Chapter 6
Tools That Should Be Considered in Pain Assessment: Cognitive Factors, Emotion, and Personality

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Abstract In this chapter, an overview is provided of instruments to measure pain, neuropsychological domains, pain cognitions, emotion, and personality constructs. Interpretational and conceptual issues will be discussed that should be considered in pain assessment. For example, the interpretation of neuropsychological test results should be done with caution. These tests often rely on multiple cognitive functions for intact performance, and, hence, performance on a specific test can be impaired due to cognitive deficits other than the function targeted with that test. Also, emotional and personality factors are highly interrelated constructs; as such, it is advisory to examine them concurrently in relation to pain assessments. Finally, it is important to keep in mind that personality and psychological constructs and affective states and traits are used interchangeably to refer to different levels of explanation.

6.1 Introduction

The outcomes of pain assessments are determined by multiple factors. Next to cognitive functions, emotional and personality factors, such as depression and anxiety, also play key roles in determining these outcomes. In addition, it is crucial to consider the differences between pain assessment tools and the various pain constructs they target (e.g., clinical pain intensity, experimental pain tolerance) in relation to cognitive, emotional, and personality aspects.

In this chapter, a brief overview will be given of available instruments to measure neuropsychological domains, pain cognitions, and emotional and personality constructs, together with a short outline of tests for malingering or insufficient effort. The most commonly used pain tools will be summarized, and findings of pain assessments

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will be briefly discussed in relation to different pain components that can be distinguished. Finally, a short discussion of the interrelatedness between the neuropsychological, pain cognition, and emotional and personality constructs is provided.

6.1.1 Psychometric Properties

The decision to use a specific test or questionnaire relies on many factors. First, an instrument must be reliable, in that it yields similar outcomes when administered multiple times over different test sessions (test-retest reliability). Similarly, an instrument should have high interobserver reliability, that is, test assessment and scoring is standardized such that the same results are found by different examiners, and high internal consistency, indicating that different items within an instrument show consistent results. Furthermore, validity must be high, indicating that an instrument should correlate strongly with other instruments tapping the same psychological constructs (convergent validity) but not with instruments more sensitive to other psychological constructs (divergent validity); together, these two factors determine the construct validity of an instrument. In addition, content validity reflects validity of the items (in terms of formulation, selection, etc.) and is established by expert raters. Finally, criterion validity indicates the extent to which an instrument is associated with an external (non-test) criterion.

For many of the tools discussed in this chapter, comprehensive reference books exist with additional details regarding the instruments, norm scores, and their reliability and validity. These include, for example, Lezak et al. (2012) and Strauss et al. (2006) for neuropsychological tests and McDowell (2006) for an overview of health-related questionnaires.

6.2 Cognitive Functions

In this section, we will give an overview of various cognitive domains, together with examples of tests employed to measure these functions. Only a short overview of available tests will be given; for detailed test descriptions, see Lezak et al. (2012). Next, we will briefly discuss caveats that exist when interpreting these tests, in the context of chronic pain.

Cognitive function is a general construct encompassing multiple abilities, each relying on partially different brain circuits. While broad categories, such as memory, executive function, and processing speed, are commonly found in the literature, more recent studies have provided evidence in favor of further differentiation within these cognitive domains. Unfortunately, there is little consensus on the exact subdivision of these domains. Within the domain of executive functions, for example, it has been suggested that there may be as many as six different components (Testa et al. 2012). For the sake of clarity, we will follow commonly accepted theories

regarding the underlying structure of different cognitive abilities. Overall, it is generally accepted that intelligence, executive function, memory, and attention and speed of information processing form separate cognitive domains. Other domains can be distinguished, such as praxis and motor skills, visuospatial functioning, language, and perception; however, to date there is little evidence that these functions play substantial roles in relation to acute or chronic pain. Therefore, these latter domains will not be discussed in this chapter. Finally, a brief overview of suitable tests to measure insufficient effort and malingering is provided.

6.2.1 Intelligence

Intelligence is probably one of the most ill-defined constructs in psychology with many different operationalizations and subdivisions. It is a broad concept that aims to capture the integrity of various types of cognitive functions across different domains. One common distinction is that between crystallized and fluid intelligence. Crystallized intelligence refers to knowledge and skills, whereas fluid intelligence encompasses abilities such as reasoning, problem-solving, and flexibility. Multiple intelligence tests exist, including the National Adult Reading Test (NART) as an indicator of premorbid intelligence and the Raven Progressive Matrices (RPM) which primarily measures fluid intelligence. Alternatively, the Wechsler Adult Intelligence Scale (WAIS, currently the 4th edition is out) is an entire battery devised to get a comprehensive estimate of intellectual functioning. The fourth edition of this test contains both core and supplemental tests, which are used to measure four different domains as well as to obtain a full-scale IQ estimate. The domains are the Verbal Comprehension Scale, Perceptual Reasoning Scale, Working Memory Scale, and the Processing Speed Scale. Finally, the Kaufman Adult Intelligence Test (KAIT) is widely used as an indicator of intelligence. The core battery of the KAIT contains six subtests, three of which measuring crystallized intelligence and three measuring fluid intelligence.

6.2.2 Executive Functions

Executive function is another particularly heterogeneous concept that includes a variety of cognitive abilities. Previous studies have distinguished between numerous functions, such as flexibility, set switching, inhibition, working memory, abstract reasoning, planning, and even more. Factor analysis has shown that three constructs, inhibition, set shifting, and monitoring and updating account for a major part of performance on the more traditional executive function tests (Miyake et al. 2000).

There is general consensus that executive functions rely on frontal-subcortical pathways that include regions such as the prefrontal cortex and the basal ganglia; the prefrontal cortex, part of the anterior cingulate cortex, and parietal cortex are

neurocognitive resources commonly recruited during executive function tests (Niendam et al. 2012). However, the diversity and heterogeneous nature of executive functions and the tests employed is founded by the fact that differential activation patterns exist between various tests purportedly measuring executive function (Niendam et al. 2012). This is commonly interpreted as support for the existence of multiple different executive functions.

A major problem when measuring executive functions is that many of the so-called executive function tests are heterogeneous in nature. This is in part due to the large variety of functions grouped under the term executive function; as a result, correlations between these tests are often nonsignificant and/or small (Miyake et al. 2000). In addition, these tests tap multiple functions, and impaired performance may therefore be the result of cognitive deficits other than executive function loss. The most obvious one is processing speed; performance on many executive function tests is actually expressed in terms of completion time and is therefore particularly sensitive to reduced (motor and/or mental) processing speed. Whenever possible, it may therefore be appropriate to calculate proportion scores, since such scores successfully limit involvement of functions such as processing speed (Stuss et al. 2001; Oosterman et al. 2010b). Similarly, learning and memorization processes play important roles in rule induction tasks such as the Wisconsin Card Sorting Task (WCST), in which rules have to be induced based on feedback (Oosterman et al. 2014). Therefore, pure executive function tests are scarce, and caution is needed when making firm claims based on the results of tests that are reliant on multiple executive or cognitive functions.

Numerous test of executive function have been developed over the years. Some of the best-known and frequently used tasks are tests such as the Stroop Color/Word test and the Hayling Sentence Completion Test to measure inhibition of prepotent responses, the Trail Making Test to measure cognitive flexibility, the Digit Span Backward test to measure working memory, the Tower of London and the Tower of Hanoi test to measure planning ability, the WCST and the Brixton Spatial Anticipation Test to measure set shifting, and the Fluency test to measure speeded verbal production. Other, more extensive, test batteries have been developed in order to have a more comprehensive examination of various executive functions. The Behavioural Assessment of the Dysexecutive Syndrome (BADS) battery was developed to get a more ecologically valid indication of executive function. This battery contains six tests that mimic situations one can encounter in daily life; for example, the Zoo Map Test measures planning ability and consists of a route that has to be planned on a map of a zoo, while taking into account certain rules that have to be adhered to. Next to planning, this battery measures functions such as organization, problem-solving, mental flexibility, inhibitory control, and monitoring behavior and contains two questionnaires (DEX), one to be completed by the patient him- or herself and one to be completed by a significant other. The advantage of this battery is that these tests resemble daily life situations and may therefore be more sensitive in detecting problems a patient encounters in daily life, something that many of the more traditional executive function tests fail to do. One disadvantage is that detailed norm scores are only available for the entire battery; there are no norm

scores available for comparative purposes (other than a very rough profile score) when one wishes to use a single or some subtests of this battery. The Delis-Kaplan Executive Function System (D-KEFS) consists of nine subtests, each measuring different aspect of executive function, namely, flexibility of thinking, inhibition, problem-solving, planning, impulse control, concept formation, abstract thinking, and verbal and spatial creativity. Several of these tests consist of adjusted versions of preexisting tests. Normative scores are available, also for the individual subtests. Finally, the Cambridge Neuropsychological Test Automated Battery (CANTAB) contains several tests, some of which assess executive functions such as planning, set shifting, and working memory. Norm scores are stratified according to age and IQ estimates. The advantage of this battery is that it does not rely heavily on verbal abilities, making it particularly suitable for clinical assessment in patients with different cultural backgrounds or patients with reduced verbal abilities as is the case in patients suffering from conditions such as aphasia or dementia.

6.2.3 Memory

With regard to memory, a common distinction is that between *explicit memory*, which includes episodic and semantic memory, and *implicit memory*, which is concerned with procedural knowledge and priming. These two memory systems depend on functionally different brain systems, with explicit memory being mostly dependent upon the hippocampal formation and neocortical regions, whereas subcortical structures such as the basal ganglia play a crucial role in implicit memory processes. In this section, the focus will be on learning and episodic memory processes, as these have been implicated mostly in relation to pain. Commonly used measures of verbal episodic memory include the Rey Auditory Verbal Learning Test (RAVLT), the Hopkins Verbal Learning Test (HVLT), and the California Verbal Learning Test (CVLT), and the Benton Visual Retention Test (BVRT) and Location Learning Test (LLT) as measures of visual episodic memory. Some memory test batteries are also available, measuring different aspects of memory processes. For example, the Wechsler Memory Scale (currently the 4th edition has been published) consists of seven subtests. Index scores can be calculated representing auditory memory, visual memory, visual working memory, and immediate and delayed memory. Another widely used battery is the Rivermead Behavioural Memory Test (RBMT-3). This battery taps everyday memory functioning and was particularly designed for memory assessment in patients with acquired brain damage, although it is also used in other frail populations such as patients with dementia. This battery consists of 14 subtests, focusing on aspects such as verbal memory, memory for faces, and prospective memory, among others. For all tests, extensive normative data are available, making them of particular use in clinical practice.

When assessing memory functioning, it is important to consider the role of executive control processes in explicit memory performance, which facilitate memory performance through strategic encoding and retrieval processes. This is particularly

the case for encoding and free recall measures; cued recall and recognition tests are less sensitive to executive (dys)functioning. In current standard memory tests, these processes are difficult to segregate; one exception to this is the CVLT, which was specifically designed to measure processes and strategies that are part of learning and memorization stages. Apart from encoding and retrieval processes, this test measures abilities such as organizational capacities (e.g., semantic clustering) in storing information as well as pro- and retroactive interference between two word lists that have to be memorized. Hence, this test provides detailed information regarding the executive control processes involved in memory performance. Besides executive processes, reduced speed of processing and attentional dysfunction may impair performance on memory tests. For example, several studies suggest that reduced processing speed plays a significant role in age-related decline in memory performance (e.g., Lee et al. 2012). Hence, memory may be diminished for various reasons, and this should be considered when assessing memory performance.

6.2.4 Attention and Speed of Information Processing

Attention and speed of information processing are strongly related constructs and will therefore be discussed together. Traditionally, attentional functioning has been divided into sustained attention, selective attention, and divided attention. Inherent to these definitions, a large overlap is present with the so-called executive functions. For example, the ability to inhibit prepotent responses requires the ability to selectively attend to one aspect while ignoring other aspects and can be measured with tasks such as the Stroop Color/Word test. Similarly, flexibility as measured with the Trail Making Test requires the ability to divide attention between multiple sets of stimuli. Some validated tests to measure sustained attention are, for example, the continuous performance test, the d2-test, and subtests of the Test of Everyday Attention (TEA). This latter is a test battery with high ecological validity, containing eight subtests measuring functions such as selective attention, cognitive flexibility, sustained attention, and more. Norm scores are available for the TEA, and this battery is applicable to various clinical populations, from all ages. Additional information regarding attention and processing speed can be obtained from the Stroop Word and the Stroop Color cards, as well as from the Trail Making Test part A, or from simple and choice reaction time tests that are, for example, part of the CANTAB.

6.2.5 Insufficient Effort and Malingering

A clear distinction between insufficient effort and malingering is crucial. Lack of effort refers to performance that is worse than can be expected on basis of demographics (e.g., age, educational achievement) and condition (e.g., the deficits cannot be fully explained by a neurological, psychiatric, or developmental disorder).

Malingering denotes intentionally feigned or exaggerated cognitive deficits or psychological symptoms, in the context of an external motive. Tests of insufficient effort or malingering are strongly recommended in case of several situations, such as in case of litigation or when a financial incentive is involved. To diagnose malingering, the following four criteria have to be met: (1) presence of a substantial external incentive, (2) evidence from neuropsychological testing (e.g., negative or probable response bias, discrepancy between test data, and documented background), (3) evidence from self-report (e.g., self-reported symptoms are discrepant with known patterns of brain functioning or behavioral observations), and (4) criteria 1–3 cannot be fully accounted for by neurological, psychiatric, or developmental disorders (see Slick et al. 1999). Tests have been developed to get an indication of potential insufficient effort or malingering. These tests are designed to appear difficult but they are actually extremely easy to perform and can therefore even be validly administered to patients with conditions such as neurological disorders (e.g., Tombaugh 1997). Sometimes positive feedback is provided to the patients during task performance, which may trigger an even larger decline in performance in case of malingering. Normally, a cutoff score is used, and performance beyond this point is indicative of malingering. Well-validated tests include the Test of Memory Malingering (TOMM), the Word Memory Test (WMT), and the Rey 15-Item Memory Test (RMT) and questionnaires such as the Structured Inventory of Malingered Symptomatology (SIMS). Apart from these tests, other (sub)tests may be indicative of possible malingering of insufficient effort (e.g., from the WMS or from the WAIS or particular items from questionnaires such as the Minnesota Multiphasic Personality Inventory-II).

Even though these tasks are very simple, studies have shown that performance can no longer be interpreted validly in case of severe cognitive decline, such as is the case in dementia patients. A significant part of these patients perform below the cutoff point on malingering tests, a finding that is associated with disease severity as expressed with measures such as the Mini-Mental State Examination (Merten et al. 2007).

6.2.6 Interpreting Neuropsychological Test Performance in Chronic Pain Patients

Several studies have reported compromised cognitive functioning in chronic pain patients, and some studies additionally found inverse associations between pain reports and cognitive functioning, in that an increase in pain severity is associated with a decline in cognitive ability. Domains typically affected include executive function, attention, processing speed, and episodic memory (Moriarty et al. 2011). However, many studies focusing on executive function and attention actually relied on tasks that also place heavy demands on processing speed. Importantly, there is evidence that the executive impairments found in chronic pain patients can be accounted for by reduced processing speed (Oosterman et al. 2012; Veldhuijzen et al. 2012). Furthermore, whereas controlled memory performance is diminished in

these patients, more automatic memory processes are intact (Grisart and Van der Linden 2001). This illustrates the importance of task selection if one wishes to obtain reliable indicators of cognitive function performance in patients. More specifically, since attention and speed of information processing may be particularly affected in chronic pain, it is crucial that future studies isolate the genuine memory and executive function impairments in these patients.

Regarding the interpretation of malingering tests in chronic pain patients, it is crucial to consider whether an external incentive is present. Although studies have shown alarmingly high prevalences of malingering in over 30 % of patients with pain or somatoform disorders (Mittenberg et al. 2002), such high numbers appear to be directly related to those involved in litigation or compensation seeking (Gervais et al. 2001); in case there is no legal context or financial incentive, evidence for malingering in these patients is limited or even absent.

6.3 Pain Cognitions

Pain cognitions constitute a separate category, apart from cognitive functions measured with neuropsychological tests. These cognitions refer to aspects such as pain catastrophizing and pain control beliefs and determine in important part pain coping strategies and future development of emotional disorders associated with pain (e.g., depression and anxiety). In addition, these factors may be associated with metacognitions regarding pain-related thoughts (Yoshida et al. 2012). Traditionally, questionnaires are used to measure these cognitions, such as the Pain Catastrophizing Scale (PCS), the Beliefs about Pain Control Questionnaire (BPCQ), the Pain Beliefs Questionnaire (PBQ), the Pain Beliefs and Perception Inventory (PBPI), the Pain Cognition List (PCL), the Multidimensional Locus of Pain Control Questionnaire (MLPC), the Coping Strategies Questionnaire (CSQ), the Pain Attitudes Questionnaire (PAQ), and the Survey of Pain Attitudes (SOPA). Various studies have published on psychometric properties of these questionnaires; overall, these appear to be in order (e.g., Osman et al. 2000; Ter Kuile et al. 1993).

The importance of these cognitions is underscored by many studies. They are, for example, positively associated with experimental pain sensitivity (Forsythe et al. 2011) and may predict future pain following skeletal trauma (Vranceanu et al. 2014). Also, cognitions such as catastrophizing tend to be associated with pain intensity ratings and with pain interference or pain-related disability in various pain populations (e.g., Osborne et al. 2007; Turner et al. 2002).

6.4 Emotional Factors and Personality Traits

The notion that pain sensitivity is strongly associated not only to emotional factors but also to certain personality characteristics probably seems rather intuitive to most of us. Moreover, emotional factors such as high levels of anxiety are an integral part

of higher-order personality constructs such as neuroticism. Therefore, it is difficult to disentangle the unique roles of personality and emotions, respectively, in pain experience. Adding to this, some basic emotions, like fear and anxiety, are also often regarded to be personality traits (e.g., Spielberger 1970), and some personality constructs that encompass a collection of behavioral and affective features, like depression, are sometimes referred to as (transient) affective states (e.g., Sáez-Francàs et al. 2014). Therefore, it may be crucial to consider emotions and personality concurrently when examining pain and pain-related disability. This section will provide a brief outline of frequently employed questionnaires to measure emotion and personality in relation to pain. Next, personality factors and their interrelatedness with emotion and pain will be discussed. The focus will be on personality characteristics related to negative affectivity/neuroticism given the large amount of studies on pain experience in various conditions characterized by heightened (trait) anxiety and/or depression.

6.4.1 Questionnaires

Some of the most widely used scales to measure depression include the Beck Depression Inventory (BDI), the Hamilton Rating Scale for Depression (HRSD), the Depression Anxiety and Stress Scale (DASS), the Zung Depression Scale (ZDS), the Center for Epidemiological Studies Depression Scale (CES-D), the Hospital Anxiety and Depression Scale (HADS), and the Geriatric Depression Scale (GDS) for older adults. In general, studies show that these scales are quite capable of differentiating between chronic pain patients with depression and those without (e.g., Geisser et al. 1997; Turk and Okifuji 1994). Note it has been suggested that the use of higher cutoff scores may be more suitable for these patients, such as a score of 19 instead of 16 on the CES-D (Turk and Okifuji 1994), as these questionnaires contain questions addressing somatic symptoms and patients are more likely to give positive responses on these items.

There are also various questionnaires to assess anxiety personality constructs. For instance, the State-Trait Anxiety Inventory (STAI) is one of the best-known instruments used to measure trait and state anxiety and has often been used in pain studies. Other commonly used measures include the Beck Anxiety Inventory (BAI), the Hamilton Anxiety Rating Scale (HARS), the DASS, and the HADS. Finally, pain-related anxiety or fear of pain can be measured with the Pain Anxiety Symptom Scale (PASS) or the Fear of Pain Questionnaire (FPQ), respectively.

Several instruments have been developed to measure personality and individual differences. The Minnesota Multiphasic Personality Inventory (MMPI) is one of the best-known instruments and has often been used to study pain as a function of personality. The MMPI assesses personality profiles based on ten clinical scales. The first three scales are hypochondriasis, depression, and hysteria (the so-called neurotic triad), and patients suffering from chronic pain generally tend to score relatively high on these scales (Gough 1946). Among these three classifications of personality, depression has received a relatively large amount of attention in the empirical

literature, and many (self-report) scales have been developed for its assessment. Other well-known instruments are the NEO-PI, the Eysenck Personality Inventory (EPI), Cattell's 16PF, and the HEXACO Personality Inventory, among others.

While most studies on negative affectivity/neuroticism, personality, and pain have employed self-report instruments measuring the relative *presence* of negative traits, a handful of questionnaires have been developed to measure the relative *absence* of traits such as fear and anxiety. These (self-report) measures are readily found in research on psychopathy. For instance, it has recently been shown that fearlessness and low anxiety are comprehensively captured by the Psychopathy Checklist-revised (PCL-R (Neumann et al. 2013)), a semi-structured interview used to assess psychopathy based on maladaptive behavioral tendencies. Other instruments, such as the Psychopathic Personality Inventory (PPI; (Lilienfeld and Andrews 1996)), include subscales targeting lack of fear and anxiety. For an overview of emotion and personality questionnaires, see McDowell (2006).

6.4.2 *Anxiety and Depression as Clinical Conditions: Negative Affectivity as a Common Factor*

In general, many have focused on depression and various anxiety-related conditions as more or less discrete psychiatric classifications representing a collection of behavioral and psychological features rather than moods and emotions. However, there is evidence that many personality disorders share genetic vulnerabilities and can be described in terms of overarching dimensions representing the commonalities between the disorders (Vaidyanathan et al. 2009). Indeed, there is a growing body of evidence highlighting a link between higher prevalence of pain conditions and personality constructs encompassing a heightened predisposition to experience aversive states such as fear and anxiety (i.e., *negative affectivity*; (Watson and Clark 1984)), often combined with feelings of depression (i.e., *neuroticism*, (Sáez-Francàs et al. 2014)). For instance, McWilliams and colleagues (2003, 2004) found relatively large associations between chronic pain and various anxiety disorders in a (non-institutionalized) sample. More specifically, individuals diagnosed with an anxiety disorder were more likely to suffer from chronic pain conditions. This positive association has also been found in relation to other personality constructs such as alexithymia (Shibata et al. 2014), depression, and increased trait anxiety (Celiker et al. 1997), thus suggesting that negative affectivity might be a common denominator in explaining the relationship between personality facets and pain. Such an approach could also partly account for the high comorbidity between depression and anxiety disorders, which are clinical conditions characterized by high negative affectivity.

In contrast, recent (neuroscientific) findings point out that pain experience is reduced in individuals scoring unusually *low* on personality traits such as fear and anxiety. These studies often measured diminished negative affective reactivity as a function of psychopathy. From a clinical perspective, psychopathy is a personality disorder characterized by abnormalities in the interpersonal-affective domain

combined with antisocial personality styles (Hare 2003). The interpersonal-affective component includes personality characteristics positing reduced negative affectivity, such as callousness and lack of empathy, a lack of feelings of guilt or remorse and shallow affect. Therefore, studying pain in relation to psychopathy provides insight into personality correlates of pain in those scoring low on personality traits related to reduced negative affectivity. Earlier studies in offenders with psychopathy used painful shocks to study reduced fear reactivity in offenders with psychopathy (Hare 1965a, b). While these studies showed that pain elicited less fear reactivity in psychopathy, they were not primarily concerned with pain itself. More recent neuroscientific studies are beginning to elucidate how the interpersonal-affective disturbances found in youth and adults with psychopathic tendencies are related to various aspects of pain. These studies were primarily focused on empathic pain, and, taken together, the findings indicate a negative relationship between empathic pain and interpersonal-affective functioning (Decety et al. 2013; Lockwood et al. 2013; Marsh et al. 2013). That is, the increased presence of personality predispositions capturing reduced negative affectivity is related to reduced neural responses to stimuli depicting other individuals experiencing pain.

6.4.3 Extraversion

In addition to neuroticism, some researchers have argued that extraversion is also an important personality factor when it comes to pain. Extraversion is a personality dimension that includes sub-components such as sociability, high activity levels, and positive emotionality. Thus, extraversion encompasses personality facets related to positive psychological adjustment to pain. It has been suggested that individuals scoring high on extraversion should show higher pain thresholds and tolerance (Lynn and Eysenck 1961). This notion has received some empirical support, and there is evidence that extraversion is related to the employment of more efficient strategies to cope with pain, while increased negative affectivity/neuroticism is linked to the use of maladaptive coping strategies (for a more extensive discussion, see Ramírez-Maestre and Esteve 2013; Ramírez-Maestre et al. 2004). Unfortunately, there are relatively few studies on the role of extraversion in populations suffering from chronic pain, and future studies should aim to incorporate measures of extraversion (Table 6.1).

6.5 Pain Tools and Different Components

Different tools are currently employed for pain assessment purposes; for an overview, see McDowell (2006). The most widely used include the McGill Pain Questionnaire (MPQ), Brief Pain Inventory (BPI), the Chronic Pain Grade (CPG), the Oswestry Low Back Pain Disability Questionnaire, visual analogue scale (VAS),

Table 6.1 An overview of available instruments

Domain		Instrument
Neuropsychology[a]	Intelligence	KAIT, NART, RPM, WAIS-IV
	Executive function	BADS, Brixton Spatial Anticipation Test, CANTAB, Digit Span, D-KEFS, Fluency, Hayling Sentence Completion Test, Stroop Color/Word test, TMT, Tower of London/ Hanoi, WCST
	Memory	BVRT, CVLT-II, HVLT, LLT, RAVLT, RBMT 3, WMS-IV
	Attention processing speed	CPT, d2, TEA, TMT-A, Stroop Word and Color cards
	Malingering and insufficient effort	MMPI, Rey 15-item Memory test, SIMS, TOMM, WMT
Pain Cognitions[a]	Catastrophizing, control beliefs, attitudes	BPCQ, CSQ, MLPC, PAQ, PBPI, PBQ, PCL, PCS, SOPA
Emotion[a]	Depression	BDI-II, CES-D, DASS, GDS, HADS, HRSD, ZDS
	Anxiety	BAI, DASS, FPQ, HADS, HARS, PASS, STAI
Personality[a]	Extraversion, neuroticism, depression	Cattell's 16PF, EPI, HEXACO Personality Inventory, MMPI, NEO-PI
	Lack of anxiety and fear, coldheartedness	PCL-R, PPI

BADS Behavioural Assessment of the Dysexecutive Syndrome, *BAI* Beck Anxiety Inventory, *BDI* Beck Depression Inventory, *BPCQ* Beliefs about Pain Control Questionnaire, *BVRT* Benton Visual Retention Test, *Cattell's 16PF* Cattell's 16 Personality Factor Test, *CANTAB* Cambridge Neuropsychological Test Automated Battery, *CES-D* Center for Epidemiological Studies Depression Scale, *CPT* Continuous Performance Test, *CSQ* Coping Strategies Questionnaire, *CVLT* California Verbal Learning Test, *DASS* Depression Anxiety Stress Scale, *D-KEFS* Delis-Kaplan Executive Function System, *EPI* Eysenck's personality Inventory, *FPQ* Fear of Pain Questionnaire, *GDS* Geriatric Depression Scale, *HADS* Hospital Anxiety and Depression Scale, *HARS* Hamilton Anxiety Rating Scale, *HRSD* Hamilton Rating Scale for Depression, *HVLT* Hopkins Verbal Learning Test, *KAIT* Kaufman Adult Intelligence Test, *LLT* Location Learning Test, *MLPC* Multidimensional Locus of Pain Control Questionnaire, *MMPI* Minnesota Multiphasic Personality Inventory, *NART* National Adult Reading Test, *NEO-PI* NEO Personality Inventory, *PASS* Pain Anxiety Symptom Scale, *PAQ* Pain Attitudes Questionnaire, *PBPI* Pain Beliefs and Perception Inventory, *PBQ* Pain Beliefs Questionnaire, *PCL* Pain Cognition List, *PCL-R* Psychopathy Checklist-revised, *PCS* Pain Catastrophizing Scale, *PPI* Psychopathic Personality Inventory, *RAVLT* Rey Auditory Verbal Learning Test, *RBMT* Rivermead Behavioural Memory Test, *RPM* Raven Progressive Matrices, *SIMS* Structured Inventory of Malingered Symptomatology, *SOPA* Survey of Pain Attitudes, *STAI* State-Trait Anxiety Inventory, *TEA* Test of Everyday Attention, *TMT* Trail Making Test, *TOMM* Test of Memory Malingering, *WAIS* Wechsler Adult Intelligence Scale, *WCST* Wisconsin Card Sorting Test, *WMS* Wechsler Memory Scale, *WMT* Word Memory Test, *ZDS* Zung Depression Scale

[a]The functions within each domain represent a selection of those aspects relevant in relation to pain assessments; naturally, each domain encompasses more aspects than currently denoted in this table

numerical rating scale, Short Form 36 Bodily Pain Scale (SF-36 BPS), Faces Pain Scale (FPS), Verbal Descriptor Scale, and Self-Rating Pain and Distress Scale. When distinguishing between the different pain components, scales such as the MPQ are useful. In case of cognitive impairment, scales such as the FPS and VAS may be less reliable; additional information from observation tools is advisable then.

The literature on factors contributing to pain reports and experience is extensive. Sometimes, controversial findings have been reported, which may be due to factors such as differences in study design and the different pain components that have been assessed. Next to a distinction between findings that result from either clinical or experimental pain assessment methods, a crucial differentiation is one between different pain components, such as sensory and cognitive-evaluative or affective-emotional aspects, since the processing of these aspects relies on different neural pathways. For example, whereas the processing of sensory-discriminative pain component relies on more posterior brain structures as well as the primary and secondary somatosensory areas (the "lateral pain system"), the cognitive-evaluative and affective-emotional aspects are primarily being processed by frontal-limbic brain regions (the "medial pain system"). This system includes brain regions also heavily involved in cognitive functions (e.g., dorsolateral prefrontal region, anterior cingulate cortex, hippocampal formation) as well as in the processing of affective information such as fear and anxiety (e.g., orbitofrontal and ventromedial prefrontal cortex, amygdala). This overlap is evident in studies showing interrelatedness between pain reports and cognitive, psychological, and personality measurements.

In experimental pain studies, consistent patterns of results have been observed showing particular overlap between medial pain aspects on the one hand and emotional or cognitive aspects on the other. In patients with fibromyalgia, for example, depressive symptoms were found to be associated with neural activation patterns in those brain regions associated with affective pain processing, but not with the more sensory-discriminative pain pathway (Giesecke et al. 2005). Similarly, several studies showed that mood induction alters pain tolerance, but not pain intensity levels (e.g., Loggia et al. 2008; Kut et al. 2011; Villemure et al. 2003). Cognitive inhibition is also significantly associated with pain tolerance levels, but not with pain threshold (Oosterman et al. 2010a). Some studies do not, however, support this overlap, in that emotion induction has also been associated with both altered pain intensity and unpleasantness ratings in healthy controls (Kamping et al. 2013).

6.6 The Overlap Between Cognition, Emotion, and Personality in Relation to Pain

From the previous sections, it is evident that both personality/emotional and cognitive factors are significantly associated with clinical and experimental pain reports. The extent to which these factors are interrelated is unclear as the

evidence is unequivocal. For example, in fibromyalgia patients, neuroticism and conscientiousness are associated with catastrophizing, whereas neuroticism, agreeableness, and openness relate to pain anxiety. Similarly, another study showed that factors such as fear and catastrophizing are strongly associated with negative personality constructs (e.g., neuroticism, Lee et al. 2010). Catastrophizing may mediate the relationship where higher dispositional optimism is associated with reduced endogenous pain facilitation responses (Goodin et al. 2013). Finally, significant associations have been reported between pain cognitions and personality constructs such as neurotic traits, depression, and anxiety (Williams et al. 1994).

On the other hand, evidence regarding the relationship between cognitive functioning and emotional/personality constructs is less conclusive. For example, both cognitive inhibition and fear of pain may independently contribute to experimental pain tolerance (Oosterman et al. 2010a). It has furthermore been shown that the effects of mood on pain processing may be independent from attentional factors (Villemure and Bushnell 2009). On the contrary, catastrophizing may increase the distractive effects of pain on concurrent task performance, in both pain-free volunteers and in chronic pain patients (Crombez et al. 2002; Vancleef and Peters 2006). High catastrophizers may further have a heightened attentional focus on pain (Seminowicz and Davis 2006). In addition, depression and, to a lesser extent, anxiety and catastrophizing predict self-reported memory problems in chronic pain patients (Muñoz and Esteve 2005). Catastrophizing and coping may also be associated with memory functions as assessed with neuropsychological tests (Jorge et al. 2009). However, relationships of catastrophizing or depressive symptoms with processing speed, attention, and executive function may be less clear (Oosterman et al. 2012; Veldhuijzen et al. 2012), and, overall, not much support exists for the notion that psychological and pain cognition scores are related to cognitive test performance in chronic pain patients (see Moriarty et al. 2011, for a review).

6.7 Recommendations for Clinicians

When deciding which tools to use, several points are important to consider. Pain can be reliably assessed with measures such as the NRS, assessing pain from a unidimensional point of view, or with more generic tools assessing multiple dimensions of pain, such as the MPQ and CPG. It is advisable to assess cognitive functioning, since many patients suffering from chronic pain report cognitive problems (mostly memory and concentration) and display mild cognitive decline. When one wishes to have an extensive assessment of cognitive functioning, batteries such as the WAIS-IV (full-scale IQ), D-KEFS (executive functioning), TEA (attention), and WMS-IV (memory functioning) can be employed. For brief examinations of cognition, the NART or WAIS-IV subscales (IQ estimate), WMS-IV subtests (e.g. story recall), or word list learning paradigms such as the RAVLT, HVLT, or CVLT-II (memory functioning) and the TMT, Stroop test, or WCST (executive functioning)

can be administered. Subtests of the TMT and Stroop may also be used to measure psychomotor speed and attention.

Regarding pain cognitions, catastrophizing measured with, for example, the PCS or PCL and pain beliefs measured with lists such as the PBPI or CSQ are recommended since catastrophizing behavior and pain beliefs have been repeatedly associated as important factors influencing (or even moderating) pain processing and treatment success in chronic pain patients. Lists such as the BDI-II, CES-D, STAI, and PASS are useful to measure the level of depressive symptoms and anxiety. HEXACO and NEO-PI, as well as the PPI, are suitable to measure personality traits and negative affectivity, respectively.

6.8 Summary and Conclusions

This chapter focused on interpretational and conceptual issues that should be considered in pain assessments and also provided a comprehensive overview of neuropsychological tests, pain cognitions, and emotional and personality constructs. One conclusion is that the interpretation of neuropsychological test results should be done with caution, bearing in mind that neuropsychological tests require multiple functions for intact performance. Also, emotional and personality factors are highly interrelated constructs, suggesting it is important to examine them concurrently in relation to pain assessments. Finally, it is important to keep in mind that personality and psychological constructs and affective states and traits are used interchangeably to refer to different levels of explanation.

Future studies are needed in which the diverse pain components are compared in relation to cognition, emotion, and personality. Not only does this imply a distinction between experimental indices such as pain threshold and pain tolerance levels, but it is also crucial to differentiate between sensory-discriminative, affective-motivational, and cognitive-evaluative aspects. Particularly little is known about potential differences between these latter two aspects in relation to cognitive and emotional/personality factors. It has been suggested that brain regions involved in cognitive-evaluative aspects (e.g., prefrontal cortex) are compromised in irritable bowel disease, whereas feelings of anxiety and depression may be primarily associated with diminished gray matter density in brain regions involved in processing the affective-motivational pain aspects (Seminowicz et al. 2010). Therefore, a differentiation between the medial pain aspects may be pivotal when examining associations with cognitive and emotional factors; hence, a further examination of these different pain aspects in relation to neuropsychological performance, pain cognitions, and emotional and personality constructs is warranted. The independent contributions of each factor should be investigated when possible, preferably within mediation models that concurrently integrate these distinct functions.

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