pain intensity, more pain catastrophizing and greater disability, and that cognitive fusion would mediate the association between pain catastrophizing and disability.

## MATERIALS AND METHODS

### Participants

The study sample was one of convenience recruited from five secondary schools of Tarragona, a city in the south-east of Catalonia. Some information on this group of participants has already been reported in a previous paper that examined the psychometric properties of a Catalan version of the Cognitive Fusion Questionnaire (CFQ)[28]. Study eligibility criteria included (1) being able to read, write, and speak in Catalan and (2) being between 11 and 20 years old. Participants were excluded if they had an intellectual disability that interfered with participation in the study procedure and if they did not experience any pain episode in the previous three months. A total of 456 adolescents and young adults were approached to participate in this study. Of those, 20 % (n=89) did not return the informed consent and 5% (n=23) declined to participate, leaving 344 who were enrolled into the study. Three hundred and fourteen of participants (91%) experienced some form of pain in the three months prior to the assessment (e.g., headache caused by a flu episode or damage to the ankle by a fall) and, of those, complete CFQ data was obtained from 281 (89%), who were included in the analyses. The average age of the 281 participants was 14.44 years (SD = 1.69, range = 11 to 20 years) and 61% were girls/young women. The most frequent pain locations were head (23%), abdomen (14%) and knee (10%).Twenty percent of participants for whom we have information regarding the presence or absence of chronic pain, that is, a pain for longer than 3 months, had chronic pain. See Table 1 for additional information.

## Table 1. Sample characteristics (N=281)

| | | |
|---|---|---|
| **Sex** (N, %) | | |
| Girls/Young women | 172 | 61 |
| **Age** (Mean, SD) | 14.44 | 1.69 |
| **Chronic pain** [a] (N, %) | 57 | 20 |
| **Maximum intensity of the most frequent pain**[b] (N=278) (Mean, SD) | 7.91 | 1.68 |
| **Localization of the most frequent pain**[c] (N, %) | | |
| Head (exclude face) | 64 | 23 |
| Abdomen | 39 | 14 |
| Knee | 28 | 10 |
| Thigh | 20 | 7 |
| Mid-Back | 20 | 7 |
| Calf | 11 | 4 |
| Ankle | 11 | 4 |
| Upper back | 11 | 4 |
| Throat/neck | 10 | 4 |
| Shoulder | 10 | 4 |
| Low back | 10 | 4 |
| Groin/pubic area | 8 | 3 |
| Hand | 7 | 3 |
| Wrist | 5 | 2 |
| Foot | 5 | 2 |
| Chest | 5 | 2 |
| Hip | 3 | 1 |
| Elbow | 2 | 1 |
| Forearm | 2 | 1 |
| Face/jaw/temple | 2 | 1 |
| Upper arm | 1 | 0 |

[a] Information missing in 70 cases (there were 70 cases because this question was introduced a posteriori (after some students had completed some assessment forms), so 66 of 281 cases were not asked about that question, the other 4 cases did not answered to that question). Chronic pain is defined as pain lasting for more than 3 months.
[b] Information missing in 3 cases.
[c] Information missing in 7 cases.

## Procedure

As described in a previous report[28], seven secondary schools were invited to participate in this study and five agreed. A letter was delivered to the children and parents of the participating schools. Either one of the parents could provide consent to allow his/her child to participate; adolescents 18 years old or older provided their own informed consent. Adolescents whose parents agreed to participate and older adolescents who provided their own consent completed the assessment forms during one hour within school time following the instructions provided by research staff. Questions regarding pain duration which were used to identify participants with chronic pain were added to the study protocol once data collection had begun. Thus, information regarding the presence of chronic pain in the sample is missing for 70 of the cases: 4 of them did not provide the requested information, and 66 were never asked the questions. Those 70 cases were not included in the analyses comparing the participants with and without chronic pain; however, they were included in all of the other analyses.

## Measures

### Socio-demographic/descriptive information

All participants were asked to provide information related to their age, sex, school grade and pain location by means of a pain drawing that divided the body figure into 21 areas [29]. Questions about pain duration were added to the protocol after data collection had begun, so pain duration information is only available for a subset (n = 211) of the participants.

### Cognitive Fusion

The Cognitive Fusion Questionnaire (CFQ) [22,28] is a 7-item measure that is designed to assess the single construct of cognitive fusion. Respondents rate each item that reflects an aspect of cognitive fusion on a 1-7 Likert scale, with 1 = "Never true" and 7 = Always true." A higher score indicates higher levels of cognitive fusion; the possible score range is 7 to 49. The CFQ has evidence supporting its reliability and validity in adults and adolescents, including a good internal consistency coefficient (Cronbach's alpha between 0.88 and 0.93 in studies with different adult samples, with and without chronic pain, namely: community samples, people with a mental health problem, people with multiple sclerosis with chronic pain, and caregivers of people with dementia), and significant associations with measures of related constructs [22,28]. In the current sample the Cronbach's alpha was 0.79. Examples of the CFQ items are: "*I get so caught up in my thoughts that I am unable to do the things that I most want to do*", "*I over-analyze situations to the point where it's unhelpful to me*" or "*It's such a struggle to let go of upsetting thoughts even when I know that letting go would be helpful*".

Pain intensity

Participants were asked to report whether they had any pain in the last three months and identify the most frequent pain problem over that period of time. They were then asked to rate the recalled worst pain intensity in the past three months for the most frequent pain problem using the 0 – 10 Numerical Rating Scale (NRS-11). This procedure of requesting information of the recalled worst pain intensity has been successfully used with non-clinical pediatric pain samples (e.g., [30]). Pediatric pain intensity reports provided with the NRS-11 have demonstrated their validity in children as young as 6 years old [30–33]. The endpoints for the NRS-11 were ‘‘No pain” and ‘‘Very much pain”. Pain was considered chronic if it had lasted for three months at least [34,35]. In addition, those indicating that they had intermittent pain (i.e., had at least some pain-free periods) had to report a minimum of one pain episode each month in the previous three months in order to be deemed to have chronic pain. This criterion has also been used successfully in other studies (e.g.[1,36]).

Pain catastrophizing

Pain Catastrophizing was assessed by the child version of the 13-item Pain Catastrophizing Scale (PCS-C) [23] which asks respondents to indicate the extent to which they respond to pain with catastrophic beliefs on a 0 = “Not at all” to 4 = “Extremely” scale. The PCS-C assesses 3 catastrophizing domains: rumination (i.e. *“I cannot keep it out of my mind”)*, magnification (i.e.*“I am afraid that pain will get worse”)* and helplessness (i.e.*“There is nothing I can do to reduce pain”*) [37]. In the current study, a slightly modified version of the PCS-C was translated into Catalan, following a back-translation process. Specifically, respondents were asked for the frequency of beliefs instead of intensity because frequency was more understandable in Catalan (i.e., 0=”Never”, 1= “Rarely”, 2=”Sometimes”, 3= “Often”, and 4=”Always”). This form has already been used successfully in previous studies [38,39]. Higher scores indicate more frequent pain catastrophizing beliefs (scoring from 0 to 52). The English version of the PCS-C has shown to be reliable and valid in community and clinical samples of children and adolescents [23,37] and the Catalan version used in this study also demonstrated good internal consistency (Cronbach's alpha for the total scale = 0.86).

### Disability

The 15-item Functional Disability Inventory (FDI) [40] was used to assess the impact of illness on children's physical and psychosocial everyday functioning over the last 2 weeks. With the FDI, respondents indicate the extent to which they have trouble engaging in each of 15 activities on a 0 = "No trouble" to 4 = "Impossible" Likert scale. Higher scores indicate more disability (possible range, 0 to 60) [40,41]. The inventory has shown suitable reliability as well as construct, concurrent and predictive validity and clinical utility in young people [40–42]. It has been used with a wide range of chronic pain-related conditions such as back pain, fatigue syndrome, fibromyalgia and arthritis [43–47]. The Catalan version has also evidenced good psychometric properties [48] and the measure demonstrated excellent reliability (Cronbach's alpha = 0.88) in the current sample.

## Statistical Analyses

A square root transformation was applied to the FDI score in order to normalize the distribution of this measure, given that the planned regression analyses assume that the mediator and predictor variables be distributed normally. We then used t-tests to determine if there were differences between participants with chronic pain (N=57) and those with acute pain (N= 154) on the CFQ score and pain-related variables; participants for which we did not have the information about pain status were not included in these analyses. We also computed a series of Pearson correlation coefficients to test the hypothesized associations between the cognitive fusion scores and the pain-related variables (pain intensity, pain catastrophizing and disability). These associations were also examined separately in the chronic pain and acute pain groups, and z statistics were computed to determine if there were significant differences between the correlation coefficients of the two groups. Finally, we performed a series of multiple regression analyses to determine if cognitive fusion mediated the association between catastrophizing and disability. Most of analyses were performed using SPSS 17.0 (IBM, http://www01.ibm.com/software/analytics/spss/). The exception to this was that the z statistics obtained to explore the significance of the difference between two correlation coefficients were computed using http://vassarstats.net/rdiff.html. For the mediation analyses, we installed the custom dialogs for SPSS (indirect.spd) developed by Andrew F. Hayes which allow for mediation analysis and to estimate bootstrap confidence intervals for total and specific indirect effects of the independent variable (catastrophizing) to the dependent variable (disability) through the mediator variable (http://www.afhayes.com/introduction-to-mediation-moderation-and-conditional-process-analysis.html). In order to conclude positive evidence for mediation, the analyses must meet three criteria according to Baron and Kenny [49]. First, changes in the levels of the independent variable should reflect changes in the mediator (*path a*). Second, changes in the mediator should reflect changes in the dependent variable (*path b*). Third, when *paths a and b* are controlled, the relationship between the independent and dependent variables (*path c*) should become non-significant (complete mediation) or should decrease (partial mediation).

## RESULTS

### Differences between chronic pain and acute pain groups

Two hundred and eleven people from the total sample of participants answered the questions about pain duration and were defined as having chronic pain (i.e. pain that had been present for 3 months or longer) or acute pain (i.e. when the duration of pain was less than 3 months). Statistically significant differences between the chronic pain (N=57) and acute pain (N=154) groups were found on the maximum pain intensity level (t (207) = 4.64, p < 0.001, effect size: r = 0.31). No other differences between the two groups were identified for any of the variables in the study.

**Table 2. Differences between chronic pain and acute pain group**

| | Total Sample Mean (SD) | Chronic pain group Mean (SD) | Acute pain group Mean (SD) | t (df) |
|---|---|---|---|---|
| **Cognitive Fusion** | 24.47 (8.66) | 26.95(9.36) | 24.31 (8.19) | 2 (209) |
| **Pain Catastrophizing** | | | | |
| **-Total score** | 23.50 (10.15) | 25.78 (10.35) | 22.58 (10.03) | 1.94 (189) |
| **-Helplessness** | 9.11 (4.77) | 9.98 (5.34) | 8.74 (4.55) | 1.59 (189) |
| **-Magnification** | 5.04 (2.94) | 5.57 (2.67) | 4.84 (3.04) | 1.52 (189) |
| **-Rumination** | 9.35 (4.31) | 10.24 (4.07) | 9.00 (4.38) | 1.76 (189) |
| **Maximum intensity of the most frequent pain** | 7.91 (1.68) | 8.79 (1.39) | 7.63 (1.68) | 4.64 (207)** |
| **Disability** | 11.33 (9.58) | 10.84 (6.81) | 11.74 (10.17) | 0.31(125.07) |

** p<0.001

## Pearson's correlations between cognitive fusion, pain-related variables, and age

Consistent with the study hypotheses, all of the pain-related variables showed positive associations with cognitive fusion, including pain catastrophizing (r = 0.47, p < 0.001) and its subscales (Helplessness, Rumination and Magnification; rs range = 0.39 to 0.42, all ps < 0.001), maximum intensity of the most frequent pain (r = 0.24, p < 0.01) and disability (r = 0.28, p < 0.001). The CFQ score was also significantly and positively correlated with age (r = 0.19, p < 0.01). When we examined those correlations in the chronic and acute pain groups separately, we did not find significant differences between the correlations with pain-related variables of the two groups. However, the chronic pain group showed a stronger correlation (r = 0.37) between cognitive fusion scores with age (z score = 2.96, p < 0.01), than the acute pain group (r = -0.08).

**Table 3. Pearson's correlations between CFQ and pain related variables**

| | CFQ Total Score | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Total Sample** (N=281) | **Chronic pain** (N=57) | **Acute pain** (N=154) | **Total Sample** (N=281) | | | | | | |
| **Pain Catastrophizing** (N=194)[a] | | | | | | | | | | |
| **1. Total score** | 0.47** | 0.54** | 0.43** | 1 | 0.89** | 0.72** | 0.87** | 0.28** | 0.21* | 0.08 |
| **2. Helplessness** | 0.39** | 0.50** | 0.33** | 0.89** | 1 | 0.50** | 0.66** | 0.23* | 0.20* | 0.14^ |
| **3. Magnification** | 0.42** | 0.39* | 0.43** | 0.72** | 0.50** | 1 | 0.48** | 0.22* | 0.15^ | 0.06 |
| **4. Rumination** | 0.39** | 0.47** | 0.35** | 0.87** | 0.66** | 0.48** | 1 | 0.26** | 0.17^ | -0.01 |
| **5. Maximum intensity of the most frequent pain** (N=278)[b] | 0.24* | 0.31^ | 0.17^ | 0.28** | 0.23* | 0.22* | 0.26** | 1 | 0.10 | 0.13^ |
| **6. Disability** (N=257)[c] | 0.32** | 0.30^ | 0.20^ | 0.21* | 0.20* | 0.15^ | 0.17^ | 0.10 | 1 | 0.00 |
| **7. Age** | 0.19* | 0.37* | -0.08 | 0.08 | 0.14 | 0.06 | -0.01 | 0.13^ | 0.00 | 1 |

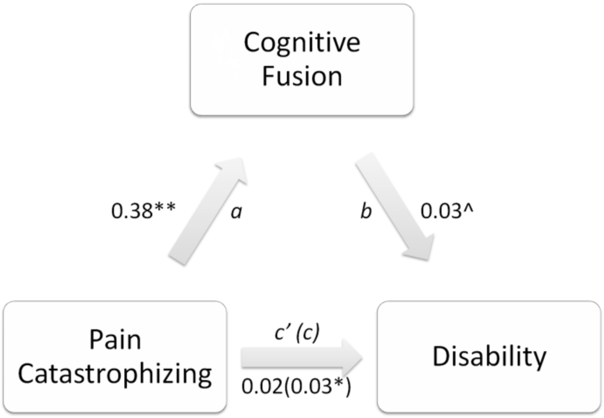
** p<0.001
* p<0.01
^ p<0.05

[a] Information about catastrophizing missing in 87 cases of 281 participants.
[b] Information about pain intensity missing in 3 cases of 281 participants.
[c] Information about disability missing in 24 cases of 281 participants.
1=Pain Catastrophizing (total score); 2=Pain Catastrophizing (helplessness); 3=Pain Catastrophizing (magnification); 4=Pain Catastrophizing (rumination); 5=Maximum intensity of the most frequent pain; 6=Disability; 7=Age

## Mediation analyses

The meditational model proposed cognitive fusion as a mediator for the association between pain catastrophizing and disability. In support of the model, catastrophizing was found to predict cognitive fusion (*path a*: β=0.38, t(177)=6.76, p<0.001), cognitive fusion predicted disability (*path b*: β=0.03, t(177)=2.24 , p<0.05) and catastrophizing was found to predict disability (*path c*: β=0.03, t(177)=2.84, p<.01). Given that the *paths a* and *b* were statistically significant, indirect effects were tested using the Booststrapping method with bias corrected confidence intervals, and the mediating role of cognitive fusion was confirmed (β=0.01, CI= 0.002 to 0.024 at 95% confidence level, 5000 bootstrap resamples). In addition, the direct effect of catastrophizing on disability became non-significant when controlling for cognitive fusion (β=0.02, t(177)=1.55, p>0.05), consistent with the conclusion that the effects of catastrophizing on disability were fully mediated by cognitive fusion.

**Figure 1. Indirect effect of catastrophizing on disability through cognitive fusion**



Note: ^p<0.05, *p<0.01, **p<0.001

## DISCUSSION

This study tested the hypothesized associations between cognitive fusion and important pain-related variables in a sample of young people. The results supported the study hypotheses, and indicate that cognitive fusion is related positively with catastrophizing beliefs, pain intensity and disability. The findings are consistent with previously published reports on the correlates of cognitive fusion in adults with chronic pain, that have also shown significant positive associations between cognitive fusion and both pain intensity and disability [17–19].

To our knowledge, this study is the first time that the association between cognitive fusion and pain-related catastrophizing has been examined. However, there is evidence supporting significant associations between depressive rumination (a concept that appears related to pain-related rumination) and cognitive fusion in adults [22], which is congruent with our findings. Our results also show that cognitive fusion works as a mediator between pain catastrophizing and disability. These findings suggest that young people who have greater catastrophizing and high levels of cognitive fusion showed increased disability. This finding is consistent with the idea that catastrophizing - which is an exaggerated way of negative thinking - might play some role in facilitating greater fusion, which then may influence disability. While this potential mediation effect of cognitive fusion on disability has not previously been evaluated to our knowledge, Vowles and [50]colleagues have presented evidence for another ACT process – acceptance – as having a similar mediating effect between catastrophizing and disability. These findings are consistent with the present results, as acceptance is negatively correlated to the fusion process[28].

Apart from the association between catastrophizing and disability, cognitive fusion could potentially mediate the relationships between other variables and disability, in particular, those relationships where catastrophizing has been found to work as a mediator. For example, parental catastrophizing has been shown to mediate the relationship between protective parental responses to pain and children's disability over time[51]. Based on the current findings it is reasonable to hypothesize that cognitive fusion might also work as a mediator or co-mediator of these associations. Parents who are more fused to thoughts about the negative consequences of pain may react by protecting their child more than parents who deal with negative thoughts in a defused way.

Cognitive fusion has not been examined as an outcome or treatment mediator in ACT research. However, *decentering* a similar concept to cognitive defusion has been explored in adults. Decentering has been defined as: *"the ability to observe one's thoughts and feelings as temporary objective events in the mind, as opposed to reflections of the self, or one's circumstances, that are necessarily true" (p117)*[52]. Decentering has been found to increase after an applied relaxation treatment for generalized anxiety disorder [53] and after a mindfulness intervention for people with a variety of conditions (i.e. general stress, chronic pain, primary depression, cancer) [54]. It is possible that these interventions may also have beneficial impact on cognitive fusion (i.e., decrease cognitive fusion), and that these changes in cognitive fusion might then explain some of the benefits of these treatments. An important next step is to determine the effects of ACT and other

Cognitive Behavioral Treatments (CBT) on the processes hypothesized by ACT theory (e.g. committed action, values) to explain treatment outcomes, and identify those that actually mediate treatment outcome in the context of clinical trials. A study that analyzed differences and common points between CBT and ACT found that both therapeutic alternatives seem to have a great deal of overlap[55].

The findings from this study, if replicated in clinical samples, could potentially be useful for better patient-treatment matching. That is, they suggest the possibility that young people who report more catastrophizing and cognitive fusion could potentially benefit more from learning defusion techniques than young people who report less catastrophizing. Future clinical trials assessing cognitive fusion and catastrophizing and comparing different forms of CBT (such as relaxation, cognitive restructuring, pacing) and ACT strategies (such as mindfulness, defining valued directions or building committed action) are needed to determine if some strategies are more or equally effective for some patients with specific levels of catastrophizing and fusion.

When we examined the relationship between age and cognitive fusion, the findings showed that higher scores in cognitive fusion were reported by older participants, and that this association was even stronger among those participants with chronic pain than those with acute pain. If replicated in other samples, these results suggest that cognitive fusion may be a construct that is somewhat age-related, or even that negative experiences such us having chronic pain might influence the development of cognitive fusion. However, because the current study used a cross-sectional design, we were not able to identify or test for causal associations. Future longitudinal research is needed to test for and clarify causal associations between age, the experience and chronicity of chronic pain, and the development of cognitive fusion.

This study has some important limitations that should be considered when interpreting the findings. First, the study participants were a convenience sample of young people from the general population. Thus, they might differ in some important (but unknown) ways from the general population of individuals who are 11 to 20 years old. Replication of the findings is needed in order to determine their generalizability. Second, given that just 20% of participants that provided information about the duration of pain had chronic pain, we must be cautious when extrapolating our results to clinical samples. Third, as mentioned previously, the data are cross-sectional. Therefore it is not possible to draw conclusions regarding the causal relationships among the study variables. Clinical trials of ACT and other CBT interventions that assess cognitive fusion as a potential mediator of treatment outcome are needed to be able to determine the impact of cognitive fusion on outcomes. Moreover, additional studies with young people with chronic pain and greater disability levels are required to further validate these results.

Despite the study's limitations, however, the findings provide useful new information in a new sample (young people) regarding the importance of a concept that is central to ACT, an intervention that has been shown to benefit individuals with chronic pain, including young people. Future lines of research that would be worthwhile pursuing include: (1) exploring how cognitive fusion works as a treatment outcome for chronic pain problems given its relationship with pain related-variables; (2) examining the extent to which the defusion techniques used in ACT and other CBT interventions reduce cognitive fusion and at the same time, determine if that reduction improves pain and pain-related disability in young people with chronic pain; and (3) exploring how cognitive fusion is related to the other core processes described by the ACT model (e.g., acceptance, committed action, self as a context). Finally, the results support the need for longitudinal and experimental research to understand how cognitive fusion changes over time in youth with chronic pain, and if those changes in cognitive fusion have a subsequent influence on pain and other key measures of functioning. The results of such research could substantially increase our understanding of how processes such as cognitive fusion influence overall adjustment to pain and quality of life in young people.

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# 5. DISCUSSION

In this Dissertation we studied three cognitive factors related to the pain experience of adolescents: pain catastrophizing, pain beliefs and cognitive fusion. The first three objectives concerned the use of sound psychometric measures for assessing these cognitive factors. The final objective focused on the association between cognitive fusion and pain-related variables. In this section, we summarize and discuss the main results of each study. We then identify the main limitations of this research and suggest alternative future lines of study.

Our first objective was to evaluate the psychometric properties of the Pain Catastrophizing Scale for Children. Specifically, we aimed to explore the factor model, internal consistency, and convergent, discriminant and criterion-related validity of the questionnaire. Our findings confirmed the original three-factor structure (Rumination, Magnification and Helplessness subscales) (Crombez et al., 2003). However, for two main reasons and as proposed by Parkerson (Parkerson et al., 2013) and Pielech (Pielech et al., 2014), they also supported the removal of item 8 ("*When I am in pain, I want the pain to go away*"). First, because it contributes to a poor overall model fit and second, because it has no significant variability and, as previous studies have reported (Parkerson et al., 2013; Pielech et al., 2014), it produces a ceiling effect (most adolescents scored highly in this item).

Our study of the internal consistency of the PCS-C showed good properties for the total scores and for the Rumination and Helplessness subscales. However, the scores for the Magnification subscale presented a weak internal consistency (below 0.70), a result that is supported by two other studies (Crombez et al., 2003; Tremblay et al., 2008). An explanation for this is that the Magnification subscale has only three items. Study I also provides support for the convergent, discriminant and criterion-related validity of the PCS-C scores. We would like to point out that as convergent and discriminant validity has not previously been examined, this is new information regarding the psychometric properties of the PCS-C.

Our second objective was to develop and analyze a revised version of the Pediatric Survey of Pain Attitudes (Peds-SOPA). This revised version, in which new items have been added and existing items have been removed, contains 35 items (five per scale). The original pediatric version of the SOPA comprised 29 items. The seven-factor structure of the original form of the Peds-SOPA was confirmed with an improvement in factor fit and factor loadings. The scores for the Peds-SOPA-R showed an improvement in reliability for all scales except Medical Cure, which requires extra work. Criteria validity was supported by the associations between the scales of the questionnaire and pain intensity and disability. As we hypothesized, negative or maladaptive pain beliefs (i.e. disability and solicitous beliefs) were positively related to pain intensity and/or disability, whereas some pain beliefs that were considered positive or adaptive (control and exercise scales) were negatively related to these pain-related variables. These associations had been reported in previous studies with clinical samples (Engel et al., 2012; Mikael Thastum et al., 2005) and samples of schoolchildren (Huguet, Eccleston, Miró, &

Gauntlett-Gilbert, 2009; Miró et al., 2014; Miró, Nieto, & Huguet, 2008). Three scales of the Peds-SOPA (Medical Cure, Medication and Emotion) were not related to any of these variables. Results were found in the same direction for Medication (Engel et al., 2012) and Medical Cure in samples of adolescents (Miró et al., 2014).

Our third objective was to evaluate the psychometric properties of the Cognitive Fusion Questionnaire when used with adolescents. Our findings showed that when the Cognitive Fusion Questionnaire was used with Catalan adolescents, the one-factor solution of the original CFQ (Gillanders et al., 2014) was confirmed. Moreover, the criteria validity was also supported by a positive correlation of the CFQ with anxiety sensitivity and a negative association with acceptance. These relationships have also been established in other studies (Greco et al., 2008; McCracken et al., 2014). The CFQ has recently become popular and has been translated into other languages apart from Catalan (e.g. Spanish, Italian, Persian/Farsi, Turkish, Dutch, German, French, Portuguese – both European and Brazilian – Polish, Japanese, Hebrew and Greek) (Gillanders, 2014). However, to our knowledge, studies of its psychometric properties have only been conducted with adult samples using the Spanish (Romero-Moreno, Márquez-González, Losada, Gillanders, & Fernández-Fernández, 2014) and Italian (Orco et al., 2012) versions. In line with our findings, the scores of both these studies demonstrate suitable reliability and validity properties. Moreover, the Spanish study also confirmed the original one-factor structure that we also found in our results.

Our final objective was to study the association between cognitive fusion and pain intensity, disability and pain catastrophizing, and evaluate the role of cognitive fusion as a mediator between catastrophizing and disability. Our findings showed a positive significant association between cognitive fusion and pain intensity and disability, which is in line with other studies of adults with chronic pain (Wicksell, Olsson, et al., 2010; Wicksell et al., 2008). They also showed a positive association between cognitive fusion and pain catastrophizing. In fact, this is the first time the association between these cognitive constructs has been explored. Cognitive fusion was found to mediate the relationship between pain catastrophizing and disability, which implies that adolescents with higher catastrophizing tend to be more cognitively fused and become more disabled. Another study, by Vowles and colleagues (Vowles, McCracken, & Eccleston, 2008), is in line with our findings, although those authors showed the mediating role of acceptance (another ACT process that is negatively correlated to cognitive fusion) between catastrophizing and disability in a sample of patients with chronic pain.

Finally, we also wished to discuss the role played by these cognitive factors in the fear–avoidance model (Vlaeyen & Linton, 2012). As we mentioned in the introduction, pain catastrophizing is one of the main components of the fear-avoidance model. According to this model, catastrophizing leads to pain being interpreted as something threatening, which activates pain-related fear, which in turn generates avoidance behaviors and hypervigilance to body sensations. These avoidant and hypervigilant reactions to pain may lead to disuse, foster disability, and result in depression. Maladaptive beliefs (such as that one is unable to function because of pain or that others should be solicitous in response to one's pain) may also boost avoidance behaviors that can result in disuse, disability, and depression. For example, the belief that one is unable to function because of pain contributes to avoidance behaviors when, for instance, an adolescent avoids doing sport or going out with friends, leading to a higher level of disability. On the other hand, adaptive beliefs (such as that one is able to control pain or that exercise is beneficial for managing pain) could help to reduce pain-related fear and promote confrontation with daily activities, leading to functioning. These ideas are in line with an extension of the fear-avoidance model proposed by Pincus and colleagues (Pincus, Vogel, Burton, Santos, & Field, 2006), which is called the social beliefs approach. Pincus et al. (2006) suggest that it is not necessary to activate fear to generate disuse and disability and that maladaptive pain beliefs may themselves (without fear) produce avoidance behaviors that lead to poor recovery, whereas healthy pain beliefs lead to recovery. Cognitive fusion would regulate the way that young people relate to their feelings, thoughts or beliefs. This process could influence the levels of pain catastrophizing and pain-related fear, which in turn could influence pain-avoidance behavior, thus affecting the level of functioning and disability. This prediction was empirically confirmed in Study IV, where cognitive fusion mediated the relationship between catastrophizing beliefs and disability. In fact, cognitive fusion promotes a decrease in the reaction to thoughts and feelings that may attenuate pain avoidance behavior (one possible reaction), which may contribute to disability.

## Main limitations of this Dissertation

In each article the specific limitations of each individual study are described. In this section, however, we highlight the two main limitations that are shared by all the studies developed for this Dissertation. First, as all the samples were convenient community samples from the general population, we do not know how representative they are of the clinical population. This could affect the generalizability of our results to clinical populations. It is therefore necessary to evaluate the psychometric properties of the three questionnaires and reexamine Study IV in samples of adolescents with chronic pain. Second, as the participants were aged between 11 and 20, the results may not be generalizable to younger children. Additional studies with younger children are therefore needed. Despite these limitations this Dissertation provides relevant contributions to the study of cognitive factors involved in the pain experience of adolescents.

## Future research lines

We hope the results of this Dissertation will inspire future lines of research. We would like to make the following proposals:

1) Certain psychometric properties of the questionnaires remain unexplored or unsupported and new studies are needed to

examine them. Examples are: for the PCS-C, clinical utility and feasibility; and for the Peds-SOPA-R, convergent and discriminant validity for all scales and criteria validity for Emotion, Medical Cure and Medication.

2) More work is needed to improve the reliability of the Medical Cure scale of the Peds-SOPA-R.

3) A new line of research is needed to explore these cognitive concepts (pain catastrophizing, pain beliefs and cognitive fusion) at early stages. Several questions remain unsolved, such as: When do the first thoughts about pain catastrophizing appear? Do the pain beliefs evolve or change with age? Does cognitive fusion appear at early ages or does it develop later? This would allow us to identify whether these cognitive factors, along with other physical, emotional, and behavioral variables, help to determine how chronic pain develops in young people.

4) We believe that these cognitive factors should be included as outcomes in chronic pain treatment studies in order to help clinicians and researchers evaluate how changes in these cognitive factors predict changes in pain related variables. This information could help to identify the most effective treatments for adolescents who are high catastrophizers, have maladaptive beliefs about pain, or have a high level of cognitive fusion. It may also be interesting to examine which adaptive beliefs predict the

best results after chronic pain treatment in order to promote them as part of the treatment process.

5) Finally, it would be interesting to test the role that other beliefs (apart from pain catastrophizing) and cognitive fusion have in the fear-avoidance model of chronic pain in children and adolescents. We believe the results would be in line with the hypothesis presented in the Discussion section, though further research is needed to confirm this assumption.

# 6. CONCLUSIONS

1. Cognitive factors (such as catastrophizing, pain beliefs and cognitive fusion) are relevant concepts for explaining the pain experience of adolescents. From the literature existing on pediatric pain, pain catastrophizing emerges as one of the most influential cognitive variables. Other pain beliefs are beginning to be studied, and cognitive fusion seems to be a promising and useful construct. It is essential to have suitable tools to properly assess these cognitive factors.
2. The Pain Catastrophizing Scale for Children is one of the most popular questionnaires for evaluating catastrophizing in children and adolescents. Its scores were reliable and valid (i.e. they showed consistent, discriminant and criteria validity) when used with a sample of Catalan schoolchildren. The original three-factor structure with 13 items was confirmed, though the removal of certain items (8 and 12) seemed to improve the fit of the structure.
3. The pediatric version of the Survey of Pain Attitudes is one of the main scales for evaluating the pain beliefs of children and adolescents. As this survey showed several weaknesses, a modified version was developed. The scores of this modified version demonstrated adequate reliability for most scales (except Medical Cure) and good criteria validity for all maladaptive belief scales and two adaptive belief scales (Control and Exercise). The original Peds-SOPA seven-factor structure has been confirmed.

4. The Cognitive Fusion Questionnaire, a brief measure of cognitive fusion, has shown valid and reliable scores when used with adolescents. This questionnaire may help to study the role of cognitive fusion in the development of pain in young people.
5. Cognitive fusion has been found to be moderately-to-strongly related to pain-related variables (pain intensity, disability and pain catastrophizing) and to mediate the association between pain catastrophizing and disability.

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