A Psychophysiological Investigation of Self-Harm Ideation and Enactment

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Thesis submitted in fulfilment of the requirements for the Degree of Doctor of Philosophy

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September 2015

Abstract

Background

Many individuals have thoughts of self-harm, but only a proportion act upon them and engage in self-harm behaviour. Currently, our ability to differentiate which individuals who think about self-harm will translate those thoughts into actions, is limited, and is a critically important area for future research to inform suicide prevention efforts. This thesis presents three empirical studies underpinned by the recently proposed model of suicidal behaviour, the Integrated Motivational-Volitional model (IMV; O'Connor, 2011), which specifically makes predictions about factors which differentiate between suicidal thoughts and behaviours. Two putative variables within this model may be sensitivity to emotional and physical pain; indeed threshold and tolerance for physical pain have been found to be elevated in individuals who have engaged in self-harm, relative to healthy controls. Furthermore, previous research has suggested that elevated physical pain tolerance may be potentiated by an individual's state of distress. Emotional pain sensitivity, however, has been demonstrated to be reduced in those who have engaged in self-harm. Whether changes in sensitivity to emotional and physical pain are a cause or a consequence of self-harm, is unknown, and could be an important target for treatment and intervention development.

Methods

A systematic review of the literature around physical pain and self-harm (n = 25 studies) was conducted in order to assess the quality and extent of the existing knowledge in this area. Three empirical studies were then conducted investigating the relationship between emotional and physical pain in self-harm ideation and enactment. Two of these (n = 102; n = 88) were laboratory studies, employing a combination of self-report and behavioural measures of emotional and physical pain sensitivity, and one took the form of a large online self-report study (n = 351).

Results

The studies within this thesis found no evidence to suggest that behavioural threshold or tolerance for physical pain is elevated in self-harm ideation or enactment. Furthermore, pain tolerance does not appear to differ as a function of stress. Self-reported sensitivity to

emotional pain was highest in those who had engaged in self-harm, followed by those who had ideated about self-harm and was lowest in healthy controls. There were no significant associations between self-reported and behavioural measures of emotional and physical pain sensitivity. Negative mood decreased following administration of a painful stimulus for all groups (controls, self-harm ideation and self-harm enactment). As predicted, motivational phase variables within the IMV did not differ significantly between the ideation and enactment groups, however, volitional phase variables did exhibit a significant difference.

Conclusions

The findings from this thesis provide some support for the IMV model of suicidal behaviour (O'Connor, 2011), demonstrating that the volitional phase variables impulsivity and exposure to social modelling of self-harm, differentiate between those with thoughts (only) of self-harm and those who have gone on to engage in the behaviour. This is an important finding with implications for intervention and treatment development. The similar pattern of elevated emotional pain sensitivity across self-harm ideation and enactment suggests that this could be a pre-motivational phase variable within the IMV. The lack of expected between-group differences in behavioural measures of emotional and physical pain call into question the findings of previous studies. Furthermore, as neither of the laboratory studies presented within this thesis found significant differences in pain threshold or tolerance between self-harm ideation, self-harm enactment and control groups, there is a clear need for more research in this area.

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List of Publications Arising from this Thesis

Kirtley, O. J., O'Carroll, R. E., & O'Connor, R. C. (2015). Hurting inside and out: The relationship between emotional and physical pain in self-harm ideation and enactment. *International Journal of Cognitive Therapy, 8*(2), 156-171.

Kirtley, O. J., O'Carroll, R. E., & O'Connor, R. C. (2015). The role of endogenous opioids in nonsuicidal self-injury: methodological challenges. *Neuroscience and Biobehavioral Reviews, 48*, 186-189.

Kirtley, O. J., O'Carroll, R. E., & O'Connor, R. C. (Submitted). A Systematic Review of Experimental Research into Pain and Self-Harm.

Acknowledgements

"Is there anyone so wise as to learn by the experience of others?"

Voltaire

During the course of my PhD, I have learned so much from the experience of so many wonderful others, and I hope very much that this has made me wiser.

Two very wise men, Professor Rory O'Connor and Professor Ronan O'Carroll, have been my supervisors and mentors for the last four years. They have been a constant source of support and encouragement. Rory and Ronan have always been so giving of their precious time and wealth of expertise, and I am incredibly grateful to have two such brilliant and kind supervisors. Whenever challenges arose, they were always there to guide me and inspire me. Thank you.

My mother, Elizabeth, has always been a source of unwavering support and has always believed in me. From my earliest days, she fostered my love of learning and has encouraged me to develop this into a passion for research. Thank you Mum, for always being there, for reading my papers, for driving me all the way up to Scotland to start university all those years ago, so that I could do what I really wanted to do. I would also like to thank my fantastic 'other' family, Jane, Bradley, Duncan and Lauren, for all of their support, not just for these last four years, but also for the winding journey it took to get here. My good friend, Tricia Stewart, is a constant inspiration and I endeavour to always put as much heart into my work as a psychologist, as she does in hers.

The last four years have brought some truly wonderful people into my life. I would like to thank Sophie Conaghan-Sexon and Emma Nielsen for being such great friends and for listening to me talk at length about my research for the last few years. Thank you to Eva Dumon for her encouragement in these final months of my PhD. I am very fortunate to have so many lovely friends and colleagues: Karen, Seonaid, Sarah, Jack, Tiago, Marco, Kat, Arlene, Gen, Matt and Leanne. Thank you for the late night chats when we are all still in the office, for the late night drinks and dinners when we manage to tear ourselves away from our desks, and for all the laughter and fun since I came to Glasgow in 2013. Jess gets

a special mention for being a complete superstar when, at the eleventh hour, all of my formatting went awry, she patiently sat with me reading out every single heading in my entire thesis so that I could put it right. Thank you! And a special thanks also to Sarah Eschle for doing a sterling job of proofreading my thesis. Thank you so much.

My heartfelt thanks go to the 545 people who have given their time to take part in my PhD studies. For people to trust me with their private and, often, very painful experiences around self-harm and suicide, is the privilege of a lifetime. Every person who has spoken to me during the course of my research has taught me a valuable lesson, and I hope that I have always seemed a willing student. Upon leaving the lab after participating in one of my studies, some participants have asked me 'Will it make a difference?' I always answer that it will, because that is what I passionately believe. And as I move into the next phase of my career in suicide research, I promise to do everything I can to make sure it really does make a difference.

Olivia J. Kirtley

September 2015

Author's Declaration

"I hereby declare that I am the sole author of this thesis, except where the assistance of others has been acknowledged.

It has not been submitted in any form for another degree or professional qualification."

Olivia J. Kirtley

September 2015

Chapter 1: Introduction

Background

This chapter provides an introduction to self-harm and the relationship between emotional and physical pain among those who think about and engage in self-harm. It also discusses current challenges in identifying which individuals who experience thoughts of self-harm will go on to enact self-harm behaviour and the possible value in exploring psychophysiological variables to explain affect regulation in self-harm. These research strands provide a rationale for the current thesis, informing three specific research questions outlined within this chapter.

Methods

The different nomenclature surrounding the definition of self-harm thoughts and behaviours is discussed and self-harm prevalence statistics are presented in order to highlight the extent of the problem. Emotional and physical pain in self-harm are discussed, as well as the potential relationship between these two variables in individuals who think about and engage in self-harm. A variety of theoretical models are discussed in relation to self-harm as a method of affect regulation and the Integrated Motivational-Volitional (IMV) Model of suicidal behaviour (O'Connor, 2011) is presented as a framework for investigating the transition from self-harm thoughts to behaviours.

Results

The IMV model is identified as an important contemporary framework, through which the transition from thoughts to behaviours may be better understood and predicted. The paucity of research evidence underlying the relationship between emotional and physical pain within individuals who self-harm is highlighted. Further exploration of this relationship may potentially provide critical insight into the affect regulating properties of self-harm.

Conclusions

This chapter presents the structure and aims of the current thesis, setting out the three key foci of the thesis: 1. the transition from ideation to enactment; 2. the relationship between emotional and physical pain in self-harm ideation and enactment and 3. How do established psychological variables associated with self-harm and suicide relate to emotional and physical pain? Each of these research strands is investigated within the

conceptual framework of the IMV model of suicidal behaviour and through the use of psychological and psychophysiological methods.

1.1 General overview

Recent figures estimate that over 804,000 people die by suicide globally each year (WHO, 2014), however far more people will have thoughts (ideate) about self-harm (self-injury), with or without suicidal intent, than will go on to harm themselves or die by suicide. Our knowledge regarding which of the individuals who ideate about self-harm, will go on to engage in (enact) the behaviour is poor and has been identified as a key priority area for future study (Klonsky & May, 2014).

Current models of suicidal behaviour, such as the Integrated Motivational-Volitional Model (IMV; O'Connor, 2011), have posited that variables linked with suicide may be differentially associated with ideation or enactment. Certain factors, e.g. being highly socially-perfectionistic, may therefore confer increased risk of developing suicidal ideation, but not of making a suicide attempt. A wide range of psychological variables have been consistently and reliably associated with suicide, but little is known regarding whether these are more strongly linked to suicidal ideation or enactment (O'Connor & Nock, 2014). Furthermore, there is a chronic dearth of research integrating psychological and psychophysiological correlates of suicidal behaviour, such as increased physical pain tolerance; a variable that has been suggested as a key component of an individual's acquired capability to make a suicide attempt (Joiner, 2005; Van Orden et al., 2010).

The relationship between physical and emotional pain has received much attention over the past decade, with seminal work in the field of social neuroscience (Eisenberger Lieberman & Williams, 2003) leading to a substantial body of literature on the topic. This and other studies suggest that there is a common neural circuitry for emotional and physical pain, such that if one is more sensitive to emotional pain, one will also be more sensitive to physical pain and *vice versa* (Eisenberger, Jarcho, Lieberman & Naliboff, 2006). However, the social neuroscience model of sensitivity to emotional and physical pain appears to contradict evidence from self-harm research, that has found those who self-harm appear to have a *lower* tolerance for emotional pain (Nock & Mendes, 2008; Nock, Wedig, Holmberg & Hooley, 2008) and yet a *higher* tolerance for physical pain (Franklin, Aaron, Arthur, Shorkey & Prinstein, 2012).

Not only does exploring increased pain tolerance in self-harm behaviour have the potential to extend our understanding of factors that may contribute to the translation of suicidal thoughts into suicidal behaviours, it also offers the opportunity to potentially answer another key question within the field: how does non-suicidal self-harm fulfil its function of relieving emotional pain? Regulating affect is one of the most frequently cited reasons for engaging in non-suicidal self-harm behaviour (Klonsky, 2007; O'Connor, Rasmussen, Miles & Hawton, 2009) and yet we still know very little about the mechanism(s) that result in self-harm bringing about such changes in mood (for further discussion see section 1.6 of this chapter; also Chapter 2, sections 2.3.3.2 and 2.3.6.2). Indeed, increased tolerance for physical pain may be specific to circumstances in which an individual is experiencing overwhelming emotional pain (Gratz et al., 2011), therefore clarifying the relationship between emotional and physical pain could represent a vital pathway to preventing suicidal and non-suicidal self-harm.

Whether or not these differences in emotional and physical pain tolerance also exist in those who ideate about self-harm, but have never engaged in the behaviour, is unknown. Should a similar pattern exist in both those who ideate about and enact self-harm behaviour, this could indicate that changes in the cognitive-affective pathways that regulate emotional and physical pain sensitivity begin to alter even before an individual has engaged in self-harm behaviour. Advancing our ability to predict which of the individuals who ideate about self-harm will go on to act upon their thoughts is a critical challenge for suicide prevention research. Improving our understanding of these factors could lead to innovative new interventions to prevent thoughts of self-harm from becoming suicide deaths.

The current chapter explores in more depth self-harm thoughts and behaviours (both suicidal and non-suicidal in motivation) and their relationship to emotional and physical pain tolerance, as well as other key psychological correlates. All of these factors are considered within the theoretical framework of the IMV model of suicidal behaviour (O'Connor, 2011). The final section of this introductory chapter describes the overarching research questions investigated herein and provides an overview of the thesis structure.

1.2 Introduction to self-harm

1.2.1 Non-suicidal and suicidal self-harm

There is an ongoing debate around the nomenclature and language we use when discussing and defining self-harm thoughts and behaviours; issues which are discussed more fully in section 2.3 of this chapter. In the UK, the term self-harm is most commonly used and refers to "self-injury or self-poisoning irrespective of the apparent purpose of the act" (NICE: National Institute for Health and Care Excellence, 2004, 2011). Behaviours included within this definition include cutting, burning or bruising of the skin and also the ingestion of prescription/non-prescription medications (in quantities that exceed recommended dosage) or chemical substances (Tantam & Huband, 2009). In part due to variations in the language used to define self-harm behaviours, prevalence estimates can differ markedly between sources.

Self-harm encompasses both suicidal and non-suicidal behaviours and is the term employed throughout this thesis, with a few exceptions where the work of US researchers is discussed and they have used the term NSSI (non-suicidal self-injury). The scope of self-harm behaviours included within the three studies presented in this thesis includes overdose, self-cutting, bruising, biting, scratching, hanging, jumping from a height, and inhaling car exhaust fumes. This is consistent with the NICE (2004; 2011) definition of self-harm. Where participants responded that their behaviours were exclusively without the intention to die, these were taken to be 'non-suicidal self-harm' behaviours, whereas if participants indicated their behaviours were carried out specifically with the intention to end their life, these were taken as 'suicidal self-harm' behaviours. Where participants endorsed both non-suicidal and suicidal motivations for engaging in self-harm, these were 'behaviours of mixed intent'.

1.2.2 How many people self-harm?

Global prevalence statistics for suicide are subject to much variation and figures are further nuanced by country, age-group, gender etc. (Hawton & Van Heeringen, 2009; O'Connor & Nock, 2014). Some studies estimate global lifetime prevalence of suicide attempts in adults as 2.7% and suicidal ideation as 9.2% (Nock et al, 2008), although figures from the 2007 England Adult Psychiatric Morbidity Survey suggest that prevalence may be higher: 16.7% of respondents endorse having lifetime thoughts of suicide and 5.6% report a previous suicide attempt (McManus, Meltzer, Brugha, Bebbington & Jenkins, 2009).

Figures for adult self-harm (without suicidal intent) range from 2% (Meltzer et al., 2002) to 4.9% (McManus et al., 2009), but in children and adolescents, the prevalence is far greater (Klonsky, Victor & Saffer, 2014). Lifetime prevalence of NSSI in American college students appears to vary widely, from 13.7% (Whitlock et al., 2013) to 35% (Gratz, 2001). In the UK, 10% - 13.8% of younger (school-aged) adolescents report having engaged in self-harm at some point in their lives by the age of 16 years (O'Connor, Rasmussen & Hawton, 2014; O'Connor, Rasmussen, Miles & Hawton, 2009) and a similar number (12.2%) report that they have had thoughts of self-harm, but have not acted upon them (O'Connor, Rasmussen & Hawton, 2012).

Many statistics regarding non-suicidal self-harm prevalence are derived from hospital admission numbers; however there are many individuals who engage in self-harm but have never presented to hospital, therefore these figures are likely to be a significant underestimate of the true prevalence of self-harm within the population (Hawton, Rodham & Evans, 2006). Estimates regarding the number of individuals who die by suicide usually come from government maintained registers of deaths, recorded either as suicide or unexplained[1]. In England 49,251 deaths were recorded as suicide or unexplained between 2003- 2013 and 8,928 in Scotland, according to the latest figures from the National Confidential Inquiry into Suicide and Homicide (NCISH, 2015), however, these statistics are only for those with a current diagnosis of a mental illness. It is widely acknowledged that there is huge variability in the reporting of suicide deaths (Jobes, Berman, Josselson, 1987; Silverman, Berman, Sanddal, O'Carroll & Joiner, 2007), and often there is a marked disparity between actual numbers of suicide deaths and those registered as suicide. For example, one study of suicide deaths in Ireland found an average of 6% more suicide deaths than the number of deaths registered as suicides (Corcoran, Arensman & O'Mahony, 2006).

1.2.2.1 Self-harm in Scotland

Changes to the coding system used by National Records of Scotland (NRS)- the organisation in Scotland responsible for maintaining records of suicide deaths- to classify suicides and unexplained deaths led to a difference in the number of recorded suicides

[1]Deaths recorded by the Coroner (England, Wales and Northern Ireland) or the Procurator Fiscal (Scotland) as of "undetermined intent" are also included within the suicide death statistics according to coding set out in the International Statistical Classification of Diseases and Related Health Problems (ICD). These are deaths in which insufficient evidence exists to definitively determine the person's actions as having been carried out specifically with the intention of harming or killing themself.

relative to previous years (pre-2011). For 2014, 696 suicide deaths were recorded within the general population of Scotland (including deaths of undetermined intent), whereas under previous coding rules, 659 suicide deaths would have been recorded (Scottish Public Health Observatory, 2015). In 2013, 795 suicide deaths were recorded, and the 2014 decrease represents a pattern of declining suicide deaths in Scotland; the last ten years have seen a 17.8% decrease in the national suicide rate in Scotland (Choose Life, 2015). The Scottish suicide statistics, however, still present a stark picture: 2.5 times more males than females died by suicide in Scotland in 2014 and between 2010-2014, the rate of suicide in the most deprived areas was far in excess of the rate seen in less deprived areas of Scotland: 24.5 deaths per 100,000 vs. 7.5 per 100,000, respectively (Scottish Public Health Observatory, 2015).

In a large-scale self-report survey of 2008 Scottish adolescents, 13.8% reported that they had enacted self-harm behaviour at some point during their lifetime (O'Connor et al., 2009). Acute hospital admissions where the reason was recorded as 'intentional self-harm' ranged from 13,825 – 12,741 between 2007-2010 (Scottish Government, 2011). Self-report surveys, such as that carried out by O'Connor and colleagues (2009), are more likely to capture a fuller picture of self-harm prevalence than hospital admission statistics, as many individuals who self-harm never present to hospital or their GP (Hawton et al., 2002). The rate of self-harm in the community that does not require hospitalisation is largely unknown in Scotland.

1.2.3 Who self-harms?

Non-suicidal self-harm and NSSI is disproportionately associated with females, whereas suicidal self-harm is most frequently associated with males (Hawton et al., 2012; Hawton & Van Heeringen, 2009). There does however appear to be considerable variation depending upon the type and age of population sampled; in community samples of adults who have engaged in NSSI, several studies have found no significant association between gender and lifetime history of NSSI (Gratz, 2001; Klonsky, 2011). We can potentially infer from this that more females than males are likely to present to hospital as a result of non-suicidal self-harm, but as discussed in the previous section, it may not be the case that this reflects actual numbers of individuals who self-harm. This is further supported by the latest report from the Manchester Self-Harm (MaSH) project, which shows that between 2010 and 2011, the rate of self-harm (indexed by emergency department presentation) was greater in females than males across all but one (50-54 year old) age-group (Bickley et al.,

2013). However, the rate of self-harm in middle-aged (40-44 year old) males did show some evidence of increasing from previous years' figures (Bickley et al., 2013).

Recent statistics released by the UK Office for National Statistics (ONS) state that more than three times as many males as females died by suicide in 2013 (ONS, 2015) and this pattern appears to be robust across the Western world, although several countries in Asia exhibit a reverse of this, with females being more likely than males to die by suicide (Hawton & Van Heeringen, 2009; O'Connor & Nock, 2014). See previous section for a discussion of Scottish suicide rates by gender.

1.2.4 Nomenclature: Using NSSI vs. Self-harm

1.2.4.1 NSSI

There has long been a heated discussion about the nomenclature we use to talk about self-harm and specifically to delineate non-suicidal from suicidal self-harm (Claes & Vandereycken, 2007; Silverman, 2011). In recent years passions about this debate have run particularly high amongst the suicide research community with the inclusion of "NSSI disorder" and "Suicidal behaviour disorder" within the disorders for further study section of the DSM-5. Proponents of the term NSSI argue that some individuals injure themselves without any suicidal intent and that it is a conceptually and functionally distinct behaviour from other types of self-injuring, therefore a specific term should exist to reflect this (Butler & Malone, 2013). A further case for NSSI is that, historically, self-injury has only existed within the DSM as part of the diagnostic criteria for borderline personality disorder (BPD), however not all individuals who self-injure fulfil the criteria for BPD (Selby, Bender, Gordon, Nock & Joiner, 2012). As a result of this, it is critical to develop new terminology which will separate self-injury as being distinct from BPD.

1.2.4.2 Self-Harm

Conversely, researchers who advocate for the use of "self-harm" argue that creating terminology that dichotomises self-injury into suicidal and non-suicidal, obfuscates fluctuating motivations for engaging in self-injurious behaviour (Kapur, Cooper, O'Connor & Hawton, 2013). Many of those who report having engaged in NSSI behaviours also report that they have thought about or made a suicide attempt (Klonsky & Glenn, 2009; Stanley, Gameroff, Michalsen & Mann, 2001), suggesting that individuals do not necessarily always fit into discrete categories of those whose self-injury is carried out in

either the presence or absence of suicidal intent. In addition to this, the scope of behaviours included within the definition of self-harm, i.e. any form of self-injury including overdose (NICE, 2004), is broader than those that fall into the category of NSSI, which specifically excludes overdose (Kapur et al., 2013). Often those who report having taken an overdose endorse no suicidal intent in relation to their behaviour (Hawton, Harriss & Rodham, 2010) and so excluding this method from the NSSI definition may mean that self-injurious behaviours carried out in the absence of suicidal intent are missed, whereas they would be included within studies of self-harm. Employing the term self-harm also allows for individuals who use multiple methods of self-injury (Hawton et al., 2012).

A further complication is that many studies of NSSI do not actually assess suicidal thoughts and behaviours (e.g. Andover, 2014), therefore it cannot be known whether these thoughts and behaviours do not exist within this population, or that they are simply absent due to non-assessment. We take the view that the term self-harm better reflects the nuanced and multifaceted nature of self-injury and takes into account the fluidity of motivations which often accompany these behaviours.

1.2.4.3 Self-harm ideation

Many more individuals will think (ideate) about self-harm, than will go on to engage in (enact) self-harm behaviour (Kessler, Borges & Walters, 1999). For some (a minority), ideating about self-harm can be a comfort (Crane et al., 2014) and can be something that individuals contemplate for weeks or even months before engaging in self-harm: 14% of Northern Irish adolescents surveyed reported thinking about self-harm for more than a week and 24% for more than a month before self-harming (O'Connor, Rasmussen & Hawton, 2014).

1.3 From ideation to enactment

Our ability to identify which individuals who ideate about self-harm will go on to enact the behaviour is distinctly lacking and this has been highlighted as a critical focus for research moving forward (Klonsky & May, 2014).

1.3.1 The Integrated Motivational-Volitional Model

The recently proposed Integrated Motivational-Volitional Model of suicidal behaviour (O'Connor, 2011) provides a framework for conceptualising the suicidal process, from

ideation to enactment of self-harm behaviour. The model incorporates other contemporary theories of suicidal behaviour, including the Cry of Pain model (Williams, 2001) and the Interpersonal Psychological Theory (IPT; Joiner, 2005) and aims to tease apart the variables associated with making the transition from thoughts to behaviours (O'Connor, 2011). A further aim is to shift the focus from a heavy reliance upon psychiatric disorder as the main explanatory factor for suicide. The majority of individuals who die by suicide will have a current diagnosis of a mental illness at the time of their death, most frequently a mood disorder such as depression, however, only approximately 4% of individuals with depression die by suicide (Bostwick & Pankratz, 2000). Mental illness alone, therefore, is not a sufficient explanation for why an individual takes their own life. The approach of the IMV is more nuanced and characterises suicide as a *behaviour*, preceded by the formation of the *intention* to act upon thoughts of suicide and not simply as a symptom of psychiatric disorder (O'Connor, 2011). The IMV is a tripartite model, composed of: pre-motivational, motivational and volitional phases. A graphical representation of the model is shown below in Figure 1.1 and each phase is explored in more detail in the following three subsections.

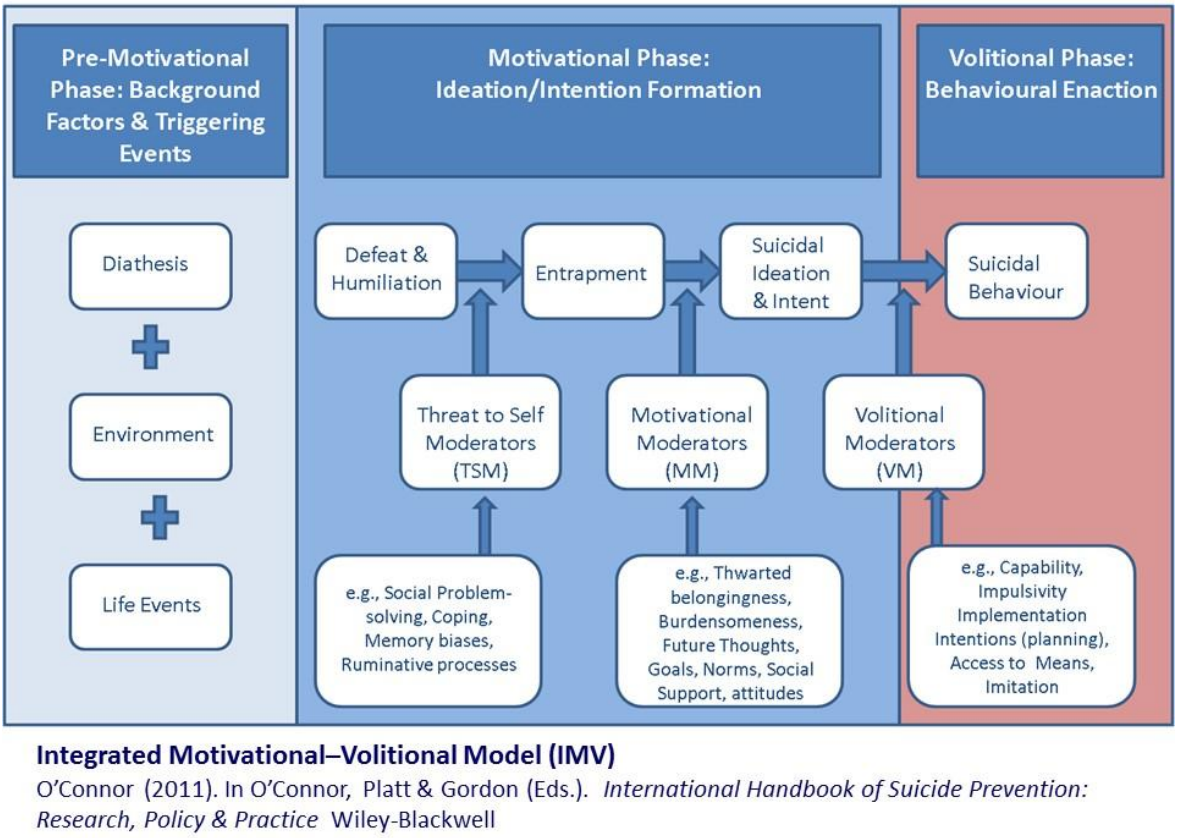

Figure 1.1 The Integrated Motivational-Volitional (IMV) Model of suicidal behaviour (O'Connor, 2011).

1.3.1.1 Pre-motivational phase

The first phase of the model is based upon a diathesis-stress paradigm; an individual may possess vulnerability factors that pre-dispose them to respond adversely to stressors. These vulnerability factors may take the form of biological or genetic variables, but also stable cognitive and personality traits that confer elevated risk of developing suicidal thoughts, such as being highly socially perfectionistic or self-critical (O'Connor, 2007). In the presence of pre-existing background vulnerability, stress from the environment, e.g. deprivation, may combine with distress resulting from troubling life events such as job loss or relationship breakdown, to produce a psychologically toxic combination that leads an individual to be at increased risk for developing suicidal ideation (O'Connor, 2011).

1.3.1.2 Motivational phase

The second phase of the model concerns suicidal ideation and the formation of the intention to attempt suicide. This part of the model draws heavily upon Williams' (2001) Cry of Pain model of suicidal behaviour that posits the combination of defeat, entrapment and humiliation to be the common final pathway to suicidal ideation. Early work incorporates the concepts of defeat and entrapment from the animal behaviour literature to human research, suggesting that when an individual feels low and defeated with no possibility of escaping from the situation, they have an increased likelihood of developing depression (Gilbert & Allan, 1998). The IMV contends that the pathway from defeat to entrapment is moderated by a range of other cognitive and affective variables, e.g. rumination (repetitive focus on negative thoughts) and social problem-solving ability, referred to as 'threat to self' moderators (O'Connor, 2011). The route from entrapment to suicidal ideation may also be moderated by psychological and social factors, including social support and presence of positive future thoughts. An advantage of the model is that it allows for clear experimental predictions, some of which are tested in this thesis. Whilst clear differences in pre-motivational and motivational phase variables between those with and without a history of suicidal thoughts and behaviours should be evident, there should be no significant differences in such variables between individuals reporting ideation only and those endorsing suicidal behaviour (O'Connor, 2011). Recent research has supported this prediction, finding higher levels of social perfectionism and brooding rumination in those reporting ideation or enactment, relative to controls (O'Connor, Rasmussen & Hawton, 2012).

1.3.1.3 Volitional phase

The final phase of the model is arguably the most critical and also represents an area with sparse evidence; the key factors involved in the transition from ideation to enactment. The variables within this phase of the IMV are thought to determine who will go on to act upon their thoughts of suicide and are derived from extant research on factors associated with attempted suicide, e.g. high levels of impulsivity and having access to the means (methods) of carrying out suicide (O'Connor, 2011). Many of these variables are drawn from Joiner's Interpersonal Psychological Theory of suicide (IPT; Joiner, 2005; Van Orden, 2010), including acquired capability, of which an increased tolerance for physical pain (allowing the use of lethal means) is a key component, along with decreasing fear of death. Crucially, variables within the volitional phase of the model should differ between those with thoughts (who have never acted upon them) and those who have engaged in suicidal behaviour (O'Connor, 2011). Impulsivity and exposure to social modelling of self-harm by friends or family (imitation), are both volitional phase variables, and in recent studies of adolescents (O'Connor et al., 2012) and healthy adults (Dhingra, Boduszek & O'Connor, 2015), were found to differ significantly between ideation and enactment groups, supporting the utility of the IMV for differentiating ideation from enactment. Research conducted within the framework of the IMV is in its infancy and further studies are urgently needed to fully explore the veracity of the model. Increasing our knowledge of volitional variables and their moderators is crucial to suicide prevention efforts, as these factors provide the greatest opportunity for intervention and treatment development to prevent suicidal thoughts from becoming suicide deaths. Altered physical pain tolerance, a component of acquired capability (Van Orden et al., 2010), has received an increasing amount of attention and the exploration of this as a potential volitional variable forms an important strand of this thesis.

1.4 Self-harm and pain

1.4.1 Altered pain tolerance

Self-harm has been previously described as a behaviour that appears to overcome the "safety-catch": an intrinsic internal mechanism that instils in us a desire for self-preservation (Tantam & Huband, 2009). A steadily growing body of literature suggests that those who engage in self-harm (either suicidal or non-suicidal) have a higher threshold and tolerance for physical pain than those who have never self-harmed (Hooley, Ho, Slater & Lockshin, 2010; Orbach et al., 1997). Indeed, some individuals who self-harm report

that they experience no pain whatsoever whilst injuring themselves (Kemperman et al., 1997; Russ et al., 1992; Russ et al., 1994). This raises the question of whether those who self-harm experience pain in a fundamentally different way to individuals with no history of self-harm? Furthermore, what psychophysiological mechanisms underpin this phenomenon?

1.4.2 Limitations of the evidence

Research in this area is growing, but the evidence for the existence of altered pain threshold and tolerance in this population is at times mixed, with some studies finding no significant differences between controls and those who have self-harmed (Bohus et al., 2000; Franklin et al., 2011). Many early studies focus on clinical populations, primarily patients with BPD and/or eating disorders (e.g. Russ et al., 1992; Schmahl et al., 2004) and it is only very recently that studies are beginning to explore altered pain tolerance in non-clinical community samples of self-harming individuals. Despite the growing interest in this area, answers as to how and why altered pain tolerance may occur in self-harm, remain elusive. Furthermore, there has been no research exploring whether sensitivity to pain is also altered in self-harm ideation; knowledge that could be critical to our understanding of the genesis of self-harm behaviour. The relationship between pain and self-harm will be covered extensively within the systematic review in the following chapter.

1.5 Self-harm and emotion

1.5.1 Emotion reactivity

Whilst physical pain sensitivity appears to be reduced in those who have engaged in self-harm, sensitivity to emotional pain appears to be markedly elevated (Nock & Mendes, 2008). Emotional sensitivity (reactivity) can be characterised by three elements: an acute sensitivity to emotional stimuli; a highly intense response, even to minor emotional stimuli; and a marked difficulty in returning to neutral levels of emotional arousal (Linehan, 1987; Nock et al., 2008). This heightened reactivity or sensitivity to emotional pain, may mean that even low-level emotional events are experienced as overwhelming and highly distressing. Potentially this could fuel an individual's desire to escape from their emotional pain by engaging in behaviours such as NSSI (Nock et al., 2008).

1.5.2 Self-harm and emotion reactivity

A number of studies have associated increased emotional sensitivity with NSSI (Glenn et al., 2011; Kleiman et al., 2014) and also with suicide attempts (Dour, Cha & Nock, 2011) in community samples. The relationship between emotion reactivity and self-harm may not be a direct one and it may be the case that it is only particularly pernicious when combined with other factors. One previous study found that high emotion reactivity alone was not significantly associated with suicide attempt, but that it was the interaction between emotion reactivity and poor social problem-solving skills that was significantly correlated with suicide attempt (Dour et al., 2011). More recent work has sought to tease apart the nuances of the relationship between emotion reactivity and NSSI, and has found that emotion reactivity only mediates the relationship between depressive symptoms and NSSI, as well as suicide attempts, in females (Kleiman et al., 2014). Heightened sensitivity to emotional pain may therefore not be a factor that is universally associated with self-harm.

1.5.3 The relationship between emotional and physical pain in self-harm

Emotional and physical pain have a shared vocabulary; a relationship break-up may be described as "heart breaking" or having to part from a loved one as "agonising" (MacDonald & Leary, 2005). It was this colloquial association between emotional and physical pain that in part provided the inspiration for a now seminal paper by Naomi Eisenberger and colleagues, positing a common neural circuitry for emotional and physical pain (Eisenberger, Lieberman & Williams, 2003). Further work by this group has suggested that those who are more sensitive to emotional pain are also more sensitive to physical pain and *vice versa* (Eisenberger & Lieberman, 2004; Eisenberger, Jarcho, Lieberman & Naliboff, 2006). This "social neuroscience model" of emotional and physical pain is especially interesting when considered in relation to self-harm, where individuals appear to be *less* sensitive to physical pain (Franklin et al., 2011; Hooley et al., 2010) and yet *more* sensitive to emotional pain (Nock & Mendes, 2008). As previous research focuses almost exclusively upon healthy (non-injuring) populations, the social neuroscience model may not be supported in self-harming individuals. Furthermore, as no studies of pain and self-harm have included those who ideate about self-harm (but have never engaged in the behaviour), we do not know if this potential dysregulation of the relationship between emotional and physical pain is a cause or a consequence of self-harm behaviour. Many questions exist around the temporal dynamics and generalisability of the

relationship between emotional and physical pain, but these represent empirically testable hypotheses of particular salience to self-harm research. To this end, Eisenberger and colleagues' studies have been readily adopted within the field of self-harm and pain research, as a potential pathway to understanding how self-harm brings about relief from terrible states of mind.

1.6 Self-harm as affect regulation

One of the most frequently cited reasons for engaging in self-harm behaviour is to relieve emotional pain (Nock, Prinstein & Sterba, 2009; O'Connor et al., 2009) and it is widely regarded by those who engage in the behaviour as a pathway to reducing negative affect (Nock & Prinstein, 2004). More recent studies posit that an increase in positive affect may be an alternative or even complementary result of engaging in self-harm (Franklin, Lee, Hannah & Prinstein, 2013). Ideation about self-harm may also alter affect, with a small number of individuals (15%) reporting that they derived feelings of comfort from thinking about self-harm (Crane et al., 2014), although comparatively little is known about the effect of ideation, relative to behaviour, upon mood within this population. The mechanism by which self-harm brings about relief from emotional pain is largely unknown and whilst there have been numerous theories proposed, there remains no clear consensus.

1.6.1 Theories of affect regulation in self-harm

Although there is no single overarching theory of how self-harm regulates affect in those who engage in the behaviour, four main theories have emerged within the literature as competing explanations for this phenomenon.

1.6.1.1 I. Endogenous opioids

When an individual injures themselves, either unintentionally or intentionally, this stimulates the release of neurotransmitters with analgesic properties: endogenous opioids, which are released in response to physical and emotional pain (Stanley & Siever, 2010). Individuals who engage in NSSI appear to have lower resting cerebrospinal fluid (CSF) levels of the endogenous opioids β-endorphin and met-enkephalin than non-injuring controls and it has been suggested that NSSI represents a method of artificially increasing opioid levels and thus increasing positive affect (Sher & Stanley, 2008; 2010). Neuroscientific studies have suggested activation of endogenous opioid receptors (i.e. increased opioid activity) is associated with increased positive affect (Berridge, 2003;

Leknes & Tracey, 2008) and also that greater levels of negative affect are associated with reduced endogenous opioid activity (Zubieta et al., 2003). One hypothesis is that the pain caused by self-harm stimulates endogenous opioid release which, as a by-product, results in a small and temporary decrease in negative affect (Bresin & Gordon, 2013). The endogenous opioid theory of affect regulation in self-harm is highly plausible, but lacks a solid evidence base; there is a general dearth of studies in this area and all of the extant research has been conducted with BPD patients (Bresin & Gordon, 2013). There are also inherent challenges to measuring endogenous opioids, further compounding research on this subject. For a further discussion of the role of endogenous opioids in self-harm, see Kirtley, O'Carroll and O'Connor (2015), included within Appendix E.

1.6.1.2 II. Offset analgesia

Offset analgesia is a theory of affect regulation that has been present within the broader pain literature for quite some time, but has only recently gained currency as a potential explanation for affect regulation in self-harm. The offset analgesia hypothesis posits that it is not the pain itself that brings about relief, but actually the reduction or removal (offset) of the painful stimulus (Grill & Coghill, 2002), resulting in negative reinforcement of self-harm. This may perhaps be thought of as an extension to the endogenous opioid theory of affect regulation, as offset analgesia appears to be neurally modulated by the periaqueductal grey (PAG) and the rostral ventromedial medulla (RVM), brain areas associated with endogenous opioid analgesia (Derbyshire & Osborn, 2009). Current research into offset analgesia as a mechanism of affect regulation in self-harm is just gaining momentum. Preliminary studies suggest that the removal of painful electric shock stimuli produces a simultaneous reduction in negative affect and an increase in positive affect in individuals who engage in NSSI, but also in healthy controls (Franklin, Lee, Hanna & Prinstein, 2013; Franklin et al., 2013). Those who self-harm must therefore first cause themselves physical pain, in order to experience the emotional relief from removing that pain. When taken in conjunction with earlier work from the broader pain literature (e.g. Derbyshire & Osborn, 2009), findings from the self-harm field indicate that offset analgesia may not only be implicated in affect modification in individuals who self-harm, but also in those who have never intentionally harmed themselves.

1.6.1.3 III. Opponent-process theory

Opponent-process theory (Solomon, 1980) is another idea that has been adopted from the broader psychological literature for its possible utility in explaining affective relief

following self-harm. The theory posits that when an aversive stimulus, such as painful electric shock is removed, elevation in mood will follow: a negative process (pain) will result in a positive process (improved affect) (Solomon, 1980; Solomon & Corbit, 1974). After repeated presentation of the negative shock stimulus, the individual will habituate and the shock will cease to produce a negative response, instead eliciting a gradually stronger positive process (Solomon, 1980). Opponent-processes have been incorporated within Joiner's Interpersonal Psychological Theory of suicidal behaviour (IPT; Joiner, 2005) and form a significant underlying strand for the concept of acquired capability (Van Orden, Witte, Gordon, Bender & Joiner, 2008). Within the context of self-harm: when the negative stimulus (self-injury) is removed, individuals will experience relief and over time, this opponent-process will grow stronger, resulting in the negative affective response to self-harm being extinguished and a strong feeling of relief taking its place (Van Orden et al., 2010). In short, repetition of self-harm leads to increased feelings of relief over time. Some earlier studies gave further weight to this idea (e.g. Franklin et al., 2010), however more recently this has not been supported, as positive affect was not found to increase with repeated stimulus application (Franklin, Lee, Hanna & Prinstein, 2013).

1.6.1.4 IV. The defective self-hypothesis

Another frequently endorsed motivation for engaging in self-harm is self-punishment (Klonsky & Glenn, 2009; O'Connor et al., 2009). To this end, *post-hoc* analysis of data from a study of pain endurance in NSSI found that those who report greater feelings of worthlessness, social ineptitude and guilt, also exhibit a significantly higher endurance for physical pain (Hooley, Ho, Slater & Lockshin, 2010). From this, the defective self hypothesis was put forward; individuals who see themselves as faulty or defective are more willing to tolerate physical pain, because they feel it is a justified punishment and derive emotional relief from "getting what they deserve" (Hooley et al., 2010). Studies have yet to further explore the defective self hypothesis and whether or not the relationship between pain and affect varies with the level of self-critical thoughts an individual experiences. Given the likely influence of offset analgesia upon affect, any unique effects of self-criticism may be difficult to tease apart.

1.7 The current thesis

Three overarching strands of research have been discussed within this introductory thesis chapter: the transition from self-harm ideation to behavioural enactment; the relationship

between physical and emotional pain in self-harm ideation and enactment; and the role of physical pain in affect regulation in self-harm. This thesis aims to explore these three research strands and to this end, these have been developed into the three specific research questions stated below.

1.8 Research question

The current thesis aims to answer the following three research questions:

1) What factors differentiate those who ideate about self-harm from those who go on to enact the behaviour?

2) What is the relationship between emotional and physical pain in self-harm ideation and enactment?

3) How do established psychological variables associated with self-harm and suicide relate to emotional and physical pain?

1.9 Structure

Chapter 2 provides a detailed systematic review of the extant literature on pain and self-harm and discusses the strength of the evidence for altered pain tolerance in those who self-harm, as well as potential psychological correlates of this phenomenon. Chapter 3 gives details of the methods used within this thesis and a study-by-study breakdown of the measures employed. Chapters 4, 5 and 6 present the three empirical studies from this PhD, investigating stress-dependent pain tolerance in self-harm ideation and enactment, self-reported sensitivity to emotional and physical pain in self-harm ideation and enactment and the relationship between behavioural and self-report measures of emotional and physical pain in self-harm ideation and enactment, respectively. Chapter 7 presents a general discussion of the findings from the three empirical studies, including consideration of the conclusions that can be drawn from this research, its limitations and future directions.

Chapter 2: Pain and self-harm: A systematic review

Background

There is a growing body of research exploring altered physical pain threshold and tolerance in non-suicidal self-injury (NSSI). Despite this recent attention, however, the evidence is inconsistent such that the nature of the relationship is unclear. Additionally, whether or not this effect is also present in suicidal self-harm is equivocal. A further question also exists as to what mechanisms may account for altered pain tolerance within these populations. This systematic review, therefore, aimed to: 1) evaluate the strengths and limitations of the evidence for/against altered pain threshold and tolerance in NSSI and suicidal self-harm; 2) identify psychological correlates of altered threshold and tolerance for physical pain; and 3) identify candidate explanatory mechanisms for the phenomenon.

Methods

A keyword search of three major psychological and medical databases (PsycINFO, Medline and Web of Knowledge) was conducted, yielding 1,873 records of which (following duplicate removal), 1483 records were screened. Following screening, the remaining 46 articles were read to determine if they met the inclusion criteria, yielding 25 that were included in the final systematic review. All articles were quality assessed.

Results

There is strong evidence for increased pain tolerance in NSSI and some evidence for this in suicidal individuals. There was a total absence of prospective research examining the relationship between NSSI and suicidal self-harm and altered pain threshold and tolerance. No studies have explored pain threshold and tolerance in those with NSSI or suicidal ideation, or in those who have not previously engaged in self-harm behaviour. There was also a marked lack of research examining pain tolerance in suicidal individuals, compared to the number of studies focussed on NSSI. The review also highlighted the lack of substantive focus on psychological correlates of altered pain tolerance in this population. Several candidate explanatory mechanisms were proposed within the reviewed studies, including offset analgesia, endogenous opioid activity and opponent process theory.

Conclusions

Prospective research investigating altered pain tolerance in those who engage in NSSI and suicidal self-harm is a critically important area for future research, as this will help to determine if altered pain threshold and tolerance are a cause or a consequence of the behaviour. Similarly, future studies should also aim to include those with NSSI/suicidal ideation, as this may provide further answers. Psychological correlates of increased pain tolerance have been a neglected area of research and could provide opportunities for treatment/intervention development, if mediating or moderating pathways can be identified. Too few studies have directly investigated candidate explanatory mechanisms to draw definitive conclusions.

2.1 Introduction

Self-harm remains one of the most important and intriguing behavioural phenomena within psychology; a behaviour that appears to go against natural instincts for self-preservation (Tantam & Huband, 2009). It is a world-wide public health issue; 48,206 individuals presented to hospital in Ireland from 2003-2006, following an episode of self-harm (Perry et al., 2012), and 7,344 individuals presented to hospitals in Leeds, Manchester and Oxford during an 18 month period, subsequent to self-harming (Lilley et al., 2008).

Previous literature has reported self-harm prevalence in the community as ranging from 13.8% in a sample of Scottish adolescents aged 15-16 years old (O'Connor, Rasmussen, Miles & Hawton, 2009) to as high as 38% in a sample of American college students (Gratz, Conrad & Roemer, 2002). Generally, self-harm also appears to be more prevalent in females than males (Hawton, Harriss & Rodham, 2010; Nock, Prinstein & Sterba, 2009; O'Connor et al., 2009).

A primary function of self-harm appears to be as a method of gaining relief from terrible states of mind; however others have also cited it as a form of self-punishment or as being driven by a wish to die (O'Connor et al., 2009). In addition, Gratz (2003) has reported that those who engage in non-suicidal self-injury (NSSI) feel that it is a method of externalising emotional pain by transforming it into a tangible physical sensation. The exact mechanism or mechanisms that enable self-harm to fulfil these functions however remain, as yet, unclear. (See Klonsky (2007) and section 1.6 of the previous chapter for a discussion of this issue). Self-harm appears to overcome the "safety-catch"- the intrinsic mechanism that promotes the avoidance of potentially painful experiences (Tantam & Huband, 2009), which raises the key question of whether those who engage in self-harm may have altered pain threshold and tolerance?

Given the heterogeneous and multiple motives that underpin self-harm (Hawton, Saunders, & O'Connor, 2012), in this review, all studies of self-harm irrespective of motive were included, however, whether or not the relationship between pain and self-harm varied as a function of suicidal intent (i.e., studies focused on NSSI were compared with those on suicide attempts) was also investigated. I would like to stress, however, that this is not an attempt to homogenise all forms of self-harm into a single category. The specific aim of

including all studies of pain and self-harm was to try and tease apart the complex and nuanced relationships that exist between motivations and self-harm behaviour.

2.1.1 Pain

Pain can be defined as the cognitive and affective interpretation of nociception (Tracey, 2008), i.e. a noxious sensory experience (Merksey & Bogduk, 1994). The lowest level of intensity of a stimulus that an individual perceives as painful is known as their pain threshold, with pain tolerance being characterized as the greatest duration or intensity of painful stimuli that one is able to bear (International Association for the Study of Pain, 2012).

2.1.2 Pain and self-harm

A growing body of research has investigated the relationship between pain threshold and tolerance and self-harm, revealing some interesting, but sometimes-inconsistent findings and the strength of the evidence for altered threshold and tolerance of physical pain is therefore uncertain. Much of the extant research also appears to have been conducted in clinical populations and although there has been a proliferation of studies employing community samples in recent years, whether findings are generalisable across clinical and non-clinical populations is unknown. Several psychological correlates of pain threshold and tolerance have been explored in this population however yet again, the results are sometimes contradictory. As yet, there remains no clear consensus regarding the underlying mechanism for altered pain tolerance in self-harm, nor for how self-harm appears to fulfil an affective regulation function for some individuals (see section 1.6.1 of the previous chapter for a further discussion of this). Thus, what we actually *know* about the relationship between pain and self-harm is uncertain. In order to define the direction in which future research should progress, these numerous areas need clarification and lines of convergence and divergence within the literature must be identified, hence the need for a systematic review of progress, to date.

2.1.3 Research aims of this systematic review

Focussing on the areas of ambiguity discussed in the previous sub-section, three key aims for the current systematic review were defined:

1) To evaluate the strengths and limitations of the evidence for/against altered pain threshold and tolerance in NSSI and suicidal self-harm.

2) To identify psychological correlates of altered threshold and tolerance for physical pain.

3) To identify candidate explanatory mechanisms for the phenomenon.

2.2 Methods

2.2.1 Search strategy and screening of results

A search was made of the three key psychological and medical databases in March 2014 and updated in September 2015: PsycINFO (1895-September 2015); Medline (1966-September 2015 and Web of Knowledge (1981-September 2015) using the following keywords: self injur* AND pain threshold OR pain tolerance OR pain sensitivity OR pain perception; self harm* AND pain threshold OR pain tolerance OR pain sensitivity OR pain perception; NSSI AND pain threshold OR pain tolerance OR pain sensitivity OR pain perception; nonsuicidal self-injur* AND pain threshold OR pain tolerance OR pain sensitivity OR pain perception; suicid* AND pain threshold OR pain tolerance OR pain sensitivity OR pain perception. For Medline, the MeSH terms "self-injurious behaviour" and "suicide" were also employed. This search yielded 1,873 database entries, which were then screened by the researcher according to the four-stage Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) process (Moher, Liberati, Tezlaff & Altman, 2009). See Figure 2.1 for a graphical representation of the assessment process. The reference sections of all studies meeting the inclusion criteria (described below) were then hand-searched to ensure that no relevant articles were missed.

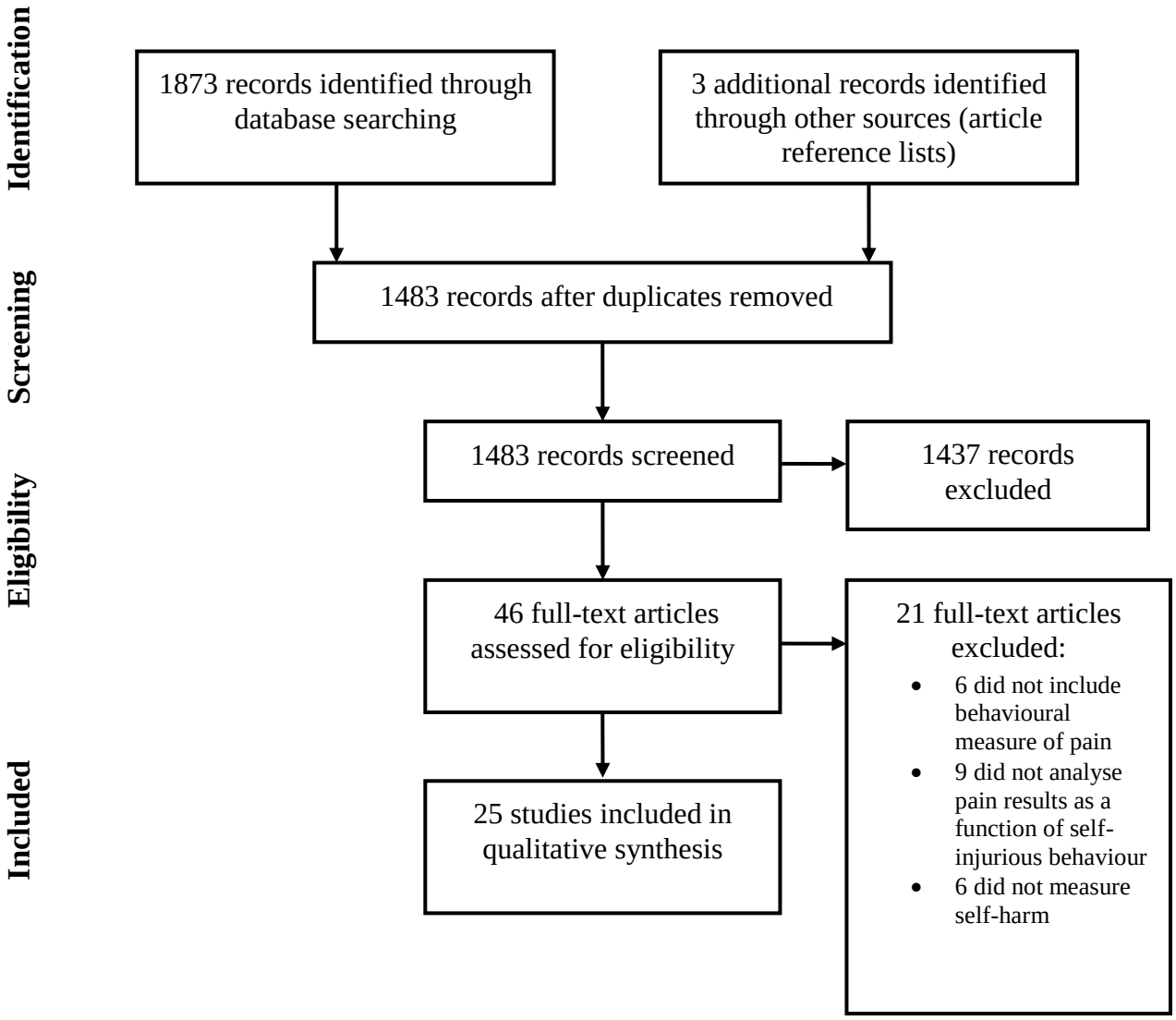

Figure 2.1 Procedure for identifying, screening and determining the eligibility of studies for inclusion in the review

2.2.2 Inclusion and exclusion criteria

Consistent with Morrison and O'Connor (2008), the inclusion criteria were 1) the study must be original, published research using human participants; 2) the article must be published in the English language; additionally 3) the studies must include a laboratory pain manipulation and a manipulation check, the results of which were analysed as a function of self-harm; and 4) the studies must directly assess self-harm. Studies were excluded if the participants' self-harm was the result of developmental disorder, e.g. Autistic Spectrum Disorder and organic brain dysfunction or dysfunction caused by traumatic brain injury. Studies were not excluded from the review if they had not screened participants for suicidal intent or ideation, as this is an important methodological point to consider when assessing extant research in this area.

Given the general paucity of research in this area and that there has been no investigation of whether altered pain threshold and tolerance may be specific to either suicidal or non-suicidal self-harm, the studies included within this review encompass a wide range of behaviours, of both suicidal and non-suicidal intent. This is consistent with the definition of self-harm which includes "self-poisoning and self-injury irrespective of suicidal intent" (NICE, 2004; 2011). Studies reporting behaviours conforming to definitions of NSSI, i.e. "the socially unaccepted, intentional and direct injuring of one's own body tissue without suicidal intent" (Nock, 2009), were also included.

2.2.3 Quality assessment

Increasingly, critical assessment or quality assessment tools are being used in the evaluation of research, although these are not always well suited to appraising all types of studies; often they are more applicable to evaluating clinical trials (Crowe & Sheppard, 2011). For the present purpose, as there is no suitable existing tool in this area, a quality assessment framework was designed by the researcher and her supervisors (see Appendix A, Table 1), within which studies were evaluated yielding a quality score which was employed to afford greater or lesser "weight" within the review.

2.3 Results

The search strategy yielded 25 studies in total, the majority of which (n=15) were cross-sectional (see Table 2.1), with some additional case-control studies (*n*=10); see Table

2.2). There were no prospective studies and the review yielded only three studies that examined suicidal self-harm. The heterogeneity of methods employed by the studies precluded meta-analysis, therefore a narrative systematic review is presented here.

Results are separated into findings from cross-sectional studies and findings from case-control studies (as per O'Connor et al., 2007; McLaughlin, O'Carroll & O'Connor, 2012). They are then further divided into subsections based upon the three aims of the review: strengths and limitations of the evidence, psychological correlates and candidate explanatory mechanisms. Each section begins with the results of the quality assessment for studies in each category, followed by a brief description of the study populations in relation to demographic variables, clinical characteristics and potential confounding variables. The main results are then presented.

2.3.1 Cross-sectional studies

2.3.1.1 Results of quality assessment for cross-sectional studies

Following application of the quality assessment framework, only five studies were rated as being "medium" or "high" quality, scoring seven or above: Gratz et al., (2011); Hooley, Ho, Slater and Lockshin (2010); Hooley & St Germain (2014); Ludascher et al., (2009); and St Germain and Hooley (2013) and were consequently given more weight within the review, relative to the other cross-sectional studies included. For full details of the quality assessment outcome for each study, see Appendix A, Table 2.

TABLE 2.1

Cross-Sectional Studies of Pain and Self-Harm

Study Country Quality assessment (QA) score	Sample	Type of behaviours included	Measures Pain Threshold/Tolerance and Other Physiological	 Psychological	Results
Bresin & Gordon (2013) USA QA score = 4	115 University students. 59 people who had engaged in NSSI (34 females) 56 healthy controls (31 females) Mean age= 19.48 yrs.	NSSI	Thermal heat stimuli administered via TSA Thermal Sensory Analyzer. Temperature range of 35-50º C, .7s exposure to each temperature. Then second exposure to temperature rated as either 20 or 60 on 1-100 pain intensity scale.	Shortened version of PANAS (Watson, Clark & Tellegen, 1988)	No effect of NSSI on pain intensity ratings at first stimuli exposure. Those in the NSSI group who received the painful stimulus displayed a significantly greater reduction in negative affect than those who received the non-painful stimulus. But following the painful stimulus, the NSSI group did not significantly differ from controls in negative affect.
Franklin, Aaron, Arthur, Shorkey & Prinstein (2012) USA QA score = 6	72 University students (52 females). 25 people who had engaged in NSSI 47 healthy controls Mean age= 19.09 yrs.	NSSI	CPT at 2º C for maximum of 2 minutes. Self-reported pain intensity, time to reach threshold and tolerance measured.	6 items from DERS (Gratz & Roemer, 2004) FASM (Lloyd, Kelley & Hope, 1997) Subjective Units of Distress Scale.	People who had engaged in NSSI displayed a higher pain threshold and tolerance than controls and lower ratings of pain intensity. Pain tolerance and emotion dysregulation strongly correlated. Both emotion dysregulation and pain threshold significantly moderated the association between NSSI and pain tolerance.
Franklin, Hessel & Prinstein (2011) USA QA score = 6	67 University students (47 females) 16 people who had engaged in NSSI 51 healthy controls. Mean age= 19.25 yrs.	NSSI	CPT at 2º C for maximum of 2 minutes. Self-reported pain intensity, time to reach threshold and tolerance measured.	FASM (Lloyd, Kelley & Hope, 1997) PPE Scale (Bender et al., 2011) Modified ACS Questionnaire (Van Orden et al., 2008)	Pain tolerance significantly associated with both PPE and ACS score. No significant differences in pain tolerance or pain intensity at threshold between NSSI and control groups. Significant between-group differences in threshold and intensity at tolerance. Tolerance only significant (but modest) mediator of association between PPE and ACS.

Gratz et al. (2011) USA QA score = 9	95 University students and community participants. 43 people who had engaged in NSSI (N=30 females). Mean age= 19.3 yrs. 52 healthy controls (N=38 females). Mean age= 20.4 yrs.	NSSI	CPT at 0.55º C & Algometer. Time to reach pain threshold and tolerance measured.	DSHI (Gratz, 2001) BEST (Pfhol & Blum, 1997) CES-D (Radloff, 1977) PANAS (Watson, Clark & Tellegen, 1988) MTPT-C (Strong et al., 2003)	People who had engaged in NSSI in the distressed group had a significantly higher pain tolerance than those in the neutral group. Males took significantly longer to terminate algometer task.
Hooley, Ho, Slater & Lockshin (2010) USA QA score = 7	Community sample. People with NSSI ideation (N=7); people who had engaged in NSSI (N=31) & Controls (N=29). Overall sample mean age= 22.4 yrs. 53 females.	NSSI	Algometer. Time to reach pain threshold and tolerance measured.	NEO-FFI (Costa & McRae, 1992) BHS (Beck, Weissman, Lester & Trexler, 1974) LCB (Craig, Franklin & Andrews, 1984) DES (Bernsetein & Putnam, 1986) SITBI precursor (Nock, Holmberg, Photos & Michel, 2007)	People who had engaged in NSSI had higher pain threshold and tolerance than controls. Significant correlation between number of years of NSSI and pain threshold. NSSI group showed greater external locus of control, neuroticism, openness and negative affect than controls.
Hooley & St Germain (2014) USA QA score = 7	Community sample. People who had engaged in NSSI (N = 50); controls (N= 84). Overall sample mean age = 24.09. 101 females.	NSSI	Algometer. Time to reach pain threshold and tolerance measured.	SITBI precursor (Nock, Holmberg, Photos & Michel, 2007) SCID-CV (First et al., 1996) Mood VAS	Individuals in the NSSI group exhibited significantly greater pain endurance than controls. Following positive self-worth manipulation, those in the NSSI group demonstrated reduced pain endurance.
Kemperman et al. (1997) USA QA score = 3	34 female inpatients with BPD. Subdivided into BPD (mean age= 31.5 yrs); BPD-NP (mean age= 28.3 yrs); and BPD-C (mean age= 32.1 yrs). 7 healthy female controls. Mean age= 26.9 yrs	NSSI	Thermal heat stimuli, delivered via Dolorimeter at 33.7º C, 36.2º C, 46.0º C & 49.5º C. Pain intensity rated on 1-8 categorical scale.	DES (Bernsetein & Putnam, 1986) SPRAS (Sheehan et al., 1988) BDI (Steer, Beck & Garrison, 1986)	Patients in the BPD-P group were better able to distinguish between painful stimuli of similar intensity, relative to patients in the BPD-NP and BPD-C groups. The BPD-NP group was significantly less likely to describe stimuli as painful.

Ludäscher et al. (2009) Germany QA score = 7	48 female psychiatric inpatients, outpatients and students. People with current NSSI mean age= 28 People with previous NSSI mean age= 30 Controls mean age= 25	NSSI	Thermal heat stimuli at 32-50º C. Laser stimulation was at 540 mJ.	BSL (Bohus et al., 2007) DSS (Stiglmayer, Shapiro, Stieglitz, Limberger & Bohus, 2001)	BPD patients who were currently engaging in NSSI had lowest pain threshold, followed by BPD patients who had previously engaged in NSSI, and then controls.
Niedtfeld et al. (2010) Germany QA score = 5	20 female outpatients with BPD recruited via adverts on BPD websites. Mean age= 30.50 yrs. 23 healthy female volunteer controls recruited via newspaper advertisements. Mean age= 27.13 yrs	NSSI	Thermal heat stimuli. fMRI analysis was conducted during pain testing. Individualized levels of thermal stimuli applied, based on pre-experiment trials.	SCID (First et al., 1995) IPDE (Loranger, 1999) BSL (Bohus et al., 2007) ERQ (Gross & John, 2003)	BPD patients showed significantly higher pain threshold than healthy controls. Amygdala, insula and ACC had significantly higher activation in the BPD group, than in the control group. Decreased amygdala and ACC activation was found in BPD patients, following negative image presentation.
Russ, Campbell, Kakuma, Harrison & Zanine (1999) USA QA score = 5	N= 41 inpatients BPD-P: 22 females with BPD (Mean age= 31.1 yrs); BPD-NP: 19 females with BPD (Mean age= 25.8 yrs). 15 females inpatients with no history of BPD or NSSI (Mean age= 33.3 yrs).20 healthy female volunteers from the community. Mean age= 30.1 yrs.	NSSI	CPT at 10º C (maximum 4 mins). Time to reach pain tolerance measured. EEG activity measured during CPT.	SCID-II (Spitzer et al., 1987) SCID-P (Spitzer at al., 1988) POMS (McNair et al., 1971) BDI (Steer, Beck & Garrison, 1986) Pain intensity scale (1-9)	Significant difference in the number of subjects terminating CPT before maximum time. Pain ratings were significantly lower in BPD-NP than BPD-P and healthy controls. No significant difference in pain rating between the depressed inpatients and the other groups.

Russ et al. (1992) USA QA score = 3	11 female inpatients with BPD (BPD-NP). 11 female inpatients with BPD (BPD-P). Mean age for BPD groups= 22.60 yrs. Controls: 6 female volunteer controls. Mean age= 22.2 yrs.	NSSI	CPT at 10º C (maximum 4 mins). Pain intensity and unpleasantness were rated on a 1-9 scale.	POMS (McNair et al., 1971) SCID (Spitzer et al., 1987) BDI (Steer, Beck & Garrison, 1986)	Pain ratings -P group and healthy controls. No significant difference in pain ratings between BPD-P and healthy controls. For the BPD-NP group, self-reported ratings of vigor were higher following the CPT, but not in the BPD-P group. Ratings of depression, anger and confusion were also lower following the CPT, but only in the BPD-NP group.
Russ et al. (1994) USA QA score = 3	11 female psychiatric inpatients. BPD-NP (mean age= 21.7 yrs); BPD-P (Mean age= 32.3 yrs)	NSSI	CPT at 10◦ C. Pain intensity and unpleasantness were rated on a 1-9 scale.	POMS (McNair et al., 1971)	BPD-P experienced more pain following saline but BPD-NP reported more pain following naloxone. Tension and depression decreased in BPD-NP group post-CPT, but not BPD-P. Naloxone did not increase pain intensity ratings.
Schmahl et al. (2004) Germany QA score = 4	10 female BPD patients Mean age= 29 yrs Controls: 14 healthy female volunteers. Mean age= 26 yrs.	NSSI	LEP. Laser detection and pain threshold recorded. Rating of pain quality. Pre-LEP quantitative sensory testing for BPD group. EEG during LEP.	SCID-II (First et al., 1996) SCID-I/P (First et al., 1995) DIB-R (Zanarini et al., 1989)	Nociception reduced in BPD group, relative to controls. Laser detection and pain thresholds were significantly higher in the BPD than in the control group. EEG revealed that LEP amplitudes in BPD were either within the normal range, or higher than controls.
St Germain & Hooley (2013) USA QA score = 9	48 individuals reporting direct NSSI (41 female) 37 individuals reporting indirect NSSI (19 female) 63 non-injuring controls Mean age for total sample = 25.4 yrs	NSSI	Pressure algometer applied to fingers for maximum of 8 minutes.	MAST (Selzer et al., 1971) DAST (Skinner, 1982) EDEQ (Fairburn & Beglin, 1994) SHI (Sansone, Wiedermen & Sansone, 1998) SNAP: SUICIP SNAP: LSE (both Clark, 1993)	Both NSSI groups demonstrated significantly greater pain endurance than control groups, but the two NSSI groups evidenced comparable pain endurance.

Weinberg & Klonsky (2012) Canada QA score = 6	72 Undergraduate students. Mean age= 20.24 yrs. 39 people who had engaged in NSSI (29 females). 33 healthy controls (17 females).	NSSI	Electric shocks, increasing from 0v in increments of 0.7v, each administered for 5s. Participants rated pain on 1-10 scale, then following mood manipulation, were randomized to receive either high (painful) or 2v low rated shock.	ISAS (Klonsky & Glenn, 2009) DASS-21 (Henry & Crawford, 2005) BSL-23 (Bohus et al., 2009) MSI-BPD (Zanarini et al., 2003) DERS (Gratz & Roemer, 2004) SAM (Lang, 1980)	The NSSI group selected higher levels of shock than controls, but did not report pain as being more intense. No significant between-group differences in subjective pain ratings at high shock, but at low shock, the NSSI group rated shock as significantly less painful. People who had engaged in NSSI showed greater reduction in NA following high shock. Opposite effect for controls. Higher shock predicted greater decrease in NA, but not associated with subjective pain rating.

Note: ACS= Acquired Capability for Suicide Scale; ASI= Anxiety Sensitivity Inventory; BEST= Borderline Evaluation of Severity Over Time; BDI/BDI-II= Beck Depression Inventory; BHS= Beck Hopelessness Scale; BPD= Borderline Personality Disorder; BPD-C= BPD-Calm; BPD-D= BPD-Distressed; BPD-NP= BPD-No Pain during self-harm; BPD-P= BPD-Pain during self-harm; BSL= Borderline Symptoms List; CES-D= Center for Epidemiologic Studies Depression Scale; CPT= Cold Pressor Test; DASS-21= Depression Anxiety Stress Scale; DAST= Drug Abuse Screening Test; DERS= Difficulties in Emotion Regulation Scale; DES= Dissociative Experiences Scale; DIB-R= Diagnostic Interview for Borderlines Revised; DSHI=Deliberate Self-Harm Inventory; EEG= Electroencephalogram; EDEQ= Eating Disorder Examination Questionnaire; ERQ= Emotion Regulation Questionnaire; FASM= Functional Assessment of Self-Mutilation; ISAS= Inventory of Statements About Self-Injury; IPDE= International Personality Disorder Examination; LCB= Locus of Control of Behavior Scale; LEP= Laser Evoked Potential**;** MAST= Michigan Alcoholism Screening Test; MCMI-I= Millon Clinical Multiaxial Inventory; MSI-BPD= McLean Screening Instrument for Borderline Personality Disorder; MTPT-C= Computerized Mirror-Tracing Persistence Task; NA= Negative Affect; NEO-FFI= Neuroticism Extraversion and Openness- Five Factor Inventory; NSSI= Non-suicidal self-injury; PANAS= Positive and Negative Affect Scale; PPE= Painful and Provocative Events Scale; POMS= Profile of Mood States; SAM= Self-Assessment Manikin; SCID/SCID-P/SCID-I/P = Structured Clinical Interview for Personality Disorders axis I; SCID-II= Structured Clinical Interview for Personality Disorders axis II; SCID-CV= Structure Clinical Interview for Axis I Disorders- Clinician Version; SH= Self-Harm; SHI= Self-Harm Inventory; SITBI= Self-Injurious Thoughts and Behaviors Interview; SNAP: Schedule for Non-Adaptive and Adaptive Personality: Low Self-Esteem; LSE= SNAP: SUICIP= Schedule for Non-Adaptive and Adaptive Personality: Suicide Proneness; SPRAS= Sheehan Patient-Rated Anxiety Scale; VAS= Visual Analogue Scale

TABLE 2.2

Case-Control Studies of Pain and Self-harm

Study	Population		Types of behaviour included	Measures		Results
Country Quality assessment (QA) score	Cases	Controls		Pain Threshold/ Tolerance & Other Physiological	Psychological	
Bohus et al. (2000) Germany QA score = 6	12 female psychiatric inpatients with BPD. Mean age= 29.1 yrs	N= 19 females with no Axis I disorders or BPD. Mean age= 27.3 yrs.	NSSI	CPT at 10◦ C (maximum 4 mins) & TPT. Pain intensity and unpleasantness assessed for both CPT & TPT. Time to reach pain threshold and tolerance measured for TPT only. HR and SCRF also measured.	5 questions derived from the SDQ-5 (Nijenhuis et al., 1997) and DES (Bernstein & Putnam, 1986), measuring distress, numbness, visual and auditory sensitivity and anesthesia.	BPD-D reported less pain than BPD-C. Onset of TPT pain significantly later in BPD-D than BPD-C. No significant difference between groups in TPT tolerance. No significant difference between BPD-C & BPD-D in unpleasantness & intensity of pain.
Franklin, Hessel, Aaron, Arthur, Heilbron & Prinstein (2010) USA QA score = 8	16 Undergraduates reporting NSSI.	96 Undergraduate students: 24 with high affect dysregulation, but reporting no NSSI (Matched-AD). 33 with low affect dysregulation and no NSSI (Low-AD). 39 healthy controls that received no painful stimuli (No pain).	NSSI	CPT at 2◦ C for maximum of 2 minutes. Level of distress measured. Startle-alone reactivity measured by administration of 100-dB broadband noises (20 Hz-20 kHz) each of 50ms duration. PPI measured by 85-dB broadband noise of 40ms duration.	SUDS FASM (Lloyd, Kelley & Hope, 1997) Modified 6 item DERS (Gratz & Roemer, 2004)	All groups reported more distress following CPT, apart from no-pain group. Startle-alone reactivity of no-pain group constant, but decreased for all other groups following CPT. PPI increased significantly for self-injury group following CPT, but decreased for other groups.

Glenn, Michel, Franklin, Hooley & Nock (2014) USA QA score = 7	58 adolescents reporting NSSI Mean age for total sample= 17.34 yrs	21 controls with no NSSI history	NSSI	Pressure algometer applied to fingers for a maximum of 4 minutes.	A-DES II (Armstrong et al., 1997) SITBI (Nock et al., 2007) SRS (Hooley et al., 2010) K-SADS-PL (Kaufman et al., 1997)	Individuals in the NSSI exhibited significantly higher pain tolerance than controls. This was strongly associated with high self-criticism.
Hamza, Willoughby & Armiento (2014) Canada QA score = 7	31 undergraduates reporting NSSI with self-punishment motivation 25 undergraduates reporting NSSI without self-punishment motivation Mean age total sample= 21.52 yrs	26 controls with no NSSI history	NSSI	Cold pressor test at 1-4◦ C for maximum of 2 minutes	ISAS (Klonsky & Glenn, 2009) TSST (Kirschbaum, Pirke & Hellhammer, 1993) DERS (Gratz & Roemer, 2004) PPES (Bender, Gordon, Bresin & Joiner, 2011) Self-criticism subscale from DEQ (Blatt, D'Afliatti & Quinlan, 1976)	Those who engaged in NSSI with a motive of self-punishment exhibited significantly higher pain tolerance following stress induction than those without a motive of self-punishment. Self-criticism was strongly associated with pain tolerance.
McCoy, Fremouw & McNeil (2010) USA QA score = 9	11 people who had engaged in NSSI from undergraduate population (2 with previous suicide attempt)	33 healthy undergraduate controls. Overall sample mean age= 20.25 yrs.	NSSI	Algometer. Time to reach pain threshold and tolerance measured. Score on VAS.	Sensation Seeking. DSHI (Gratz, 2001) BDI-II (Beck, Steer & Brown, 1996) BHS (Beck, Weissman, Lester & Trexler, 1974) ASI (Peterson & Reiss, 1993)	Significant difference in threshold and tolerance between groups, but only on first trial. Average pain threshold did not significantly differ between groups. People who had engaged in NSSI had significantly higher pain tolerance than controls and also rated pain as significantly less intense.

Magerl, Burkart, Fernandez, Schmidt & Treade (2012) Germany QA score = 5	22 patients with BPD (20 inpatients; 15 females; mean age= 29 yrs)	22 healthy controls (15 females; mean age= 29 yrs)	NSSI	Pinprick stimuli: 7 punctate probes, ranging from 8-512mN, each applied 5 times for 1s. Chemical stimuli: Intradermal capsaicin injection (40µg in 12.5µL). Pain intensity and unpleasantness measured on 0-10 scale. Pain threshold estimated from these.	DIB-R (Zanerini, Frankenburg, Vujanovic, 1989) BPI (Leichsenring, 1997) BfS mood scale (von Zerssen, Koeller & Rey, 1970) SCID-II (First, Spitzer, Gibbon & Williams, 1996)	Higher estimated pain threshold for BPD group than controls. No significant difference in pain intensity ratings, but lower unpleasantness in BPD group. Pain threshold correlated with recency and frequency of NSSI.
Orbach, Mikulincer, King, Cohen & Stein (1997) Israel QA score = 9	38 patients who had attempted suicide (16 females; mean age= 17.68 yrs)	29 non-suicidal psychiatric patients (15 females; mean age= 17.29 yrs) 34 healthy controls (16 females; mean age= 17.02 yrs)	SB	Thermal heat stimuli administered by TSA Thermal Sensory Analyzer. Temperatures ranged from 30-50◦ C. 5 trials each for sensory threshold, pain threshold, pain tolerance, maximum tolerance and magnitude estimation. Pain intensity also measured.	MAST (Orbach et al, 1991) PAS (Sanders, 1986) CCL (Steer, Beck, Clark & Beck, 1994) BHS (Beck, Weissman, Lester & Trexler, 1974) Modified SLS (Smith, Conroy & Ehler, 1982)	Higher pain threshold, tolerance, sensory threshold and maximum tolerance in people who had engaged in NSSI than both control groups. Dissociation associated with sensation, but not pain threshold or tolerance. Hopelessness significant predictor of pain threshold but not pain tolerance.
Orbach, Palgi, Stein, Har-Even, Lotem-Peleg, Asherov & Elizur (1996a) Israel QA score = 8	37 patients who had attempted suicide (23 females; mean age= 22.3 yrs)	34 non-suicidal psychiatric patients (16 females; mean age= 21.2 yrs) 77 healthy controls (52 females; mean age= 21.2 yrs)	SB	Electric shock stimuli, ranging from 3-7mA intensity and 3-50Hz frequency. Up to 20 trials at increasing intensity, for duration of 0.5s each. Pain intensity rated on 1-9 scale, tension and motivation rated on 1-10 scale. Thermal stimuli: 75w lamp concentrated on 1.5cm skin target. Pain tolerance was time to withdrawal.	Modified SLS (Smith, Conroy & Ehler, 1982)	Those who had attempted suicide tolerated the most shocks relative to healthy control and psychiatric inpatients. Shocks were rated as less painful by those in the suicidal group. Suicidal intent was positively correlated with thermal and electrical pain tolerance.

Orbach, Stein, Palgi, Asherov, Har-Even & Elizur (1996b) Israel QA score = 8	33 patients who had attempted suicide (20 females; mean age= 21.6 yrs)	24 accidental injury patients (9 females; mean age= 22.1 yrs) 33 healthy controls (20 females; mean age= 21.2 yrs)	SB	As Orbach et al (1996a) for electric shock stimuli.	Modified SLS (Smith et al, 1982) CCL (Steer, Beck, Clark & Beck, 1994) PVS (Maddi, 1987) Modified BIS (Gray, 1977) BCS (Jourard & Secord, 1955) LES (Sarason et al, 1978)	People who had attempted suicide tolerated highest number of shocks, followed by controls and then accidental injury patients. Suicidal individuals also appraised shocks as less painful. Higher hardiness associated with lower pain appraisal in suicidal and accident patients.
Schmahl et al. (2006) Germany QA score = 6	12 female patients with BPD –NP Mean age= 28.67 yrs.	12 healthy female controls. Mean age= 27.67 yrs. 1 with social phobia.	NSSI	Thermal heat stimuli ranging from 40-48∘ C in 20x30 second blocks, delivered via thermode. Self-rating of pain on numeric rating scale. fMRI assessment during administration of painful stimuli. Threshold was temperature where 50% of trials perceived as painful.	SCID-I (First et al., 1995) IPDE (Loranger et al., 1999) BDI (Steer, Beck & Garrison, 1986) DSS (Stiglmayer, Shapiro, Stieglitz, Limberger & Bohus, 2001)	BPD group had significantly higher pain threshold than controls. fMRI showed increased activity in DLPFC during pain in BPD, but lower activity in parietal cortex. BPD had neural deactivation in perigenual ACC and the right amygdala, but not controls

Note: A-DES-II= Adolescent Dissociative Experiences Scale; BCS= Body Cathexis Scale; BDI/BDI-II= Beck Depression Inventory; BHS= Beck Hopelessness Scale; BIS= Body Image Scale; BPD= Borderline Personality Disorder; BPD-C= BPD-Calm; BPD-D= BPD-Distressed; BfS= Befindlichkeitsskala mood scale; BPI= Borderline Personality Inventory; BPD-NP= BPD-No Pain during self-harm; CCL= Cognition Checklist; CPT= Cold Pressor Test; DEQ= Depressive Experiences Questionnaire; DES= Dissociative Experiences Scale; DERS= Difficulties in Emotion Regulation Scale; DIB-R= Diagnostic Interview for Borderlines Revised; DSS= Dissociative States Scale; FASM= Functional Assessment of Self-Mutilation; fMRI= functional Magnetic Resonance Imaging; HR= Heart Rate; IPDE= International Personality Disorder Examination; ISAS= Inventory of Statements About Self-Injury;LES= Life Experience Survey; K-SADS-PL= Kiddie Schedule for Affective Disorders and Schizophrenia in School-Age Children, Present and Lifetime Version; MAST= Multi-Attitude Suicidal Tendencies Scale; NSSI= Non-suicidal self-injury; PAS= Perceptual Alteration Scale; PPES= Painful and Provocative Events Scale; PPI= Prepulse Inhibition; PVS= Personal View Scale; SB= Suicidal behaviour; SCRF= Skin Conductance Response Fluctuation; SCID /SCID-P/SCID-I/P = Structured Clinical Interview for Personality Disorders axis I; SCID-II= Structure Clinical Interview for DSM-IV Personality Disorders; SDQ-5= Somatoform Dissociation Questionnaire; SITBI= Self-injurious Thoughts and Behaviours Interview; SLS= Suicide Lethality Scale; SRS= Self-Rating Scale; SUDS= Subjective Units of Distress Scale; TPT= Tourniquet Pain Test; TSST= Trier Social Stress Test

2.3.1.2 Sample characteristics

2.3.1.2.1 Ethnicity

Six of the cross-sectional studies reported information regarding participants' ethnicity (Bresin & Gordon, 2013; Franklin et al., 2012, 2011; Gratz et al., 2011; Russ et al., 1999; Weinberg & Klonsky, 2012). The majority of participants across all samples were White, in some cases as many as 96% (Bresin & Gordon, 2013).

2.3.1.2.2 Age

All cross-sectional studies employed adult samples. It is of note, however, that the majority of participants were in their 20s.

2.3.1.2.3 Gender

Recent studies have increasingly used mixed-gender samples but seven studies recruited exclusively female samples (Kemperman et al., 1997; Ludäscher et al., 2009; Niedtfeld et al., 2010; Russ et al., 1999; 1994; 1992; Schmahl et al., 2004). Given the consistent over-representation of females within self-harm populations (e.g. O'Connor, Rasmussen, Miles & Hawton, 2009), this was to be expected.

2.3.1.3 Sample population

Just over half of the cross-sectional studies- the most recently published- used community samples (predominantly undergraduate students) and the remainder recruited participants from psychiatric populations, most commonly patients with a diagnosis of Borderline Personality Disorder (BPD). Only four of the studies employing community samples utilised some form of psychiatric assessment (Gratz et al., 2011; Hooley et al., 2010; Hooley & St Germain, 2014; St Germain & Hooley, 2013).

2.3.1.3.1 Type of self-harm

Cutting, severe scratching, skin scraping and burning were the most common forms of self-harm reported (Bresin & Gordon, 2013; Franklin et al., 2012; 2011; Gratz et al., 2011;

Hooley et al., 2010; Ludäscher et al., 2009; Niedtfeld et al., 2010; Weinberg & Klonsky, 2012). Only Hooley and colleagues (2010) included type of NSSI as a variable within their analyses and found no significant effect of self-injury type upon pain threshold or pain endurance, however subgroups were potentially too small (n=15) to allow reliable analysis.

2.3.1.3.2 Recency of self-harm

There were marked differences between studies in terms of how they classified *current* self-harm. Bresin and Gordon (2013) and Gratz et al. (2011) set inclusion criteria of at least one episode of self-injury within the past year, whereas Ludäscher et al. (2009) and Russ et al. (1999) used criteria of one and three episodes respectively, within the last 6 months. Hooley et al., (2010) and St Germain and Hooley (2013) stipulated participants must have engaged in NSSI within the last month. Two studies used a precursor to the DSM-5 (section three) diagnosis for further study criteria for Nonsuicidal Self-Injury (NSSI) of five or more episodes, instead using more than 6 episodes within the last year (Franklin et al., 2012, 2011). Others used lifetime history of self-injury (Kemperman et al., 1997; Niedtfeld et al., 2010; Russ et al., 1994; 1992; Weinberg & Klonsky, 2012) and the remaining studies did not specify.

2.3.1.3.3 Measurement of self-harm

Only half of the cross-sectional studies used a standardised measure to assess self-harm behaviours (see Table 2.1 for details). For some of the measures employed, the psychometric properties have been investigated. The DSHI has been found to have high internal consistency (α= .82) and adequate test-retest reliability 2-4 weeks after initial assessment (Cronbach's theta= .68), as well as having adequate construct, convergent and discriminant validity in an undergraduate sample (Gratz, 2001). Good construct validity and excellent internal consistency have been reported for the ISAS, with α coefficient of .80 and .88 for the interpersonal and intrapersonal factors of the scale (Klonsky & Glenn, 2009). The FASM (Lloyd et al., 1997), used by Franklin et al. (2012; 2011), has been demonstrated to have adequate internal consistency (α= .65 and .66 for moderate/severe scales respectively) and concurrent validity for adolescents (e.g. Guertin, Lloyd-Richardson, Spirito, Donaldson & Boergers, 2001). Additionally, although the psychometric properties of the SITBI precursor used by Hooley and colleagues (2010) are

unknown, the SITBI (Nock et al., 2007) has demonstrated strong inter-rater (κ = .99) test-retest reliability (κ = .70) and concurrent validity for NSSI (κ= .87) (Nock et al., 2007).

2.3.1.3.4 Suicidality

One study did not specifically state whether or not participants' self-harm was suicidal in intent, or whether participants had a history of previous suicide attempts (Niedtfeld et al., 2010). Hooley et al. (2010), Hooley and St Germain (2014) and St Germain and Hooley (2013) were the only cross-sectional studies to actively screen and exclude participants from the NSSI groups based on the suicidal intent of their self-injury. The remaining studies all defined self-injury as being without suicidal intent, i.e. NSSI, however they did not report that suicidal intent was one of their exclusion criteria. No standardised measure of suicidal ideation was administered in any of the 15 cross-sectional studies.

2.3.1.4 Possible confounding variables

2.3.1.4.1 Co-morbid psychiatric disorder and medication use

Within the clinical samples, many exhibited a range of lifetime or current comorbid psychiatric disorders within their samples, most commonly anorexia nervosa, bulimia nervosa, major depressive disorder or substance abuse. Almost half of the cross-sectional studies included participants who were currently taking psychotropic medications. Some studies reported using an 'unmedicated' sample and other studies did not specify participants' medication history (Bresin & Gordon, 2013; Franklin et al., 2012; Gratz et al., 2011; Weinberg & Klonsky, 2012). Only three of the cross-sectional studies specifically reported that they had excluded participants who were taking analgesics at the time of the study (Hooley et al., 2010; Russ et al., 1999; St Germain & Hooley, 2013) and the remaining studies did not specify these details. The sample used in Hooley and St Germain (2014) overlaps with that of St Germain and Hooley (2013), which did control for analgesics. The five studies which used an 'unmedicated' sample could potentially also have excluded participants using analgesics; however this was not specifically mentioned.

2.3.2 Strengths and limitations of the evidence for altered pain threshold and tolerance in self-harm

Most studies measured pain threshold only (n=4), with the remainder measuring both threshold and tolerance (n= 3) and three measuring pain threshold and pain endurance (see

Table 2.1). Other studies assessed pain via self-reported measures of intensity and unpleasantness (n= 3) or intensity and affect (n=1). One study (Weinberg & Klonsky, 2012) asked participants to indicate a point at which the stimulus was painful, but tolerable, which could perhaps be thought of as a midpoint between threshold and tolerance?

Across all of the cross-sectional studies, those who engaged in self-harm exhibited a higher pain threshold than healthy controls. Those with a history of NSSI demonstrated a higher threshold for and endurance of pain than controls (Hooley et al., 2010; Hooley & St Germain, 2014; St Germain & Hooley, 2013), although when Hooley et al. (2010) controlled for psychotropic medications, only pain endurance remained significantly different. Of the four studies that measured pain tolerance, all but one found that those who self-injured exhibited significantly higher pain tolerance than healthy controls (Franklin et al., 2011), however, one study found tolerance to be increased only under conditions of distress (Gratz et al., 2011). Those who engaged in self-injury chose higher (more intense) levels of electric shock stimuli than control participants, although they did not report greater subjective levels of pain (Weinberg & Klonsky, 2012), but conversely, no effect of self-injury was found upon pain intensity pre or post mood induction in the study by Bresin and Gordon (2013). None of the studies by Russ and colleagues (1999; 1994; 1992) assessed pain threshold or tolerance, but instead recorded participants' self-reported feelings of pain intensity, unpleasantness ("hedonics") and mood. Participants who reported experiencing no pain during self-harm reported significantly lower pain intensity and unpleasantness than controls (Russ et al., 1999; 1992).

2.3.2.1 Pain induction method, pain threshold and pain tolerance

Several different methods were used to induce pain, although irrespective of the wide array of different pain induction methods used, pain threshold and tolerance do not appear to differ noticeably as a function of method. The majority of studies utilised the Cold Pressor Test (CPT), whereby participants submerge their hand, up to the wrist, in thermostatically cooled or ice water (Franklin et al., 2012; 2011; Gratz et al., 2011; Russ et al., 1999; 1994). Temperatures ranged widely, from 0.5° C (Gratz et al., 2011) to 10° C (Russ et al., 1999, 1994, 1992). Other work has used thermal (Bresin & Gordon, 2013; Kemperman et al., 1997; Ludäscher et al., 2009; Niedtfeld et al., 2010) and laser techniques (Schmahl et al., 2004), which apply heat in timed pulses to the skin. Similarly electric shock stimuli, employed by Weinberg and Klonsky (2012), were also delivered in timed pulses to the skin. Three studies used a pressure algometer (Hooley et al., 2010; Hooley & St Germain,

2014; St Germain & Hooley, 2013), a device for assessing the force or pressure required to reach pain threshold or tolerance (Kinser, Sands & Stone, 2009) and one experiment used a combination of the CPT and the algometer (Gratz et al., 2011) to assess pain threshold and tolerance.

2.3.2.2 Gender, pain threshold and pain tolerance

There was some evidence that males exhibited a higher pain tolerance than females (Gratz et al., 2011) although other studies did not find a similar effect (Franklin et al., 2012, 2011; Hooley et al., 2010; Hooley & St Germain, 2014) Weinberg and Klonsky, 2012). One further study that used a mixed-gender sample (Bresin & Gordon, 2013) did not investigate gender effects within the analyses and the remainder used only female participants.

2.3.2.3 Self-harm characteristics, pain threshold and pain tolerance

The majority of cross-sectional studies (n=12) did not explore whether there was a significant association between pain threshold and the length of time participants had been self-harming. Of those that did, only Hooley et al. (2010) found that individuals who had been engaging in NSSI for longer exhibited a higher pain threshold and this effect did not extend to pain endurance. Ludäscher et al. (2009) examined pain perception in people who used to self-harm, people who currently self-harmed and healthy controls, finding that those who currently engaged in self-harm had the highest pain threshold, followed by those who use to self-harm, then healthy controls, with the latter having the lowest pain threshold.

2.3.3 Psychological correlates of altered pain threshold and tolerance

2.3.3.1 Psychological characteristics

All but two of the cross-sectional studies (Hooley & St Germain, 2014; Schmahl et al., 2004) employed some form of assessment of psychological variables in their research (see Table 2.1 for details). The focus however was predominantly upon hopelessness, depression and dissociative experiences as opposed to broader psychological characteristics such as perfectionism or neuroticism, and there was little to no substantive focus on the relationship between psychological factors and pain threshold and tolerance. Two studies examined difficulties with emotion regulation (Franklin et al., 2012; Weinberg & Klonsky, 2012), however only Franklin and colleagues (2012) found any significant

relationship: both higher pain threshold and tolerance were strongly correlated with high emotion dysregulation and emotion dysregulation was a moderator of the relationship between NSSI and pain tolerance.

2.3.3.2 Mood

Several studies manipulated participants' affect/stress levels (Bresin & Gordon, 2013; Franklin et al., 2012; Gratz et al., 2011; Hooley & St Germain, 2014; Niedtfeld et al., 2010; Weinberg & Klonsky, 2012). Using a highly personalised negative mood-induction, whereby participants were asked to describe interpersonal situations during which they felt distressed, Gratz et al., (2011) found that pain tolerance in the NSSI group increased only during distress. The other studies employing mood manipulations examined the reverse: change in affect as a function of pain, which is outside the scope of this review. Hooley and St Germain (2014) used a positive self-worth manipulation, in which participants were asked to identify 'positive characteristics' from a checklist that they thought may apply to themselves. Following this manipulation, participants in the NSSI group displayed a marked reduction in pain endurance relative to baseline.

2.3.3.3 Candidate explanatory mechanisms for altered pain threshold and tolerance in self-harm

Findings in relation to potential explanatory mechanisms for elevated pain threshold and tolerance in self-harm, are scant. Five studies cite endogenous opioids as candidate mechanisms for increased pain threshold and tolerance in self-harm (Ludäscher et al, 2009; Schmahl et al, 2004; Kemperman et al, 1997; Russ et al, 1992; 1994), however none test this mechanism directly, such as by measuring endogenous opioid levels by blood plasma sampling or by Positron Emission Tomography (PET) imaging.

2.3.3.4 Endogenous opioids

Ludäscher et al. (2009) discuss three possible explanations for the phenomenon. First that the differences in pain threshold are the result of differences between subgroups of people with BPD, the characteristics of which dispose some individuals to self-harm and others not to. Second that pain insensitivity is produced by habituation as a consequence of repeated activation of the endogenous opioid system (EOS) by self-harming. Thus resulting in pain threshold "normalising" following cessation of self-harming behaviour. A

third explanation is that improvement in BPD symptomatology results in the normalisation of pain perception.

Russ et al., (1992) suggest that the dual presence of altered mood and insensitivity to pain is indicative of neural mechanisms such as the release of endogenous opioids. This is further explored in a later study (Russ et al., 1994), using the opioid antagonist naloxone in an attempt to block the analgesia observed during administration of painful stimuli to self-harming individuals with BPD. No effect was found, however.

2.3.3.5 The "defective-self" hypothesis

Hooley and colleagues (2010) investigated a *post-hoc* hypothesis that those who engaged in self-harm would feel more deserving of punishment and be more likely to consider themselves to be bad people than controls and that this would be associated with pain tolerance. Hooley et al (2010) reanalysed their pain results as a function of 'self-rating': a brief measure of self-criticism developed by the researchers. The results confirmed their hypothesis, demonstrating that feelings of worthlessness, social ineptitude and guilt were significantly associated with pain endurance and that those with the strongest belief in their lack of worth, also exhibited the highest pain endurance. No association was found between SRS score and pain threshold. Based on this, Hooley et al (2010) propose the "defective self theory"; that pain endurance is higher in those who self-harm because they feel as though they deserve the pain and that the elevation in mood observed post-self-harm, is the result of the self-affirmation derived from experiencing pain. Hooley & St Germain (2014) give further weight to this theory by demonstrating that a positive self-worth manipulation could reduce endurance for physical pain in those who have engaged in NSSI; when individuals feel more positively about themselves, elevated pain endurance does not appear to be present.

2.3.4 Case-control studies

2.3.4.1 Results of quality assessment for case-control studies

Overall, the case-control studies were of higher quality than the cross-sectional studies and the majority scored seven or higher in the quality assessment, see Appendix A, Table 3 for full quality assessment scores for each study.

2.3.4.2 Sample characteristics

2.3.4.2.1 Ethnicity

Only two of the case control studies (Franklin et al., 2010; Glenn et al., 2014) reported any information regarding participants' ethnicity, with their sample being predominantly (75% or more) European American. Hamza et al., (2014) reported the nationality of their sample as the majority being Canadian.

2.3.4.2.2 Age

Two studies employed adolescent samples (Glenn et al., 2014; Orbach et al., 1997). The findings from these samples did not appear to deviate from studies that used adult samples.

2.3.4.2.3 Gender

Three of the studies including inpatients used predominantly female samples (Bohus et al., 2000; Magerl et al., 2012; Schmahl et al., 2006), as did Franklin and colleagues (2010). The other two studies using inpatient samples had a more even gender-split (Orbach et al, 1997; Orbach et al., 1996a)

2.3.4.3 Sample population

Two samples were derived from consecutive psychiatric hospital admissions (Bohus et al., 2000; Orbach et al., 1996b), whereas Schmahl et al. (2006) used only those BPD patients that reported partial or complete analgesia during episodes of self-harm. Little information is reported by Magerl et al. (2012) regarding recruitment of BPD patients, however all but two were inpatients at the time of participation. Other studies recruited inpatient samples for both suicidal and non-suicidal psychiatric groups (Orbach et al., 1997; Orbach et al., 1996a). One study used patients admitted to the emergency room following a suicide attempt, who were then matched for injury severity with individuals admitted because of an accidental injury and to controls for age, gender and educational level (Orbach et al., 1996b). Several of the more recent case-control studies have used community samples (Franklin et al., 2010; Glenn et al., 2014; Hamza et al., 2014; McCoy et al., 2010).

2.3.4.3.1 Type of self-harm

The majority of participants within the community sample studies endorsed cutting and self-hitting as the most common types of self-injury Franklin et al., 2010; Glenn et al., 2014; Hamza et al., 2014) and within the latter two studies, self-pinching, severe scratching and self-hitting were also reported. Little information was given by Bohus et al. (2000), Magerl et al. (2012) or Schmahl et al. (2006) regarding the type of self-injury that participants report engaging in, although cutting and burning are listed among the methods used. Orbach and colleagues' (1996a; 1996b; 1997) studies differ from the others as their participants had attempted suicide; indeed individuals who had engaged in NSSI were specifically excluded, therefore the methods reported are generally more lethal, including hanging, drowning, shooting and jumping from a height, as well as self-poisoning and cutting.

2.3.4.3.2 Recency of self-harm

Only Magerl et al. (2012) found an effect of recency of self-injury upon pain, with individuals who had last self-injured more than one year ago, demonstrating pinprick pain thresholds comparable to controls.

2.3.4.3.3 Measurement of self-harm

Three case-control studies assessed self-injury by means of self-report (Bohus et al., 2000; Franklin et al., 2010; Magerl et al., 2012) and Franklin et al. (2010) also used the FASM (Lloyd et al., 1997; see earlier cross-sectional study section for discussion of psychometric properties). Bohus et al. (2000) set an inclusion criterion of at least 3 episodes within the last two years and Franklin et al. (2010) used more than 6 episodes in the last year as their inclusion criterion. Magerl et al. (2012) used data from medical notes in addition to self-report and visual inspection of participants' injuries/scars to access lifetime history and recency of last episode. Schmahl et al. (2006) did not specify how recent participants' self-injury was.

2.3.4.3.4 Suicidality

Suicidal ideation and the suicidal intent of participants' self-injury are only reported in Orbach et al. (1996a; 1996b; 1997). Bohus et al. (2000) use a definition of self-injury that specifically defines it as being of non-suicidal intent, although lifetime or current suicidal behaviour is not mentioned in their exclusion criteria. Similarly, the three studies using community samples specify that self-harm is without suicidal intent, i.e. NSSI, but does not assess whether participants have also engaged in self-harm with the intention of ending their life (Franklin et al., 2010; Glenn et al., 2014; Hamza et al., 2014).

2.3.4.4 Possible confounding variables

2.3.4.4.1 Co-morbid psychiatric disorder and medication use

Within all but two of the case-control studies, there was some assessment of comorbid psychiatric disorder; only Franklin et al., (2010) and Hamza et al., (2014) did not report assessing participants for psychiatric disorder. Of those studies that did assess psychiatric symptoms, the overwhelming majority exhibited some degree of symptomatology, e.g. bulimia nervosa, panic disorder, social phobia, PTSD and depression (Bohus et al., 2000; Magerl et al., 2012; Orbach et al., 1996a; 1996b; 1997; Schmahl et al., 2006). These diagnoses were for the most part in addition to existing BPD diagnoses. Even within a community sample, more than half of the individuals were categorised as having a diagnosable psychiatric disorder (Glenn et al., 2014)

2.3.5 Strengths and limitations of the evidence for altered pain threshold and tolerance in self-harm

There was great variation in pain outcome variables investigated within the case-control studies: four measured both threshold and tolerance (Bohus et al., 2000; Glenn et al., 2014; Hamza et al., 2014; Orbach et al., 1997) and the others either threshold *or* tolerance only. One study estimated pain tolerance from pain intensity ratings (Magerl et al., 2012). All of the studies that assessed pain threshold found that the self-injury group demonstrated a significantly higher pain threshold than healthy matched controls. McCoy et al. (2010) found the self-injury group to have a higher pain threshold than controls on the first trial, but did not find a significant difference between groups on the two subsequent threshold trials or between the mean thresholds of the two groups; potentially suggesting that multiple trials result in habituation.

Just under half of the studies found significant between-group differences for pain tolerance (higher in self-injury group) (Glenn et al., 2014; Hamza et al., 2014; Orbach et al., 1997; Orbach et al; 1996a). Pain perception, as indexed by number of electric shocks sustained, was also found to be higher in the self-injury group compared to accidental injury patients (Orbach et al., 1996b). However, as this was a measure of the number of shocks that participants could endure and not their sensitivity to, or ability to detect the shock, this was really a measure of pain tolerance and not pain perception. Bohus and colleagues (2000) however did not find significant between-group differences for pain tolerance.

2.3.5.1 Pain induction method, pain threshold and pain tolerance

Methods of inducing pain were heterogeneous. Two studies used heat stimuli (Orbach et al., 1997; Schmahl et al., 2006) and one used electric shock stimuli (Orbach et al., 1996b). Three studies used multimodal pain assessment, one employing the CPT for pain threshold and the Tourniquet Pain Test (TPT) for pain tolerance (Bohus et al., 2000) and Magerl et al. (2012) using chemical pain (intradermal capsaicin injection) and mechanical pain (pinprick stimuli). Orbach et al. (1996a) used electric shock pain in addition to thermal pain. Franklin et al. (2010) and Hamza et al., 2014 used the CPT and Glenn et al., (2014) and McCoy et al., (2010) used the pressure algometer. Despite the heterogeneity of pain induction methods, there appears to be no marked differences in pain outcome as a function of the way in which pain was induced.

2.3.5.2 Gender, pain threshold and pain tolerance

Females were overrepresented in many of the studies using inpatients samples (e.g. Bohus et al., 2000) and in Franklin et al's (2010) community sample, therefore for the most part, any analysis of pain variables as a function of gender were precluded. Glenn et al., 2014 and Hamza et al., 2014 matched cases and controls for gender and therefore did not conduct further analyses based upon gender. McCoy et al., (2010) used a mixed-gender sample, however did not investigate effects of gender within the analyses.

2.3.5.3 Self-harm characteristics, pain threshold and pain tolerance

The two most recent studies investigated the effect of NSSI frequency upon pain endurance and tolerance, but found no effect (Glenn et al., 2014; Hamza et al., 2014).

Other work by Magerl and colleagues (2012) investigated the effect of self-injury history and frequency upon mechanical and chemical pain ratings, finding a positive correlation between recency of self-injury and estimated thresholds for both pain modalities. Orbach et al., (1997) found no significant differences for any of the pain measures between those who had attempted suicide for the first time, or those for whom it was a repeat attempt.

2.3.6 Psychological correlates of altered pain threshold and tolerance

2.3.6.1 Psychological characteristics

Again, there was little substantive focus on the relationship between psychological variables and altered pain threshold or tolerance within the case-control studies. Three studies assessed dissociation (Bohus et al., 2000; Orbach et al., 1997; Schmahl et al., 2006), of which only Orbach et al. (1997) investigated the relationship between dissociation and pain, finding a positive correlation between sensation threshold and dissociation. No other significant association between dissociation and pain were found. See Table 2.2 for details.

2.3.6.2 Mood

Bohus et al., (2000) was the only study to find any effect of mood upon pain, with self-injuring BPD patients having a higher threshold for pain during self-reported distress than calmness.

2.3.7 Candidate explanatory mechanisms for altered pain threshold and tolerance in self-harm

Few explanations are put forward by the case-control studies for the mechanisms that may underlie altered pain threshold and tolerance in those who self-harm.

2.3.7.1 Self-punishment and self-criticism

Hamza et al. (2014) compared individuals who engage in NSSI with a motive of self-punishment, to those who engaged in NSSI with alternative motivations (excluding suicide). Individuals who endorse self-punishment as their primary reason for engaging in NSSI exhibited a significantly higher pain tolerance than those who did not use NSSI as a means of self-punishment. The authors suggest that individuals are willing to tolerate

more pain because of their high levels of self-criticism, i.e. they believe they are receiving a "just" punishment.

A significant association between high self-criticism and higher pain tolerance was found in the study by Glenn and colleagues (2014), even when controlling for NSSI. They also suggest that feelings of low self-worth are a key factor in determining pain tolerance in those who engage in NSSI behaviour.

2.3.8 Discussion

This systematic review set out to examine the extant literature regarding the relationship between self-harm and pain threshold and tolerance, with a view to accomplishing three key aims: 1) to evaluate the strengths and limitations of the evidence for/against altered pain threshold and tolerance in NSSI and suicidal self-harm; 2) to identify psychological correlates of altered threshold and tolerance for physical pain; and 3) to identify candidate explanatory mechanisms for the phenomenon.

2.3.8.1 Strengths and limitations of the evidence altered pain threshold and tolerance in those who engage in self-harm

Overall, the evidence suggests that those who self-harm have an increased threshold and tolerance for physical pain. Those who engage in self-harm demonstrate higher pain tolerance in response to a wide variety of different pain modalities, including the CPT (Franklin et al., 2012; 2011), pressure algometer (Gratz et al., 2011; Hooley et al., 2010; Hooley & St Germain, 2014), thermal pain stimuli (Orbach et al., 1997; Orbach et al., 1996a), and electrical pain (Orbach et al., 1996a; Weinberg & Klonsky, 2012). This would also suggest that there does not appear to be a significant effect of pain measurement modality upon pain outcome measures within this population. Two studies found no significant differences in pain tolerance at all between control and experimental groups (Bohus et al., 2000; Franklin et al., 2011). The absence of significant between-group differences in pain tolerance reported by Bohus et al. (2000) and Franklin et al. (2011) is perhaps surprising, but the number of participants within the self-harm groups was small in both studies, potentially masking any genuine differences as a result of low statistical power.

The evidence for an association between pain threshold or tolerance and the length of time a person has been engaging in self-harm is mixed. Only three studies found an association between frequency of NSSI or the length of time a participant had been

engaging in self-harm behaviour (Hooley et al., 2010; Magerl et al., 2011; Orbach et al., 1996b), however no other studies found such an effect. The conflicting findings regarding length of time individuals had been engaging in self-harm and pain threshold or tolerance may be due to the wide variation in lifetime frequency of self-harm episodes, e.g. Bresin and Gordon (2013) reported frequency as ranging from 1-1000 lifetime episodes of self-harm and Kemperman et al. (1997) found large variations in age of onset of self-harming.

Ludäscher et al. (2009) compared current and former self-harm groups, finding that those who were engaging in self-harm behaviours at the time of the study had the highest pain threshold. Those who no longer self-harmed had a lower threshold, but it was still higher than controls. These data may suggest that pain threshold varies depending on the recency of self-harm. There was marked variation in how 'current' participants' self-harm was, ranging from within the last six months (Ludäscher et al., 2009) to lifetime episodes (Kemperman et al., 1997; Niedtfeld et al., 2010; Russ et al., 1994; 1992; Weinberg & Klonsky, 2012) and some studies do not even report this (e.g. Bresin & Gordon, 2013). The findings from Ludäscher et al., (2009) demonstrate that there may be an important relationship between recency of self-harm and response to behavioural measures of pain threshold. Furthermore, they may be indicative of a temporal aspect to altered pain threshold within this population; potentially it is a short-lived, temporary phenomenon, specific to periods of high distress, as opposed to a stable trait. The results from the study by Gratz and colleagues (2011) would strongly support this; this study found elevated pain tolerance in the NSSI group, relative to controls, only following a distress manipulation. Additionally, Hooley and St Germain (2014) found that pain endurance in NSSI could be modified by administration of a positive self-worth manipulation. It would be useful therefore, for future studies to report information on recency of self-harm, as well as investigating the change in pain threshold and tolerance across an individual's lifetime using a prospective design.

2.3.8.2 Methods of pain induction

Whilst there do not appear to be differences in the results as a function of how pain was induced, the heterogeneity of the methods employed within this area warrants further mention. Comparison across studies is problematic due to the multitudinous different methods of testing pain threshold and tolerance. For example, some studies used a cold pressor (Russ et al., 1999), whereas others used a pressure algometer (McCoy et al., 2010), chemical pain indices (Magerl et al., 2012) or a variety of other methods (Kemperman et al., 1997; Schmahl et al., 2004). The sustained exposure to the nociceptive stimuli

involved in the CPT would undoubtedly produce a distinctly different pain experience to the timed delivery of rapid thermal pulses used in other studies (e.g. Schmahl et al., 2006), potentially raising a question regarding the ecological validity of some pain induction methodologies in this population. Franklin et al. (2012; 2011; 2010) use a temperature of 2°C, citing this temperature as a more effective proxy for self-harm, due to the more acute pain generated by such cold water. Russ et al (1992; 1994), on the other hand, used a temperature of 10°C for their CPT. Regardless of temperature, however, the diffuse nature of CPT pain may still make it a less valid proxy for self-harm than methods which produce a more localised pain. The extreme differences in CPT temperatures employed across the different studies makes comparison of results very difficult, and it may be that observed differences in pain tolerance are a function of the individual CPT temperature, as opposed to self-harm. Selecting a CPT temperature that allows individuals to keep their hand immersed in the water long enough to provide meaningful data, whilst also ensuring that this temperature is sufficient to induce pain, is a significant challenge. Russ and colleagues (1992; 1994; 1999) made no behavioural assessment of pain tolerance, such as CPT termination latency, in any of their three studies included within this review, as is the case for Bresin and Gordon (2013) and Orbach et al. (1996b). Franklin et al. (2010) also make no assessment of threshold or tolerance, despite participants being administered threshold and tolerance procedures. Task termination latency (time, temperature, pressure or voltage) should be included as a behavioural measure of pain tolerance for all pain modalities.

Additionally, not all studies assessed both threshold and tolerance, with some testing only threshold (e.g. Ludäscher et al., 2009; Niedtfeld et al., 2010; Schmahl et al., 2004) or estimated threshold (Magerl et al., 2012) and others testing only tolerance (e.g. Orbach et al., 1996a; 1996b). Weinberg and Klonsky (2012) assessed a midpoint level where the stimulus was painful but tolerable, which raises an interesting point: in using pain tolerance as a proxy for self-harm we are assuming that when an individual self-harms, they are inflicting pain at the maximum level of their tolerance, when this may not in fact be the case. Both threshold and tolerance measures should still be included as standard in future research, but a better proxy for self-harm may be to administer stimuli that are painful but tolerable, as per Weinberg and Klonsky (2012). Overall, the relationship between self-harm and increased pain *tolerance* would appear to be stronger compared to the relationship between self-harm and increased pain *threshold*.

2.3.8.3 Sample and Design Limitations

Sampling and design limitations do impact significantly upon the quality of the evidence for both case-control and cross-sectional studies.

2.3.8.3.1 Sample

A significant proportion of previous research examining pain and self-harm has focused solely upon psychiatric populations - as is the case for much other self-harm research (Hawton, Harriss & Rodham, 2010)- and almost exclusively on patients with Borderline Personality Disorder (BPD) (e.g. Bohus et al., 2000; Magerl et al., 2012; Russ et al., 1999; 1994; 1992; Schmahl et al., 2006; 2004), however, it is clear that many who engage in self-harm do not suffer from a mental disorder (Barr, Leitner & Thomas, 2004). A possible reason for the overrepresentation of individuals with BPD in the pain and self-harm literature is that self-injury is included in the diagnostic criteria for BPD (Andover & Gibb, 2010) making patients an easily accessible sample for self-harm research. BPD however, is a relatively rare disorder; within samples from 10 community studies reviewed by Torgersen, Kringlen & Cramer (2001) there was a median prevalence of just 1.35%. As the estimated prevalence of non-fatal self-harm in the general population is thought to be around 4% in adults (Klonsky, Oltmanns & Turkheimer, 2003) and 14% in adolescents (O'Connor et al., 2009), significantly higher than the general population prevalence of BPD, not all self-harm can be co-morbid with BPD. Encouragingly, this is further evidenced by a proliferation of recent studies using community samples (e.g. Glenn et al., 2014; Gratz et al., 2011; Hamza et al., 2014; Hooley et al., 2010; Hooley & St Germain, 2014; McCoy et al., 2010; Weinberg & Klonsky, 2012), which make up just over half of the studies reviewed here. Future studies should continue to explore altered pain threshold and tolerance within non-clinical samples, and in clinical groups other than those with diagnoses of eating disorder or BPD. Females are consistently overrepresented in the samples of studies in this area, and thus we cannot generalise findings regarding altered pain threshold and tolerance in self-harm to males. Some studies have attempted to statistically control for this in their analyses, but with such vast differences in the gender composition of study samples in some cases, such controls may not be meaningful. Additionally, as gender differences in pain threshold and tolerance are also dependent upon the modality of pain assessment (Racine et al., 2010), this could have significant further implications for the generalisability of study findings.

A key further consideration with respect to the samples employed in studies of pain and self-harm is the variation in type and frequency of behaviour as a function of the type of sample. The majority of individuals had engaged in NSSI, but there may have been marked differences in the frequency of self-harming between those participants who were inpatients and those from a community sample, who were primarily students. Little information is provided in studies of inpatients as to the frequency of their self-harm. In some cases, e.g. Magerl et al (2012), the inpatients samples had engaged in self-harm more recently than those from community samples, e.g. Gratz et al (2011). Only three studies- those of Orbach and colleagues (1996a; 1996b; 1997)- specifically examined pain in suicidal self-harm. All of the participants within these three studies had engaged in more severe forms of self-harm (e.g. hanging, jumping from a height), than those in studies of NSSI, who primarily engaged in self-cutting. Pain tolerance may also alter as a function of the type, frequency and severity of self-harm behaviours. These differences may have important implications in terms of the comparability of results across studies, and indeed the heterogeneity of study samples may limit the generalisability of this review.

2.3.8.3.2 Design

In addition to sampling limitations, there are also considerable design limitations, with the majority of the studies reviewed here being cross-sectional (n=15) and only 10 being case-control. The complete absence of prospective studies from the literature means that our knowledge regarding the causal relationship between self-harm and increased pain threshold and tolerance is incomplete; it is therefore unknown whether altered pain threshold and tolerance is the result of self-harm behaviour, or a pre-disposing factor; although the former is considerably more plausible. There is an urgent need, therefore, for prospective studies to be conducted.

2.3.8.4 Psychological and Physiological Correlates of Altered Pain Threshold and Tolerance in self-harm

Around half of the studies included within the review actually make a formal assessment of self-harm using a validated and standardised measure. Whilst the samples used in the studies reviewed herein can be dichotomised almost evenly into those drawn from inpatient clinical populations and those from the community, it is evident that as a group, those who engage in self-harm are far from homogenous and the lack of formal self-harm assessment could potentially mean that important and more nuanced associations between altered pain threshold and tolerance and other characteristics that are present within the population, are

being overlooked. It is recommended therefore that future research include a validated measure of self-harm in order to better ascertain potential psychological correlates of altered pain threshold and tolerance.

There are numerous psychological variables that have been reliably associated with self-harm (see O'Connor & Nock, 2014 for discussion) and yet these are noticeably absent from the majority of studies within this review. Only the most recent studies (Franklin et al., 2012; Glenn et al., 2014; Hamza et al., 2014; St Germain & Hooley, 2013) devote any substantive focus to the relationship between psychological variables and pain tolerance. Several previous studies (e.g. Orbach et al., 1997; Schmahl et al., 2006) have demonstrated that altered pain threshold and tolerance do not appear to be the result of a physical lack of ability to perceive sensations (painful or otherwise) and the weight of the extant evidence would increasingly point to cognitive-affective mechanisms that underlie this phenomenon. Particularly, emotion dysregulation (Franklin et al., 2012) and self-critical beliefs (Glenn et al., 2014; Hamza et al., 2014; Hooley et al., 2010) appear to be lines of investigations that may bear considerable fruit. Based upon these findings, I argue that it is critical that we begin to dedicate more serious attention to exploring psychological variables that may mediate or moderate the relationship between self-harm and increased pain tolerance.

2.3.8.5 Candidate Explanatory Mechanisms

Ludäscher et al (2009) put forward several potential explanations for the phenomenon of altered pain threshold in self-harming individuals, including that findings were the result of differences between different subgroups of BPD patients and that improvement in BPD symptoms led to a "normalisation" of pain threshold in their formerly self-harming group. As several studies have demonstrated altered pain threshold and tolerance in community samples (Gratz et al, 2011; McCoy et al, 2010; Hooley et al, 2010), the observed differences are unlikely to be the result of either of these explanations. Much more likely is the third explanation that they present, that of habituation via endogenous opioid mechanisms of analgesia. Russ and colleagues (1994) were the only group to investigate the potential role of the endogenous opioid system in altered pain threshold and tolerance, but found no significant differences between the naloxone and saline conditions. As a possible explanation for this finding, they argue that the CPT is not sufficient to result in endogenous opioid activity (Bullinger et al, 1984); an idea that is also supported by more recent evidence (Kotlyar et al, 2008; Ring et al, 2007) finding no significant differences in self-reported pain ratings between naloxone and placebo conditions in samples of healthy and hypertensive adults respectively. This raises two interesting issues: firstly, that no

further investigation of the role of endogenous opioids in altered pain threshold or tolerance has been made in this population since Russ et al's (1994) study, even using a different pain modality and secondly, that literature regarding the effects of different painful stimuli used in the laboratory upon endogenous opioid analgesia, even in normative populations, is virtually non-existent (Kirtley et al., 2014). Particularly as there is little correlation between sensitivity to different laboratory-based methods of inducing pain (Nielsen, Staud & Price, 2009), this review strongly recommends that further basic science research be conducted to determine which methods of experimentally inducing pain provide the most reliable elicitation of endogenous opioid activity. Without such knowledge, considerable research energy may be wasted by employing methods that do not produce measurably significant changes in pain outcome variables, e.g. endorphin levels. An endogenous opioid mechanism of analgesia would seem promising and may provide psychobiological explanation for how self-harm fulfils its function of relieving emotional pain and terrible states of mind; with the endogenous opioids released in response to the physical pain of self-harm, also bringing a feeling of relief to the individual (see section 1.6.1.1 of the previous chapter for further discussion, also Bresin & Gordon, 2013; Kirtley et al., 2014, included in Appendix E).

The results of Schmahl et al (2004) suggest that altered pain threshold in this population is not the result of aberrant sensory-discriminatory perception in this populations, nor is it the result of attentional differences between self-harm and control groups. However, as this research was conducted upon inpatients with BPD, further research using non-clinical participants who self-harm may be required before such explanations can be truly ruled out. The idea that altered pain threshold and tolerance occurs at the level of cognitive-affective processing, rather than sensory-discrimination would seem highly plausible and would be consonant with the work of Melzack and Wall (1965), who first proposed the idea of a cognitive component of pain in their seminal work on gate control theory, in which they contended that emotions and cognitions moderated transmission of impulses from peripheral to central nerves, either opening or closing “the gate” to allow pain to be experienced or not.

The more recent finding of a significant relationship between being highly self-critical and having a higher pain tolerance is particularly suggestive of a cognitive-affective mechanism underlying altered pain tolerance in those who engage in self-harm (Glenn et al., 2014; Hamza et al., 2014; Hooley et al., 2010; Hooley & St Germain, 2014). Work by

Hamza and colleagues (2014) may however suggest that a self-criticism mediated mechanism may only be applicable to certain subgroups of self-harming individuals, specifically those who engage in self-harm with a motive of self-punishment. The majority of individuals who engage in self-harm endorse a motive of attempting to gain relief from a terrible state of mind (e.g. O'Connor et al., 2009). Therefore it may be interesting for future research to investigate potential differences in whether or not the relationship between self-criticism, self-hate and pain tolerance differs as a function of the motivation for engaging in self-harm.

Gratz and colleagues' (2011) results demonstrating a significant difference in pain tolerance as a function of participants' state of distress, suggests that tolerance may fluctuate with mood; partially supported by Bohus et al (2000), who found that pain tolerance was higher in BPD patients during self-reported distress relative to calmness, but when calm, BPD patients still exhibited higher tolerance than controls. This may indicate that a proportion of variability within pain tolerance is attributable to mood (state) changes, whereas another part is a consistent, more trait-like factor. Hooley and St Germain's (2014) study provides further support for this idea; those participants who had engaged in NSSI evidenced a reduction in pain endurance following a positive self-worth manipulation. Future research should investigate this phenomenon further as these findings may suggest that during a distressed state, elevated pain threshold and tolerance increases an individuals' acquired capability for engaging in self-harm.

2.3.9 Conclusions

In sum, the evidence taken as a whole, indicates that pain threshold and tolerance are elevated in clinical self-harming populations (e.g. Ludäscher et al., 2009; Schmahl et al., 2006; 2004) and also in non-clinical populations (Franklin et al., 2011; 2010; Gratz et al., 2011; Hooley et al., 2010; Hooley & St Germain, 2014; McCoy et al., 2010). The current evidence base is greatly limited by the general dearth of studies in this area as well as the heterogeneity of methods and the narrow populations from which the samples have been selected. The most significant limitation of the current body of research is the lack of substantive focus upon the relationship between altered pain threshold and tolerance, and psychological variables that we know to be associated with self-harm (e.g. perfectionism; O'Connor, 2007). Given the high likelihood of a cognitive-affective mechanism underlying altered pain tolerance within this population, inclusion of psychological

variables is a critical priority; particularly as there remains no consensus as to why pain threshold and tolerance are altered in individuals who self-harm. Additionally, many of the studies are limited by a lack of control procedures, such as ensuring participants are analgesic-free, and they also overlook the multitude of moderating psychological variables with established relationships with self-harm and suicidal behaviour. The high-degree of stimulus controllability that can be achieved with a thermode, may make it a good candidate for use in future research, although the ethical considerations of its use in populations with high pain tolerance may preclude this. Further studies in this area should attempt to establish whether there is a 'gold standard' methodology for measuring pain threshold and tolerance within this population. Future research should further explore pain threshold and tolerance in non-clinical samples of individuals who engage in self-harm as a matter of priority and should also adopt a more integrated approach, attempting to ascertain mediating and moderating pathways to elevated pain threshold and tolerance. There is an urgent need for prospective studies in this area as well as more basic scientific work to robustly establish proof of the existence of altered pain threshold and tolerance in self-harm, as a phenomenon.

Chapter 3: Methodology

Background

The relationship between emotional and physical pain sensitivity in suicidal and non-suicidal self-harm is a relatively new area of research and therefore there are no well-established "best" methods for such investigations. Indeed, this relationship has never before been studied in the context of understanding suicidal and non-suicidal self-harm ideation. Existing research on pain threshold and tolerance in other populations would suggest that employing a range of different methods including self-report and behavioural measures, would yield the most comprehensive results.

Methods

Three quantitative studies were carried out, utilising a variety of different measures. Studies 1 and 3 were conducted in a laboratory setting and Study 2 was administered as an online self-report study. Key questions identified by the initial experimental study were further investigated in the second, self-report study. These data then provided the basis for several testable hypotheses that were explored within the final experimental study.

Conclusions

The use of behavioural and self-report measures in these studies enabled the research to more fully investigate participants' physical and emotional pain experiences and psychological factors associated with these.

3.1 Introduction

Research into pain tolerance in NSSI and suicidal thoughts and behaviours is a growing field of study; however extant literature on this topic remains sparse and previous studies have used a myriad of different methods to assess pain threshold and tolerance, as detailed in the systematic review (Chapter 2). Studies of the relationship between emotional and physical pain in NSSI and suicide are even more scant and primarily employ some form of mood manipulation followed by behavioural and/or self-report assessment of pain threshold or tolerance. There is no established "best" method (i.e., gold standard) for assessing the relationship between emotional and physical pain in this population, therefore an iterative approach was taken when developing the methods used within these studies; the initial laboratory investigation of mood dependent pain tolerance, Study 1 (Stress-dependent pain threshold and tolerance in self-harm ideation and enactment), allowed us to identify important methodological gaps which were then further explored in Study 2 (Self-report study of sensitivity to physical and emotional pain in self-harm ideation and enactment**)**, leading to the refined laboratory methods employed in Study 3 (Reactivity to physical and emotional pain in self-harm ideation and enactment: Does self-report predict behaviour?) .

3.1.1 Hypothesised position of variables explored within this thesis within the Integrated Volitional Model (IMV) of suicidal behaviour (O'Connor, 2011)

As described in Chapter 1, the Integrated-Volitional Model (IMV) of suicidal behaviour (O'Connor, 2011) is a tripartite model describing the variables involved in the suicidal process; the pre-existing vulnerabilities that increase risk of developing suicidal thoughts (pre-motivational phase), to factors involved in ideation and intention formation (motivational phase) and the final (volitional) phase, comprising variables that differentiate those who ideate about suicide from those who attempt suicide. The measures used within the three studies described herein assess constructs from all three phases of the model. For some of these variables, e.g. social-perfectionism and impulsivity, their positions within the IMV have been investigated previously, e.g. O'Connor, Rasmussen and Hawton (2012). Others however, including emotional and physical pain sensitivity, have not yet been explored within the framework of the IMV.

Joiner (2005) and colleagues (Van Orden et al., 2010; Van Orden et al., 2008) have written extensively about the role of acquired capability for suicide being a key factor that

differentiates those who ideate, from those who act upon their thoughts of suicide (see Chapter 1 for discussion). They argue that increased tolerance for physical pain is a critical component of acquired capability (Ribeiro & Joiner, 2009). Based upon this, physical pain threshold and tolerance is explored as candidate variables within the volitional phase of the model. Given the social neuroscience evidence consistently linking sensitivity to emotional and physical pain (e.g. Eisenberger et al., 2003; Eisenberger et al., 2006), emotional pain sensitivity is hypothesised to also fall within the volitional phase of the IMV.

A summary of all of the variables explored within this thesis and their (hypothesised) positions within the IMV can be found in Table 3.1. A more detailed summary of the measures used to assess each variable and in which studies they feature, can be found in Tables 3.2, 3.3 and 3.4.

Table 3.1. Summary table of variables according to position within the IMV

Model phase	*Variables*
Pre-motivational	Social-perfectionism‡; Perfectionistic cognitions†‡; Perfectionistic self-presentation†‡; Self-criticism†‡
Motivational	Defeat*; Entrapment*; Humiliation*; Hopelessness*
Volitional	Physical pain threshold and tolerance*†‡; Emotional pain sensitivity†‡; Impulsivity*; Descriptive norms (social modelling)*

*Included in Study 1; † included in Study 2; ‡ included in Study 3

Table 3.2. Summary of constructs and measures included in Study 1

Study	*Constructs*	*Measures*
Study 1: **Stress-dependent pain threshold and tolerance in self-harm ideation and enactment.**	Depressive symptoms; Hopelessness; Defeat; Entrapment; Humiliation; Descriptive norms (social modelling); Impulsivity; Suicidal ideation; Suicidal and non-suicidal self-harm thoughts and behaviours; Physical pain threshold and tolerance	Beck Depression Inventory (BDI-II; Beck, Steer & Brown, 1996); Beck Hopelessness Scale (BHS: Beck, Weissman, Lester & Trexler, 1974); Defeat Scale (D-Scale; Gilbert & Allan, 1998); Entrapment Scale (E-Scale; Gilbert & Allan, 1998); Other As A Shamer Scale (OAS: Allan, Gilbert & Goss, 1994); 2 yes/no items asking about self-harm/suicidal behaviours in friends and family; 2 yes/no items asking about impulsive behaviour; 4 items from the Adult Psychiatric Morbidity Survey (APMS; McManus, Meltzer, Brugha, Bebbington & Jenkins, 2009) and the Self-Injurious Thoughts and Behaviors Interview (SITBI; Nock, Holmberg, Photos & Michel, 2007); Algometer task

NB Underlining indicates behavioural measures.

Table 3.3. Summary of constructs and measures included in Study 2

Study	*Constructs*	*Measures*
Study 2: **Self-report study of sensitivity to physical and emotional pain in self-harm ideation and enactment.**	Depressive symptoms, Emotional pain sensitivity; Physical pain sensitivity; Perfectionistic cognitions; Perfectionistic self-presentation; Self-criticism; Suicidal ideation; Suicidal and non-suicidal self-harm thoughts and behaviours	Beck Depression Inventory (BDI-II; Beck, Steer & Brown, 1996); Emotional Reactivity Scale (ERS: Nock, Wedig, Holmberg and Hooley, 2008); Pain Distress Inventory (PDI; Osman et al., 2003); Perfectionistic Cognitions Inventory (PCI; Flett, Hewitt, Blankstein & Gray, 1998); Perfectionistic self-presentation scale (PSPS; Hewitt et al., 2003); Self-rating scale (Hooley, Ho, Slater & Lockshin, 2010); ; Beck Suicide Ideation Scale (SSI; Beck, Steer & Ranieri, 1988); 4 items from the Adult Psychiatric Morbidity Survey (APMS; McManus, Meltzer, Brugha, Bebbington & Jenkins, 2009)

Table 3.4. Summary of constructs and measures included in Study 3.

Study	*Constructs*	*Measures*
Study 3: **Sensitivity to physical and emotional pain in self-harm ideation and enactment: Does self-report predict behaviour?**	Depressive symptoms, Emotional pain sensitivity; Physical pain sensitivity; Social perfectionism, Perfectionistic cognitions; Perfectionistic self-presentation; Self-criticism; Suicidal ideation; Suicidal and non-suicidal self-harm thoughts and behaviours	As for Study 2 (see Table 3.3), with Distress Tolerance Task (DTT; Nock & Mendes, 2008); Algometer task; Multidimensional perfectionism scale- socially prescribed perfectionism subscale (MPS-Social; Hewitt & Flett, 1991)

NB Underlining indicates behavioural measures.

3.1.2 Ethical considerations for working with suicidal individuals

3.1.2.1 Risk assessment and participant safety

The safety of participants taking part in the research is paramount at all times. To this end, the researcher carries out risk assessments with participants at multiple time points in the recruitment, testing and follow-up process in order to ascertain participants' current degree of suicide risk and if necessary, for the researcher to take steps to increase participant safety. A standardised risk assessment form is used (see Appendix B) and included questions regarding the participants' current degree of suicidal ideation, suicidal intent and whether or not they had a current plan for attempting suicide. In addition to these, a series of other questions gauge participants' exposure to other well-established risk factors for making a suicide attempt, such as if the individual has known anyone who has attempted or died by suicide and whether or not the participant has access to the means to carry out their plan. A risk assessment was carried out with all participants who had previously attempted suicide and in some cases, those who had not previously attempted but had current thoughts and whose safety was a cause for concern to the researcher. Advice is sought by the researcher from her supervisors on a case-by-case basis for individuals who are considered to be at high or imminent risk of attempting suicide and a plan to ensure participant safety is put into action, such as giving the participants referrals to support

services, e.g. Samaritans, or by encouraging them to contact their clinician or a friend for support. The risk assessment tool was developed by Professor Matthew Nock and colleagues for use in the suicidal research laboratory at Harvard University, then adapted for use with UK participants. This method of risk assessment has been widely used within other studies conducted at the Suicidal Behaviour Research Laboratory at the University of Glasgow.

3.1.2.2 Participant safety during behavioural tasks

3.1.2.2.1 Cold pressor and algometer tasks

Certain physical health factors can preclude safe participation in experiments involving the cold pressor (Mitchell, MacDonald, & Brodie, 2004), used as part of the mood manipulation in Study 1. These can include heart or circulation problems (specifically Raynaud's Disease); blood pressure problems; epilepsy; diabetes; and any chronic pain disorder. Some of these conditions may also represent a small risk to participants' health during the algometer task, e.g. some medications prescribed to those with heart problems, such as Warfarin, could result in disproportionate bruising following the algometer task. Prior to being recruited to the study, all participants were asked a screening question regarding a lifetime diagnosis of any of these conditions, to ensure that participants' health was not placed at risk by their participation in the study. Participants who reported any of these conditions were excluded from taking part in the study. Alternative behavioural methods for assessing pain threshold and tolerance were explored, including a thermal probe to deliver timed pulses of heat to participants' forearm. However, there is a risk that when working with individuals who exhibit extremely high degrees of pain tolerance, that the temperatures required to elicit pain in this population may result in skin burns (Derbyshire, 2012, personal email communication). Based upon this, it was decided that the algometer was the optimum method for assessing pain within this population.

3.1.2.2.2 Stress manipulation and emotional pain sensitivity tasks

The stress manipulation task employed within Study 1 and the emotional pain sensitivity task used in Study 3 both carried the risk of causing minor, short-lived feelings of distress and frustration for participants. Particularly because of the vulnerable nature of some of the individuals taking part in the study all individuals who took part were carefully observed by the researcher for signs of physical distress or agitation during the tasks. In the

event that a participant did become distressed, the experiment would be halted by the researcher. Participants would be offered the opportunity to take a break from the study, or to terminate their participation.

3.1.3 Control variables

3.1.3.1 Depressive symptoms

Depressive symptoms were assessed using the Beck Depression Inventory-II (BDI-II; Beck, Steer & Brown, 1996). The BDI-II is a 21-item scale assessing the presence and extent of depressive symptoms within domains such as loss of pleasure, changes in sleep pattern and guilty feelings. Participants are presented with groups of 4 statements (7 statements for questions 16 and 18) and are asked to indicate which statement best describes their feelings within the last two weeks, e.g. "I do not feel sad", "I feel sad much of the time", "I am sad all the time", "I am so sad or unhappy that I can't stand it". The scale is scored by summing all answer scores together and there are four different cut-off points for interpreting severity of depression from an individual's total score: 0-13 is minimal, 14-19 is mild, 20-28 is moderate depression and 29-63 is classed as severe depression (Beck et al., 1996; Osman et al., 2008). The BDI-II is a frequently employed measure of depressive symptoms in studies with suicidal individuals and reliably demonstrates strong internal consistency, with Cronbach's alpha ranging from .88 - .92 (Miranda, Ortin, Scott & Shaffer, 2014; Ribeiro, Silva & Joiner, 2014).

3.1.4 Predictor variables

3.1.4.1 Pre-motivational phase variables

Full versions of each measure can be found in Appendix C.

3.1.4.1.1 Perfectionism

In order to best capture the many facets and manifestations of socially prescribed perfectionism, several different scales were used to assess this construct.

The 15-item Multidimensional Perfectionism Scale- Social (MPS-Social; Hewitt & Flett, 1991) was used to assess stable trait perfectionism in Study 3. The scale presents participants with a series of statements, e.g. "The better I do, the better I am expected to do" and "People expect more from me than I am capable of giving", then asks them to

respond on a 1-7 Likert-type scale with the extent to which they agree or disagree that each statement is true of them. Five items are reverse scored and then all item scores are summed to provide a total score, with higher scores indicating a greater degree of social perfectionism. Internal consistency is very good: Cronbach's α = .87- .88 (Hewitt & Flett, 1991; Rasmussen, O'Connor & Brodie, 2008).

Automatic perfectionistic thoughts, characterised as more of a state, rather than trait element of perfectionism, were assessed using the Perfectionistic Cognitions Inventory (PCI; Flett, Hewitt, Blankstein & Gray, 1998). The 25-item scale includes statements such as "I certainly have high standards" and "No matter how much I do, it's never enough" and participants are asked to indicate the frequency with which they have experienced such thoughts within the past week, on a 0-4 scale, representing "not at all" to "all the time", respectively. Cronbach's α = .96, indicating very good internal consistency (Flett et al., 1998).

The degree to which one attempts to appear perfect to others by hiding imperfections or by strongly demonstrating "perfect" characteristics or deeds was measured with the 27-item Perfectionistic Self-Presentation Scale (PSPS; Hewitt et al., 2003). The self-report questionnaire is made up of a series of statements including, "I need to be seen as perfectly capable in everything I do", "I brood over mistakes that I have make in front of others" and "Admitting failure to others is the worst possible thing" and participants are asked to indicate the extent to which they agree or disagree with each statement on a seven-point Likert-type scale. The scale contains three subscales: perfectionistic self-promotion; nondisplay of imperfection; and nondisclosure of imperfection. Internal consistency for the overall scale is very good: Cronbach's α = .95 (Mackinnon & Sherry, 2012) and also for the three subscales: perfectionistic self-promotion α =.84 - .89; nondisplay of imperfection α =.83 - .91; and nondisclosure of imperfection α = .72 - .88 (Hewitt et al., 2003).

3.1.4.1.2 Self-criticism

The Self Rating Scale (SRS; Hooley, Ho, Slater & Lockshin, 2010) is an 8-item scale assessing participants' feelings of worthlessness, self-criticism and social ineptitude on a 1 (strongly disagree) to 7 (strongly agree) Likert-type scale. The scale is scored by summing the scores from each answer. This scale has been employed as a measure of self-critical beliefs in several recent studies investigating NSSI, specifically altered pain tolerance in

NSSI. Internal consistency of the SRS is good: Cronbach's alpha = .73 - .88 (Glenn, Michel, Franklin, Hooley & Nock, 2014; Hooley, Ho, Slater & Lockshin, 2010).

3.1.4.2 Motivational phase variables

Full versions of each measure can be found in Appendix C.

3.1.4.2.1 Entrapment

Participants' feelings of entrapment- being in situations from which there is no escape- were assessed by the 16-item Entrapment Scale (E-Scale; Gilbert & Allan, 1998). The scale asks participants to respond to a series of statements, e.g. "I feel powerless to change myself" on a 5-point Likert-type scale, from 0 (never) to 4 (always). Scores from each answer are then summed to give a total score and can also be calculated as scores on two separate subscales: internal and external entrapment. This scale has been widely used in research on suicidal behaviour, e.g. O'Connor and Williams (2014) and has demonstrated good internal consistency: Cronbach's α = .86 - .94 (Gilbert & Allan, 1998).

3.1.4.2.2 Defeat

Defeat was measured using the 16-item Defeat Scale (D-Scale; Gilbert & Allan, 1998). Participants respond to statements such as "I feel that I have not made it in life" on a 0 (Never) to 4 (Always) Likert-type response scale. Three of the items are reverse scored and then all items are summed to give a total defeat score, with greater feelings of defeat indicated by a higher score. The D-Scale has been used in previous studies of suicidal behaviour and has very good internal consistency, α= .93 - .94 (O'Connor, Smyth, Ferguson, Ryan & Williams, 2013; Panagioti, Gooding, Taylor & Tarrier, 2012).

3.1.4.2.3 Humiliation

Humilation was assessed using the 18-item Other as Shamer Scale (OAS; Goss, Gilbert & Allan, 1994; Allan, Gilbert & Goss, 1994), which asks participants to respond to statements such as people see me as unimportant compared to others", using a 0 (never) to 4 (always) Likert-type response scale. The role of humiliation in suicidality has received comparitively less research attention than the other Cry of Pain variables, defeat and

entrapment, however extant research has demonstrated that the scale has very good internal consistency (α= .96; Gilbert et al., 2010) when used with individuals who self-harm.

3.1.4.2.4 Hopelessness

The 20-item Beck Hopelessness Scale was used to assess hopelessness (BHS; Beck, Weissman, Lester & Trexler, 1974). Participants are asked to respond either true or false to statements such as "my future seems dark to me" or "I look forward to the future with hope and enthusiasm". Each "correct" answer is given one point and nine items are reverse scored, i.e. false is the correct answer. All answers are then summed to give a total score, with higher scores indicating greater levels of hopelessness. Internal consistency for the BHS is good in both clinical (α= .95; Rosellini & Bagge, 2014) and non-clinical populations (α= .88; Steed, 2001) of individuals who have engaged in suicidal and non-suicidal self-harm.

3.1.4.3 Volitional phase variables

Full versions of each measure (with the exception of the Distress Tolerance Task) can be found in Appendix C.

3.1.4.3.1 Exposure to social modelling of self-harm behaviours by friends and family

Two questions were employed to assess whether or not participants had been exposed to social modelling of self-harm behaviours by friends or family members. These questions were taken from O'Connor, Rasmussen and Hawton (2012) and required participants to respond 'yes' or 'no' to the following questions: "Has anyone among your close friends every attempted suicide or deliberately harmed themselves?" and "Has anyone among your family ever attempted suicide or deliberately harmed themselves?" These question responses were then pooled into an exposure score that was used in subsequent analyses.

3.1.4.3.2 Impulsivity

Impulsivity was measured with two yes/no questions from the Plutchik Impulsivity Scale (Plutchik, van Praag, Picard, Conte, & Korn, 1989): "I do things on the spur of the moment" and "I do things impulsively". These responses were then summed and a total impulsivity score used in the analyses. The overall scale has good internal consistency,

Cronbach's α= .73 (Plutchik et al., 1989). For Study 1, inter-item correlations were used, revealing a strong correlation between the two items (.73).

3.1.4.3.3 Emotional pain sensitivity

The Emotional Reactivity Scale (ERS; Nock, Wedig, Holmberg and Hooley, 2008) is a 21-item self-report questionnaire and was used to assess the extent to which participants are affected by emotions and emotional situations, by asking them to respond to a series of statements, e.g. "even the littlest things make me emotional", "my feelings get hurt easily". Each statement is rated on a 5-point Likert-type scale from 0 (not at all like me) to 4 (completely like me). Whilst there are 3 subscales within the ERS: arousal/intensity, sensitivity and persistence, there is a high-degree of intercorrelation, therefore a single-factor (total score) solution is consistently favoured (e.g. Nock et al., 2008). Internal consistency is very good, Cronbach's α= .96 (Kleiman, Ammerman, Look, Berman & McCloskey, 2014).

The Distress Tolerance Test (DTT; Nock & Mendes, 2008) was used to assess participants' sensitivity to emotional pain. This behavioural measure of distress tolerance has been widely used in studies of emotion regulation within NSSI and suicidal behaviour. Stimulus cards from the Wisconsin Card Sort Test (WCST) were used and participants were read a set of standardised instructions at the beginning of the task. The task asks participants to match each of the 64 cards within the deck to one of the 4 key cards laid out on the table in front of them. However, there is in fact no solution to the task and the researcher replies correct or incorrect to each card in a pre-determined, but essentially arbitrary way: "correct" to the first three cards, "incorrect" to the following seven cards, "correct" to the 11th card in order to maintain participant engagement and then to all subsequent cards, the researcher replies "incorrect". Participants must attempt to match a minimum of 20 cards, but after this may stop. The number of cards that the participant persists for is their distress tolerance score, with higher scores indicating greater distress and emotional pain tolerance.

3.1.4.3.4 Physical pain sensitivity and distress

Feelings of pain distress and self-perceived sensitivity to physical pain were assessed using the 26-item Pain Distress Inventory (PDI; Osman et al, 2003) and its pain sensitivity subscale. Example items from the scale are "When I am in pain, I am more dizzy or

lightheaded than usual", "I am terrified about being in pain", "When I am in pain, I tend to blame other people in general although I do not tell them openly" and "I usually feel miserable, down or awful when I am in pain". Each item is from one of the four subscales, respectively: somatic anxiety, pain sensitivity, anger and depression. Participants are asked to indicate the extent to which they feel each statement is true of them on a 0 (not at all like me) to 4 (very much like me) scale. Internal consistency for the PDI is high: $\alpha = .95$ (Osman et al., 2005) and Cronbach's alphas for the subscales are also good: somatic anxiety: .86; pain sensitivity: .93; anger: .87; and depression: .92 (Osman et al., 2005).

As the questions from the PDI relate to general cognitions around physical pain, i.e. not specific to self-harm, a single "yes/no/sometimes" question from the Inventory of Statements About Self-Injury (ISAS; Klonsky & Glenn, 2008) was also included in Study 3, asking whether participants experience pain when they self-harm.

Behavioural threshold and tolerance for physical pain was assessed using a pressure algometer, a handheld digital device which has a spring-loaded plunger with a $1cm^2$ diameter rubber end. Following demonstration of the correct procedure by the researcher, participants self-applied the algometer to the medial phalanx (middle pad) of the index finger on their non-dominant hand. Participants indicated the points at which they first perceived the algometer as being painful (pain threshold) and when it was too painful to continue (pain tolerance). The time in seconds taken to terminate the algometer task (response latency) was automatically recorded by the device, as well as the pressure (kPa) applied by the participant over the course of the trial.

Participants rated the level of pain they experienced during the algometer task, when it was the most painful, on a 100mm visual analogue scale (VAS; Scott & Huskisson, 1976;). The scale was anchored at "no pain at all" and "worst pain imaginable". For Study 1, the VAS took the form of an electronic sliding scale on a computer screen and participants used the mouse cursor to move the slider along the VAS according to how much or how little pain they experienced. In Study 3, a pen and paper version of the VAS was employed and participants drew a vertical line along the scale to indicate their level of pain during the algometer task. Following the lab visit, the distance in mm from the left-hand (no pain) end of the scale was measured with a ruler by the researcher and this was the participant's pain VAS score.

3.1.5 Rationale for use of self-report and behavioural measures of emotional and physical pain

Few existing studies exploring physical and emotional pain sensitivity within this population have utilised a mixed-measures approach, as demonstrated in the systematic review reported in Chapter 2. The majority have used either behavioural outcome measures, e.g. response latency, maximum temperature tolerated or self-report outcome measures, e.g. "did you experience pain during X task?" This goes little way to informing us about similarities or differences between participants' *perception* of their own sensitivity to physical and emotional pain and their behavioural sensitivity. In order to more fully assess both of these factors, behavioural and self-report measures of physical and emotional pain sensitivity were used in studies 1 and 3. For Study 3 this also included self-reported measures of general (usual, day-to-day) sensitivity to emotional and physical pain, as well as measures assessing response to behavioural tasks, e.g. a proxy for self-harm behaviour such as the pressure algometer task.

3.1.6 Limitations of behavioural measures of emotional and physical pain

3.1.6.1 Physical pain measures

Physical pain is an inherently subjective, multifaceted experience (Robinson, Staud & Price, 2013) and the key role of cognitive-affective components in individuals' pain experiences are well-documented (e.g. Van Ryckeghem, Crombez, Eccleston, Legrain & Van Damme, 2013; Weich & Tracey, 2009). Therefore, using only behavioural indices of physical pain tolerance, such as response latency or maximum time/temperature tolerated, does not provide us with the full picture of an individual's pain experience. Behavioural measures are limited in that they do not inform us of the unpleasantness or intensity of that pain, but rather the intensity of the *stimulus*. In fact, recent neuroimaging evidence has demonstrated that perception of stimulus intensity and self-regulation of stimulus response (i.e. experiencing pain) are governed by two distinct neural pathways (Woo, Roy, Buhle & Wager, 2015). Thus it is essential to supplement any behavioural measures of physical pain sensitivity with self-report measures, as the actual stimulus intensity and participants' experience of the stimulus intensity may diverge.

No behavioural method of assessing physical pain is without its limitations and previous research has employed a vast array of different measures, e.g. algometer, cold pressor,

laser, thermal pulse, topical capsaicin etc, as discussed in detail in Chapter 2. The algometer task, used as the behavioural measure of pain threshold and tolerance within two of the three studies presented within this thesis, can also be subject to limitations. In order to more closely approximate the experience of self-harming, participants self-applied the algometer following a demonstration by the researcher, however some participants may still have misunderstood the instructions, pressing as hard as they could (tolerance level) for both the threshold and tolerance trials. Additionally, algometer scores taken at multiple time points in the study may be subject to practice effects, i.e. as the participant becomes more familiar with the algometer, they apply it more vigorously. The order of task presentation was counterbalanced in order to reduce the potential influence of practice effects upon participants' scores in Study 3 and in Study 1, block randomisation was performed to ensure that any differences in algometer score were due to the mood manipulation and not to more practice with the algometer.

3.1.6.2 Emotional pain measures

Inconsistencies abound when comparing behavioural measures of distress tolerance to their self-report counterparts, for both physical and emotional pain (Ameral et al., 2014; Anestis et al., 2012), with numerous studies finding that consistency is good when comparing multiple self-report measures of the same construct, however much poorer when comparing across measurement modalities, i.e. self-report vs. behavioural measures. Research by Ameral and colleagues (2014) suggests that for some behavioural measures of emotional distress tolerance, their self-report counterparts appear to be measuring distinctly different constructs. They also highlight the importance of assessing participants' reasons for terminating the task; participants may set their own goals, e.g. "I decided to do 22 cards and then quit" or may quit before experiencing distress, "I thought the task may be impossible, so I stopped". This may limit the validity of behavioural measures of distress tolerance, as false negatives and false positives may arise, with some participants scoring very highly when in fact they have disengaged from the task (false negative) and others achieving very low scores, when they have not experienced the task as overly distressing (false positive).

3.1.7 Outcome variables

Full versions of these measures can be found in Appendix D.

3.1.7.1 Self-harm and suicidal thoughts and behaviours

We did not feel that any one questionnaire fully covered the scope of information about participants' self-harm and suicidal thoughts and behaviours that we required, therefore for all three empirical studies we opted to use a selection of questions from several different measures.

Four items from the Adult Psychiatric Morbidity Survey (APMS; McManus, Meltzer, Brugha, Bebbington & Jenkins, 2009) were used to assess suicidal behaviour in studies 2 and 3, with some modification to differentiate between ideation and enactment, e.g. Have you ever thought of taking your life, even though you would not actually do it? Have you ever made an attempt to take your life, by taking an overdose of tablets or in some other way? If a participant endorsed having experienced suicidal thoughts or attempts, this was followed up with a question on whether this last occurred in the past week, past year or longer ago.

Motivations for engaging in self-harm or suicidal behaviour were assessed using a single question from the Child and Adolescent Self-Harm in Europe questionnaire (CASE; O'Connor, Rasmussen, Miles & Hawton, 2009) in studies 2 and 3. Participants were presented with eight options including, "I wanted to die" and "I wanted to get relief from a terrible state of mind" and asked to answer either yes or no to each one.

In order to ascertain recency of self-harm/suicidal thoughts and behaviours as well as the length of time a participant had been thinking about or engaging in self-harm or suicidal behaviours, two questions asking when the most recent self-harm thoughts and/or behaviours occurred and two questions asking when the participant first thought about self-harming and/or first engaged in self-harm were included.

Suicidal ideation was measured in all three studies using the Beck Scale for Suicide Ideation (SSI; Beck, Steer & Ranieri, 1988). The 21-item scale has been frequently employed in previous research (McAuliffe et al., 2014; Stringer et al., 2013). All participants completed the first five items, including questions regarding their wish to live and their wish to die. Participants who scored greater than zero on questions relating to having a desire to kill oneself, or on not taking steps to save their life (if they were in a life threatening situation), then completed the remaining 16 questions. Internal consistency for this scale is good: Cronbach's $\alpha = .87$ (Beck & Steer, 1991).

Non-suicidal and suicidal thoughts and behaviours were assessed in Study 1 using the 169-item Self-Injurious Thoughts and Behaviors Interview (SITBI; Nock, Holmberg, Photos & Michel, 2007). The items are divided into five modules: suicidal ideation; suicide plan; suicide gesture; suicide attempt; and non-suicidal self-injury, with the latter also including a component on thoughts of non-suicidal self-injury. It has been widely used in extant research examining both suicidal and non-suicidal self-harm thoughts and behaviours (e.g. Cha, Najmi, Park, Finn & Nock, 2010; Franklin, Puzia, Lee & Prinstein, 2014). Administered as an interview, the SITBI has very good interrater reliability ($\kappa = .99$) and test-retest reliability ($\kappa = .70$), as well as a good degree of convergent validity with other measures of non-suicidal self-harm ($\kappa = .87$: Functional Assessment of Self-Mutilation; Lloyd, Kelley & Hope, 1997) and suicidal ideation ($\kappa = .54$: Beck Scale for Suicide Ideation; Beck, Steer & Ranieri, 1988). For the purposes of Study 1, the SITBI was administered as an online self-report questionnaire which, whilst uncommon in previous research, has been used successfully (e.g. Franklin, Puzie, Lee & Prinstein, 2013; Latimer, Meade & Tennant, 2013; Muehlenkamp, Walsk & McDade, 2010) with a Cronbach's α of .72 (Latimer et al., 2013). Information regarding suicide gestures was tangential to the main focus of the study, therefore this module was excluded. Whilst the SITBI is a lengthy measure, it is by far the most comprehensive tool for assessing the full range of self-harm thoughts and behaviours, taking into account those with and without suicidal intent. Furthermore, because the SITBI was administered as an online questionnaire, participants could be automatically "skipped" through sections which were irrelevant to them, reducing participant burden.

3.1.7.2 Mood

In order to assess baseline mood as well as changes in participants' mood over the course of the studies, participants rated aspects of their mood *at the current moment* on items from the Positive and Negative Affect Schedule (PANAS: Watson, Clark & Tellegen, 1988). The full 20-item scale demonstrates very good internal consistency for both the positive ($\alpha = .89$) and negative ($\alpha = .85$) subscales for the timescale used, the "present moment" (Watson et al., 1988). Participants' PANAS ratings also acted as a manipulation check for the DTT and for the social distress manipulation, the Maastricht Acute Stress Test (see section 1.7.1). For Study 1, there were 20 items in total, including feeling jittery, alert and distressed and participants responded on a scale anchored from 1 (very slightly/not at all) to 5 (extremely), presented as a Visual Analogue Scale (VAS). For Study 3, participants rated their mood at the current moment on 6 items from the PANAS: interested; irritable;

distressed; alert; ashamed; upset. Ratings were on a 5-point Likert-type scale, 1 (very slightly/not at all) – 5 (extremely). A 6 item version of the PANAS was employed in Study 3 following feedback from participants that the 20 item version was overly long.

3.1.8 Behavioural Manipulations

3.1.8.1 Stress manipulation

In Study 1, it was necessary to use a stress manipulation in order to examine the effect of stress upon pain threshold and tolerance.

Previous research has used a variety of methods (see Chapter 2, sections 2.3.2.1 and 2.3.5.1 - systematic review), however all of these were either too resource intensive, requring a lot of time or several confederates, or based upon earlier pilot work, did not appear to elicit measureably significant changes in participants' mood. In addition to this, none of the aforementioned studies of pain and self-harm that employed a mood manipulation, used a mixed-measures design; participants either underwent the stress-manipulation or a non-stressful control task/no task.

With these considerations in mind, the Maastricht Acute Stress Test (MAST; Smeets et al, 2012) was used to induce feelings of short-lived social distress in Study 1. Participants underwent both the stress and no-stress conditions of the MAST, with the order of presentation counterbalanced within the three groups to prevent order effects. Whilst the MAST has never before been used in studies of individuals who have thought about or engaged in suicidal or non-suicidal self-harm, numerous studies conducted with this population have used the Trier Social Stress Test (TSST; Kirschbaum, Pirkie & Hellhammer, 1993), upon which the MAST is partially based (e.g. Kaess et al., 2012). The MAST has also been used successfully in repeated measures contexts before (Meyer, Smeets, Giesbrecht, Quaedflieg & Merckelbach, 2013). The MAST was selected over the TSST for two reasons: first, it is considerably less resource intensive then the TSST, which requires multiple confederates, whereas the MAST only requires the researcher to be present. Second, the MAST has a well-matched neutral analogue task that can be used as a contrast to the stress condition. The TSST does not have a standardised control condition. As Study 1, in which the MAST was employed, is the first ever repeated measures study to explore the effect of mood upon pain threshold and tolerance, maintaining as great a

degree of consistency as possible across both mood conditions was important for comparison purposes.

In the no-stress condition, participants underwent a five minute preparation phase during which they watched a PowerPoint presentation with instructions about the task, and a 10 minute test phase where participants alternate counting aloud from 1-25 and immersing their dominant hand in lukewarm water.

Similar to the no-stress condition, the stress condition involved participants completing a five minute preparation phase during which they were given instructions about the task via a PowerPoint presentation. They were then told that they would be monitored by the experimenter and have their facial expressions video recorded for later analysis (however, they were in fact not recorded at all), whilst they immersed their dominant hand in a cold water bath (5˚C). Following a pilot study, the temperature of the cold pressor was raised from the 2˚C outlined in the original MAST procedure (Smeets et al., 2012), to 5˚C as participants were unable to keep their hand in the water for the full duration of each immersion period. Participants were told that the duration of immersion was randomly determined by the computer, but would never be more than 90s. In reality however, immersion was systematically varied from 60-90s and periods of immersion were alternated with a mental arithmetic task, where participants count down from 2043 in 17s as quickly and accurately as possible. If they made an error, they received negative feedback, e.g. “That is not correct. Start again from [last correct number].”

The following chapter is the first empirical chapter within this thesis and details a study exploring stress-dependent pain threshold and tolerance in self-harm ideation and enactment.

Chapter 4: Stress-dependent pain threshold and tolerance in self-harm ideation and enactment

Background

Several recent studies have reported higher threshold and tolerance for physical pain in individuals who have enacted self-harm behaviour. It is not known, however, whether this elevated pain tolerance is a cause or a consequence of self-harm. Furthermore, it has also been suggested that pain threshold and tolerance in individuals who self-harm, may only be elevated during stress. Additionally, the current study also sought to investigate the extent to which a number of psychological variables were associated with self-harm ideation and enactment.

Methods

187 healthy adults from across Central Scotland completed a battery of self-report measures either online or in the laboratory, assessing suicidal and non-suicidal thoughts and behaviours, defeat, entrapment, humiliation, hopelessness, impulsivity and exposure to social modelling of self-harm. 102 of these participants then took part in a laboratory study, during which physical pain threshold and tolerance were assessed following administration of negative and neutral mood manipulations.

Results

No significant differences in physical pain threshold and tolerance were found as a function of stress, across any of the groups. There was a significant effect of pain upon negative mood for all groups, such that negative affect decreased following the administration of a painful stimulus. No significant differences were found between the self-harm ideation and enactment groups in defeat, entrapment, humiliation or hopelessness, however, those in the enactment group were more impulsive and had greater exposure to social modelling of self-harm than those in the ideation group.

Conclusions

Contradicting previous research, there were no significant differences in pain threshold or tolerance as a function of self-harm status or stress. Pain was associated with a reduction in negative affect for all groups, partially supporting offset analgesia theory (Franklin et al., 2010). The ideation and enactment groups did not differ significantly on any of the motivational phase variables, but did differ on volitional phase variables, supporting the IMV model of suicidal behaviour (O'Connor, 2011). Social modelling of self-harm emerged as the strongest correlate of self-harm enactment, relative to self-ham ideation, and could provide a key target for intervention development.

4.1 Introduction

In Chapter 2, the current state of knowledge regarding the relationship between self-harm and altered pain threshold and tolerance was discussed extensively. Extant research in this area would suggest that those who have engaged in self-harm, either with or without suicidal intent, exhibit an increased threshold and tolerance for physical pain, relative to those who have never engaged in the behaviour (e.g. Glenn et al., 2014; Hamza et al., 2014; Hooley et al, 2010). There are, however, inconsistencies within the literature; some studies find a significant difference only for pain threshold (Franklin et al., 2011), and others find a difference only for pain tolerance (Hamza et al., 2014; McCoy et al., 2010). Seminal work by Gratz and colleagues (2011) may have identified a potential factor to explain these inconsistencies; namely that altered physical pain threshold and tolerance in self-harm behaviour may be stress-dependent, such that it is only when individuals are in a state of acute psychological distress that pain threshold and tolerance increase.

4.1.1 Pain and self-harm

The landscape of literature around pain and self-harm has changed considerably over the last two decades and many studies suggest that those who have engaged in self-harm have a higher threshold and tolerance for physical pain than those who have never engaged in the behaviour (e.g. Russ et al., 1994; Ludäscher et al., 2009; Hamza et al., 2014). These findings also appear to extend to both clinical and community samples (e.g. Ludäscher et al., 2009; McCoy et al., 2010). The existing evidence-base is not without inconsistencies, however, and there are a number of instances where authors have been unable to find any significant differences in pain threshold (Hamza et al., 2014; McCoy et al., 2010) or tolerance (e.g. Franklin et al., 2011) between healthy controls and those who have engaged in self-harm. These divergent findings may indicate that there are potential moderators of the relationship between pain tolerance and self-harm that are, as yet, unknown. Furthermore, as all of the previous studies in this area have been conducted with those who have already engaged in self-harm behaviour, it has yet to be determined whether altered pain tolerance is a cause or a consequence of self harm.

4.1.2 Stress and pain tolerance in self-harm

The most frequently reported reason for engaging in self-harm behaviour is to relieve a terrible state of mind or to gain respite from unbearable emotional pain (Gratz, 2000; O'Connor et al., 2009) and many recent papers have proposed the idea that self-harm plays

a role in affect regulation for those who engage in the behaviour (Bresin & Gordon, 2013; Kirtley et al., 2014). Several recent studies have sought to examine the effect of physical pain upon affect in self-harm, but only one has investigated how affect influences individuals' tolerance for physical pain (Gratz et al., 2011). In an elegant experimental study, Gratz and colleagues (2011) randomly assigned participants to undergo a negative mood manipulation or a neutral control condition, before assessing their ability to tolerate emotional distress and physical pain. Against a backdrop of previous research that appeared to suggest elevated physical pain tolerance in self-harm was always present, Gratz et al reported that increased physical pain tolerance in those who self-harmed was only evident following a negative mood manipulation. For the first time within pain and self-harm research, the possibility was raised that negative mood may provide the 'perfect storm' for increased pain tolerance and thus, for self-harm to occur. Thus differences in pain tolerance between healthy controls and self-harming individuals may be potentiated only by stress, similar to the way in which Teasdale's Differential Activation Hypothesis suggested suicidal cognitions become activated only during periods of depression (Lau, Segal & Williams, 2004).

4.1.3 Gate Control Theory

Melzack and Wall's (1965) seminal Gate Control Theory was a paradigm shift in the conceptualisation of pain processing, and suggested that pain information received by the brain was modulated by 'gates' located in the dorsal horn of the spinal cord. Neuronal transmission of impulses from the peripheral to the central nervous system occurs via two different classes of fibres: large A-fibres that carry non-nociceptive (non-pain) information and small C-fibres that transmit nociceptive (pain) information. The non-nociceptive information carried by the larger A-fibres can 'overwhelm' the transmission of nociceptive information carried by the smaller C-fibres, resulting in inhibition of pain signal transmission from the peripheral to the central nervous system (Sufka & Price, 2002). Thus, if cognitive load is high, transmission of nociceptive signals is inhibited and less pain is perceived. Within the context of self-harm, high cognitive load could potentially include acute emotional distress and negative mood, and may act as a pain inhibitor, explaining the results in the study by Gratz et al (2011), where pain tolerance was only elevated in those who self-harmed when they had been administered a negative mood induction. Emotional stress, therefore, may bring about the increased pain tolerance that contributes to individuals moving from thinking about self-harm, to actually enacting self-harm behaviours.

4.1.4 From thoughts to actions

Many individuals ideate about self-harm, only a proportion will go on to actually engage in the behaviour. In order to reduce the number of individuals who die by suicide, it is critical to better understand the factors that differentiate between those who will 'only' think about self-harm and those who will engage in the behaviour (May & Klonsky, 2014; O'Connor & Nock, 2014). To this end, a new model of suicidal behaviour has recently been proposed, the Integrated Motivational-Volitional (IMV) model of suicidal behaviour (O'Connor, 2011).

4.1.4.1 The IMV

The IMV model of suicidal behaviour (O'Connor, 2011) has recently been put forward as an explanatory framework to account for the transition from self-harm ideation to self-harm enactment. The model is tripartite in nature and comprises the pre-motivational, motivational and volitional phases. Variables within the pre-motivational and motivational phases, for example socially prescribed perfectionism and defeat, respectively, are not expected to differ between ideation and enactment groups. It is variables within the volitional phase, for example, knowing someone who has self-harmed (exposure to self-harm, social modelling), that are thought to differentiate between those who ideate about self-harm and those who will act upon their thoughts. Recent evidence from two large-scale studies of adolescents support this (O'Connor, Rasmussen & Hawton, 2012; 2014). For a full discussion of the IMV, please see Chapter 1, section 1.3.1.

4.1.5 The current study

Previous work investigating the effect of mood upon pain tolerance (e.g. Gratz et al., 2011) has employed a between-participants design and, as such, the group differences observed may potentially be the result of individual differences. The present study therefore sought to employ a within-participants design to examine differences in pain threshold and tolerance following distress, as well as when participants are in a neutral state. Additionally, no previous studies have investigated the effect of mood upon pain threshold and tolerance in self-harm ideation. Elevated tolerance for pain has been posited to be a key component in acquired capability for suicide (Joiner., 2005; Van Orden et al., 2010), as well as being an important volitional variable within the IMV model of suicide (O'Connor, 2011), potentially differentiating individuals who ideate about self-harm from those who actually go on to engage in the behaviour. For the first time, the current study

investigates differences in pain threshold and tolerance between individuals who ideate about self-harm and those who enact the behaviour. Given the lack of substantive focus on possible psychological mediators or moderators of the relationship between pain tolerance and self-harm, this study explores the association between pain tolerance, self-harm and a range of psychological variables derived from the research literature, including depressive symptoms, hopelessness, defeat and entrapment. The study was conducted in two parts: an online self-report study that acted, in part, as a screening tool for potential participants for the second part, a laboratory study.

4.1.5.1 Research questions and hypotheses

1) *Does mood affect pain threshold and tolerance in self-harm ideation and enactment?*

Hypothesis 1. It is hypothesised that pain threshold and tolerance will be significantly greater in the self-harm ideation and enactment groups relative to controls, but only following negative mood induction, as per Gratz et al (2011), due to the inhibition of pain signals by the higher cognitive load resulting from the negative mood manipulation.

2) *Are pain threshold and tolerance also elevated in self-harm ideation?*

Hypothesis 2. It is predicted that individuals who have ideated about, but not engaged in self-harm behaviour, will demonstrate a higher threshold and tolerance for physical pain as compared to those who have never engaged in self-harm behaviour. There will also be a significant difference between the ideation and enactment groups in pain threshold and tolerance, as per the IMV (O'Connor, 2011) and the Interpersonal Psychological Theory of suicide (IPT; Joiner, 2005; Van Orden et al., 2010).

3) *What are the commonalities and differences in levels of defeat, entrapment, humiliation, hopelessness, exposure to social modelling of self-harm and impulsivity, between self-harm ideation and self-harm enactment groups?*

Hypothesis 3. As per the IMV model (O'Connor, 2011), it is anticipated that motivational phase variables (defeat, entrapment, humiliation and hopelessness) will not be significantly different between the self-harm ideation and enactment groups, although both of the self-harm groups will differ significantly from controls on these measures. It is only with the

volitional phase variables (social modelling of self-harm, and impulsivity) that a significant difference is expected between the ideation and enactment groups.

4.2 Methods

4.2.1 Participants

One hundred and eighty-seven healthy adults (mean age: 21.37 years old; SD: 5.52) from across Central Scotland took part in the first phase of the study, completing self-report questionnaires online or in the laboratory. Of the total sample, 31% (n=58) were male, 66.8% were female (n= 125) and 2.1% (n=4) did not provide information regarding their gender. The majority of participants were undergraduate or postgraduate students (93%), others were unemployed (2.67%; n= 5), employed (3.74%; n=7), and 0.53% (n=1) did not answer the question. One hundred and six of the participants from the original sample completed the laboratory study (mean age: 22.14 years old; SD: 6.05), however four participants (all from the ideation group) had missing pain data due to equipment failure and were therefore excluded from the analyses. Most of the participants who took part in the second (laboratory) phase of the study were female (68.6%; n= 70), with males comprising 29.4% (n=30) of the sample and 2% (n=2) who did not answer the question. The majority of participants who undertook part 2 of the study were undergraduate or postgraduate students (90.1%; n= 90).

4.2.2 Procedure

The study received ethical approval from the Psychology Department Ethics Committee at the University of Stirling and the College of Medicine, Veterinary and Life Sciences Ethics Committee at the University of Glasgow. Potential participants responded to adverts posted online on community message boards, flyers displayed around the university and also to adverts emailed to members of the Psychology Department participant pool at each university. Those who were interested in taking part in the study were then administered a screening interview over the telephone with the researcher, assessing history of self-harm thoughts and behaviours, various demographic factors and their current degree of suicide risk. If necessary, the researcher took steps to increase participant safety, including provision of support information and safety planning. For full details of the risk assessment and participant safety protocols, see Chapter 3 section 3.1.2 and Appendix B. Due to the nature of the laboratory component of the study, it was also necessary to screen participants for various health conditions to ensure their safety during the study. Further

details of this are available in Chapter 3 section 3.1.2.2.1. Participants who reported no history of self-harm thoughts or behaviours were recruited to the control group. Those who endorsed a history of self-harm ideation, but who had not acted upon their thoughts, were recruited to the self-harm ideation group and individuals who had engaged in self-harm behaviour were included in the self-harm enactment group. For part one of the study, some participants completed the online questionnaire battery prior to their lab visit, and others completed the same set of online questionnaires whilst in the lab, immediately preceding completion of part two. For the experimental section of the study (part two), participants were invited to attend a one-hour and forty-five minute laboratory session with the researcher, where they would be asked to complete a range of self-report questionnaires and behavioural problem-solving tasks. During the initial phone-screen interview, participants were asked to refrain from taking analgesic medication, including cold and flu medication, for at least 8 hours prior to their lab visit. The researcher also confirmed that participants were analgesic-free at the time of taking part in the study when participants arrived at the lab. Participants were informed that for one of the tasks they would be asked to submerge their hand in ice water and that the other tasks would include solving number problems and applying a small pressure device to their finger. All participants provided written informed consent. The order in which the neutral and stress conditions of the Maastricht Acute Stress Test (MAST) were presented was counterbalanced within each group to minimise the likelihood of order effects, with some participants completing the MAST-neutral condition first, and others, the MAST-stress condition. Following administration of each MAST condition, participants completed an algometer task to assess physical pain threshold and tolerance, they were then asked to indicate on a visual analogue scale how unpleasant they found the pain. In order to reduce the chance that the algometer results would be confounded by habituation hypoalgesia, all participants completed a brief 15-minute filler task between the two MAST conditions, involving rating pairs of faces for different characteristics, for example, dominance and attractiveness. Participants' mood was also assessed throughout the study. See Figure 4.1 for a flowchart of the procedure. Following completion of the experimental tasks, all participants received a full debrief and were provided with the details of relevant support organisations. If necessary, the researcher also conducted a suicide risk assessment and where appropriate, took steps to increase participant safety.

Participants who took part in the second part of the study also gave consent to be contacted for a follow-up telephone interview 6 months after their lab visit. During this period the researcher moved institutions and as a result of the associated logistical challenges that this presented, the prospective component of this study had to be discontinued.

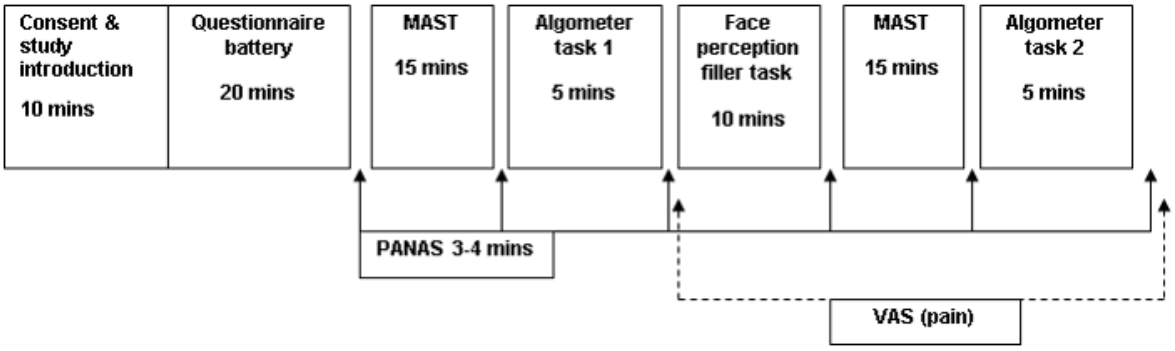

Figure 4.1. Flow-chart of study procedure and time-points for mood and pain intensity assessment.

4.2.3 Measures

A combination of self-report and behavioural measures were employed in order to measure participants' threshold and tolerance for physical pain, in addition to their lifetime and current history of self-harm thoughts and behaviours and other psychological variables included within the current study, such as social modelling of self-harm behaviours and defeat.

4.2.3.1 Self-report measures

4.2.3.1.1 Suicidal and non-suicidal self-harm thoughts and behaviours

Participants' lifetime histories of suicidal and non-suicidal self-harm thoughts and behaviours were measured using a modified version of the 56-item Self-Injurious Thoughts and Behaviors Interview (SITBI; Nock, Holmberg, Photos & Michel, 2007), with the module on 'suicide gestures' omitted. In the current study, the SITBI was administered as a self-report questionnaire; a method successfully employed in previous studies in this area (e.g. Latimer, Meade & Tennant, 2013). The other four modules ask participants questions regarding lifetime experiences of suicidal ideation; suicide plan; suicide attempt; and non-suicidal self-injury (ideation and behaviours), for example, in relation to the frequency of self-harm and the type of method used. Further information about this measure can be found in Chapter 3 section 3.1.7.1.

4.2.3.1.2 Depressive symptoms

Participants' depressive symptoms over the preceding two weeks were assessed using the 21-item Beck Depression Inventory (Beck, Steer & Brown, 1996). The scale presents participants with a series of statements regarding their symptoms, such as changes in

sleeping pattern and guilty feelings. Example items include: “I don’t feel particularly guilty”, “I feel guilty over many things I have done or should have done”, “I feel quite guilty most of the time” and “I feel guilty all of the time”. Due to a technical error, 49/187 participants received only 19 items of the BDI[2], and the rest received the full 21 items. The internal consistency for the BDI-II in this study was excellent: Cronbach’s α = .94 for the 21-item version and .93 for the 19-item version. For further details of this measure, see Chapter 3 section 3.1.3.1.

4.2.3.1.3 Hopelessness

Hopelessness was measured by the 20-item Beck Hopelessness Scale (BHS; Beck, Weissman, Lester & Trexler, 1974). Participants are asked to answer “true” or “false” to statements including “I look forward to the future with hope and enthusiasm” and nine items that are reverse scored, e.g. “I don’t expect to get what I really want”. Cronbach’s α for the BHS in the current study was .88, demonstrating very good internal consistency. Further details of this measure are provided in Chapter 3 section 3.1.4.2.4.

4.2.3.1.4 Defeat

Feelings of defeat were assessed using the 16-item Defeat Scale (D-Scale; Gilbert & Allan, 1998). Participants are asked to indicate on a 0-4 Likert-type scale the frequency with which they have experienced the feelings described by the 16 statements, over the last seven days. Example items include “I feel that I have not made it in life” and also three items that are reverse scored, e.g. “I feel that I am basically a winner”. Internal consistency was excellent, Cronbach’s α = .94. For a more detailed description of this measure, see Chapter 3 section 3.1.4.2.2.

4.2.3.1.5 Entrapment

Entrapment was measured using the 16-item Entrapment Scale (E-Scale; Gilbert & Allan, 1998). The scale presents participants with a series of statements, in response to which they are asked to indicate using a 0-4 Likert-type scale the extent to which they feel each statement is true of them. Statements include “I am in a situation I feel trapped in”. The E-Scale contains two subscales, assessing internal and external entrapment. Cronbach’s α for this measure was .95, demonstrating excellent internal consistency. Internal consistency for the external and internal entrapment subscales were also very high, .91 and .93,

[2] Items 3 (past failure) and 6 (punishment feelings) were the two missing items from the BDI-II

respectively. More detailed information about the E-Scale can be found in Chapter 3 section 3.1.4.2.1.

4.2.3.1.6 Humiliation

The 18-item Other as Shamer Scale (OAS; Goss, Gilbert & Allan, 1994; Allan, Gilbert & Goss, 1994) was employed to measure participants' feelings of humiliation. Participants are asked to rate the frequency with which they experience feelings depicted by the statements on a 0-4 Likert-type scale. Items from the scale include "I feel insecure about others' opinions of me". Cronbach's alpha for the OAS was .95, and internal consistency was high. Further details of this measure are given in Chapter 3 section 3.1.4.2.3.

4.2.3.1.7 Exposure to social modelling of self-harm behaviours

Individuals taking part in the study were asked two "yes/no" questions taken from O'Connor, Rasmussen and Hawton (2012) regarding suicidal and non-suicidal self-harm by friends and family members, in order to assess exposure to social modelling of self-harm behaviours. The two questions were: "Has anyone among your close friends ever attempted suicide or deliberately harmed themselves?" and "Has anyone among your family ever attempted suicide or deliberately harmed themselves?" More details of these questions can be found in Chapter 3 section 3.1.4.3.1.

4.2.3.1.8 Impulsivity

Impulsivity was measured by the administration of two "yes/no" questions from the Plutchik Impulsivity Scale (Plutchik, van Praag, Picard, Conte, & Korn, 1989): "I do things on the spur of the moment" and "I do things impulsively". Inter-item correlation was good, .73. A more detailed description of this measure can be found in Chapter 3 section 3.1.4.3.2.

4.2.3.1.9 Mood

A modified 24-item version of the Positive and Negative Affect Schedule (PANAS; Watson, Clark & Tellegen, 1988) was used to assess participants' mood. This was measured at six time-points throughout the study: at baseline (following questionnaire battery completion), post first MAST condition, post algometer task 1, post filler task, post second MAST condition and post algometer task 2. See Figure 4.1 for procedure flowchart. Four additional items were added to the measure in order to specifically assess feelings of

social exclusion: “ignored”, “noticed”, “included” and “excluded”. Participants were asked to rate PANAS items for “the current moment, right now” on a visual analogue scale (VAS) anchored at 1 (very little/not at all) to 5 (extremely). Internal consistency ranged from .79 to .89 throughout the study. Further details of the PANAS are available in Chapter 3 section 3.1.7.2.

4.2.3.1.10 Pain intensity

Following each of the two algometer tasks, participants were asked to rate their pain intensity at the point where ‘it was most painful’ on a VAS, anchored at 1 (no pain at all) and 5 (worst pain ever). These VAS measures were administered via computer and participants moved their mouse pointer to the desired point on the scale. Further details of this measure can be found in Chapter 3 section 3.1.4.3.4.

4.2.3.2 Behavioural measures

4.2.3.2.1 Physical pain threshold and tolerance

After each of the MAST conditions, participants’ pain threshold and tolerance were assessed by self-administration of a pressure algometer device to the medial phalanx (middle joint) of the index finger on their non-dominant hand. Pain threshold was indexed as the time until the participant first reported feeling pain, whereas pain tolerance was the time at which the participant felt that the algometer had become too painful to continue with. Both the time and maximum pressure (kPa) were recorded for pain threshold and pain tolerance. The use of pressure algometry has been widely employed as a method for assessing pain threshold and tolerance in studies of individuals who engage in self-harm (e.g. Glenn et al., 2014; Gratz et al., 2011; St Germain & Hooley, 2013). See Chapter 3 section 3.1.4.3.4 for further details of this method of behavioural physical pain assessment.

4.2.3.3 Stress manipulation

The Maastricht Acute Stress Test (MAST; Smeets et al., 2012) was used to induce feelings of social distress in participants. The MAST stress condition involves a socially evaluated cold presser test with a water temperature of 5ºC. Participants immersed their dominant hand in the water at varying time intervals, but for a maximum of 90s, and these periods of immersion are interspersed with a challenging mental arithmetic task involving counting down from 2043 in steps of 17. If participants made an error in the arithmetic task, the researcher asked the participant to begin again from the last number that they answered

correctly. Participants were also video recorded during the tasks, although in reality, this was a 'sham' recording, designed to further increase feelings of social monitoring. The stress condition of the MAST also comes with an analogue 'placebo' version whereby participants alternated between submerging their hand in room-temperature water and counting aloud repeatedly from 1-25. Whilst the MAST has never before been employed in a study of self-harm, it has been used in many other studies exploring the effects of acute stress upon behaviour (e.g. Bos et al., 2014; Meyer et al., 2013; Quaedflieg, Smulders & Smeets, 2015). A more detailed discussion of the MAST can be found in Chapter 3 section 3.1.8.1.

4.2.4 Statistical Analysis

Self-report data from part one of the study were analysed using multinomial logistic regression. Defeat, entrapment (internal and external), humiliation, hopelessness, (exposure to) social modelling of self-harm behaviours and impulsivity were entered individually into multinomial logistic regression analyses. Those variables that emerged as significantly different between the ideation and enactment groups in univariate analyses, were then entered together into a multivariate multinomial logistic regression model. However, as only depressive symptoms differed between groups, Holm's sequential Bonferroni correction procedure was followed to counter the effects of multiple comparisons (Holm, 1979). Age, gender and depressive symptoms were also investigated using univariate multinomial logistic regressions, however once Holm's sequential Bonferroni had been applied, only depressive symptoms were significantly different between groups (control vs. ideation and control vs. enactment). It was, therefore, only depressive symptoms that were included as a control variable in the univariate analyses of IMV variables. As there was no significant difference in depressive symptoms between the self-harm ideation and enactment groups, this variable was not included in the multivariate analysis.

Part two data for behavioural physical pain threshold and tolerance and mood were analysed using a series of mixed-measures ANCOVAs, with stress condition (stress; no stress) as the within-participants predictor variable and group (control; self-harm ideation; self-harm enactment) as the between-participants predictor variable. Age, gender and depressive symptoms were initially analysed using a series of one-way ANOVAs in order to ascertain if there was an effect of these variables upon pain threshold and/or tolerance. Gender emerged as having a significant effect upon pressure during pain threshold and

tolerance trials in both stress conditions, and age and depressive symptoms also demonstrated an effect upon threshold and tolerance pressure, and threshold time, respectively. Gender, age and depression were therefore also entered into the ANCOVAs as control variables. Pain threshold and tolerance data were positively skewed; therefore log transformations were employed to achieve a better approximation of normality (Tabachnick & Fidell, 2014), and it is these transformed results that are reported below.

Based on other recent studies of pain sensitivity and self-harm (e.g. Bresin & Gordon, 2013; Gratz et al., 2011), a target sample size of 135 was set (45 participants in each of 3 groups). This sample was calculated as being adequate to detect a medium effect size of .25 at an alpha level of .05 and a power of 0.73. (Power calculations were performed for main effects only). Unfortunately due to difficulties with recruitment, particularly of individuals reporting self-harm ideation in the absence of behavioural enactment, the sample size of part 2 of the study fell below this target. Thus, results should be interpreted within the context of this limited statistical power. Recruitment issues are discussed extensively in section 7.3.1.1 of Chapter 7.

4.3 Results

The demographic and self-harm characteristics of the whole sample are provided in Table 4.1, and of the laboratory (part 2) study sample in Table 4.2. The total sample size for part 1 of the study was 187: 50.3% (n= 94) were controls, endorsing no lifetime history of self-harm thoughts or behaviours, 23% (n= 43) reported self-harm ideation and 26.7% (n=50) reported having engaged in self-harm behaviours. The majority of individuals in the self-harm enactment group reported that they had never previously attempted suicide (74%; n=37). Within the ideation group, 86.1% (n= 37) reported thoughts of suicide (relative to thoughts of non-suicidal self-harm) and an overwhelming majority of individuals within the enactment group reported experiencing thoughts of suicide (82%; n= 41). The vast majority of individuals within the enactment group reported engaging in multiple types of self-harm; self-cutting was the most frequently reported self-harm behaviour (n=41), followed by self-hitting (n=34), and self-biting (n=27). Other behaviours reported were: wound picking; skin scraping; hair pulling; body picking; burning; erasing skin; overdose of prescription drugs; overdose of over-the-counter drugs; and inserting objects under the skin. Frequency of self-harming ranged from 1-800 lifetime episodes. For those reporting that they had made a previous suicide attempt, the most common method were overdose by prescription (n=6), over-the-counter (n=5) or taking other's prescription drugs (n=3). Other

methods endorsed were: hanging; jumping from a height; inhaling car exhaust fumes; using a sharp object, and multiple methods. Lifetime suicide attempt frequency ranged from 1-4 attempts. Behaviours classed as a suicide attempt were separate from self-harm behaviours, and were reported as such by participants. Of the 187 individuals who completed part 1 of the study, 102 (54.6%) went on to complete the part 2 laboratory visit. 47.1% (n= 48) of the part 2 sample reported no history of self-harm thoughts or behaviours, 18.6% (n= 19) were recruited to the ideation group and 34.3% (n=35) reported that they had engaged in self-harm behaviours. Less than half of the individuals in the enactment group for part 2 reported a lifetime suicide attempt (34.3%; n= 12), but the majority of participants within both the ideation and enactment groups endorsed lifetime thoughts of suicide, 94.7% (n=18) and 85.7% (n=30), respectively.

Table 4.1

Demographic and self-harm characteristics of whole sample

Gender	Controls n=94	Self-harm ideation n=43	Self-harm enactment n=50
Male	31	17	10
Female	60	25	40
Age M (SD)	20.52 (5.42)	22.98 (6.95)	21.60 (3.98)
Thoughts of suicide only (%)		48.4	
Thoughts of NSSI only (%)		13.95	
Thoughts of NSSI and suicide (%)		37.21	
Previous suicide attempt (%)			26

Four individuals declined to state their gender, 3 participants from the control group and 1 from the ideation group. There were no significant differences in gender, $\chi^2(1) = .037$, *ns*, or in age, $F(2, 176) = 2.86$, *ns*, between the groups.

Table 4.2

Demographic and self-harm characteristics of laboratory study (part 2) sample

Gender	Controls n=48	Self-harm ideation n=19	Self-harm enactment n=35
Male	19	7	6
Female	29	12	29
Age M (SD)	21.11 (6.04)	24.33 (8.48)	22.31 (4.16)
Thoughts of suicide only (%)		52.6	2.8
Thoughts of NSSI only (%)		5.3	14.3
Thoughts of NSSI and suicide (%)		42.1	82.9
Previous suicide attempt (%)			34.3

There were no significant differences in gender, $\chi^2(2) = 5.06$, *ns*, or age, $F(2, 96) = 1.86$, *ns*, between the groups.

4.3.1 Self-report study (Part 1) results

4.3.1.1 Between group differences in IMV and control variables

IMV variables hopelessness, defeat, entrapment, humiliation, exposure to social modelling of self-harm behaviours and impulsivity were entered individually into a series of univariate multinomial logistic regressions. Depressive symptoms, age and gender were also entered into univariate analyses, however only depressive symptoms were significantly different between groups and therefore this was the only control variable included in subsequent analyses of IMV variables.

4.3.1.1.1 Motivational phase variables

Four motivational phase variables from the IMV model (O'Connor, 2011), namely hopelessness, defeat, entrapment and humiliation, were entered individually into a series of univariate logistic regressions, controlling for depressive symptoms. The results of these can be found in Table 4.3 below with statistically significant results indicated by emboldening. There was a significant difference in defeat between the control and ideation groups and no significant difference between the ideation and enactment groups. There were, however, no significant differences between the control and enactment groups. Total entrapment score differed significantly only between the control and enactment groups, but not between the control and ideation groups or the ideation and enactment groups. In terms of internal and external entrapment specifically, both only differed significantly between the control and enactment groups. Neither humiliation nor hopelessness differed between any of the three groups.

Table 4.3

Univariate multinomial regression analyses of IMV motivational phase variables and their association with self-harm status (controlling for depressive symptoms)

Motivational phase variables	Self-harm status	OR	95% CI	*P*
Defeat				
Controls	**Self-harm ideation**	**1.07**	**1.02 - 1.13**	**.006**
Controls	Self-harm enactment	1.05	.999 - 1.10	.057
Self-harm ideation	Self-harm enactment	0.978	.931 - 1.03	.37
Entrapment				
Controls	Self-harm ideation	1.04	.999 - 1.09	.055
Controls	**Self-harm enactment**	**1.07**	**1.03 - 1.12**	**.001**
Self-harm ideation	Self-harm enactment	1.03	.990 - 1.07	.16
Internal Entrapment				
Controls	Self-harm ideation	1.2	1.0 - 1.20	.05
Controls	**Self-harm enactment**	**1.16**	**1.06 - 1.27**	**.001**
Self-harm ideation	Self-harm enactment	1.06	.978 - 1.14	.16
External Entrapment				
Controls	Self-harm ideation	1.05	.985 - 1.11	.14
Controls	**Self-harm enactment**	**1.08**	**1.02 - 1.15**	**.013**
Self-harm ideation	Self-harm enactment	1.03	.977 - 1.09	.27
Humiliation				
Controls	Self-harm ideation	1.02	.984 - 1.06	.30
Controls	Self-harm enactment	1.04	1.0 - 1.07	.05
Self-harm ideation	Self-harm enactment	1.02	.983 - 1.05	.34
Hopelessness				
Controls	Self-harm ideation	1.09	.966 - 1.25	.15
Controls	Self-harm enactment	1.12	.981 - 1.27	.10
Self-harm ideation	Self-harm enactment	1.01	.906 - 1.14	.81

4.3.1.1.2 Volitional phase variables

Social modelling and impulsivity were entered individually into univariate multinomial logistic regression analyses to investigate differences as a function of self-harm status. Impulsivity was significantly different only between the ideation and enactment groups. Exposure to social modelling of self-harm behaviours was significantly different between control and enactment groups and also between the ideation and enactment groups. Odds ratios, 95% confidence intervals and p values are reported for these analyses in Table 4.4 below.

Table 4.4

Univariate multinomial logistic regression analyses for the association between volitional phase variables and self-harm status

Volitional phase variable	*Self-harm status*	*OR*	*95% CI*	*P*
Impulsivity				
Control	Self-harm ideation	.85	.644 - 1.12	.25
Control	Self-harm enactment	1.23	.944 - 1.6	.13
Self-harm ideation	**Self-harm enactment**	**1.45**	**1.08 - 1.93**	**.012**
Social modelling				
Control	Self-harm ideation	1.02	.559 - 1.86	.95
Control	**Self-harm enactment**	**2.35**	**1.32 - 4.19**	**.004**
Self-harm ideation	**Self-harm enactment**	**2.31**	**1.26 - 4.23**	**.007**

4.3.1.1.3 Multivariate analysis of IMV variables

Impulsivity and exposure to social modelling of self-harm behaviour were the only two variables to differ between the ideation and enactment groups, and thus were entered into a multivariate multinomial logistic regression analysis in order to investigate which of these was more strongly associated with self-harm enactment relative to ideation. Both variables emerged from the multivariate analysis as significantly associated with self-harm enactment. Those participants reporting greater exposure to social modelling of self-harm behaviours by family and friends were more likely to have engaged in self-harm behaviour themselves, relative to self-harm ideation only (OR: 2.21, 95% CI: 1.21 – 4.05, p=.01). Additionally, participants scoring more highly on impulsivity were also more likely to

have engaged in self-harm behaviour, as opposed to ideation only (OR: 1.41, 95% CI: 1.05 – 1.91, *p*= .024). Graphical representations of the group differences for exposure to social modelling of self-harm, and impulsivity, are given in Figures 4.2 and 4.3, respectively.

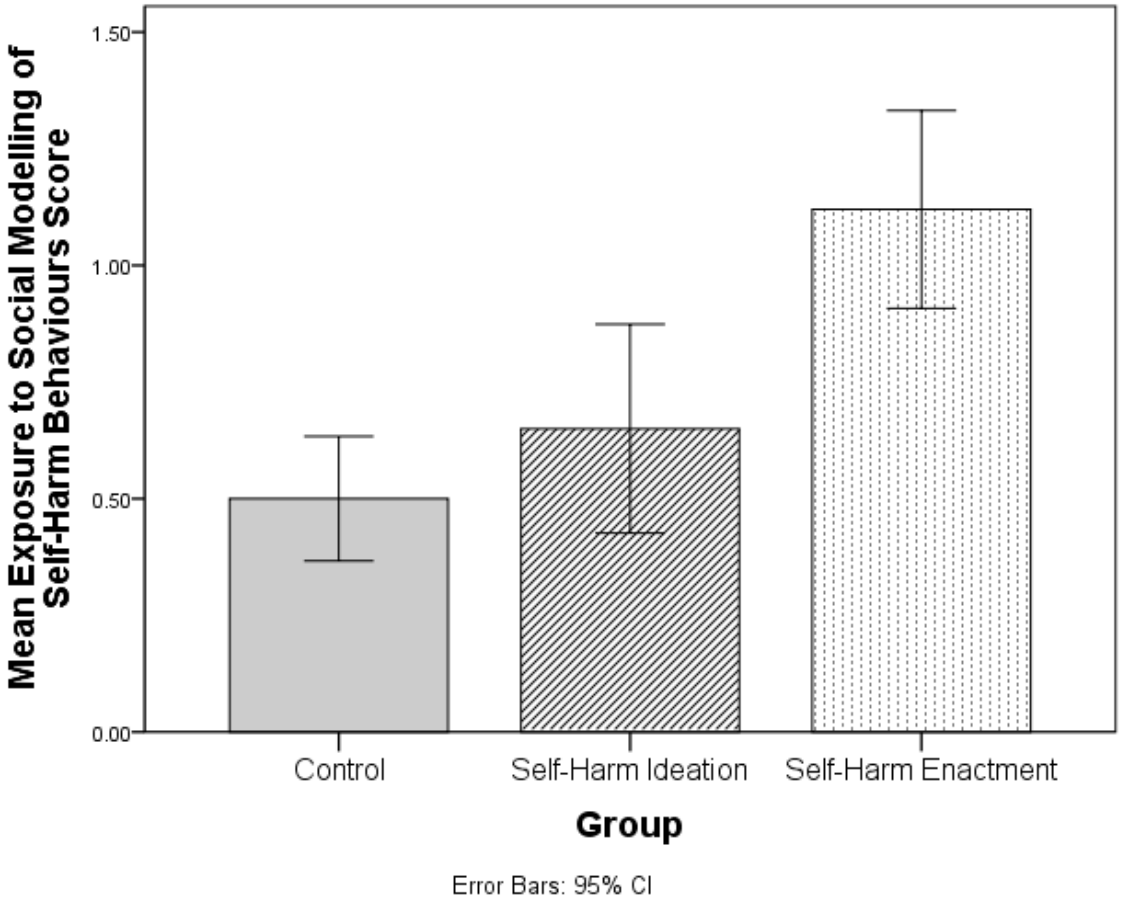

Figure 4.2. Mean score, by group, on measure of exposure to social modelling of self-harm behaviours. Individuals in the self-harm enactment and ideation groups were more likely to have a friend or family member who had engaged in self-harm. Those in the self-harm enactment group were significantly more likely to know someone who had self-harmed than those in the ideation group.

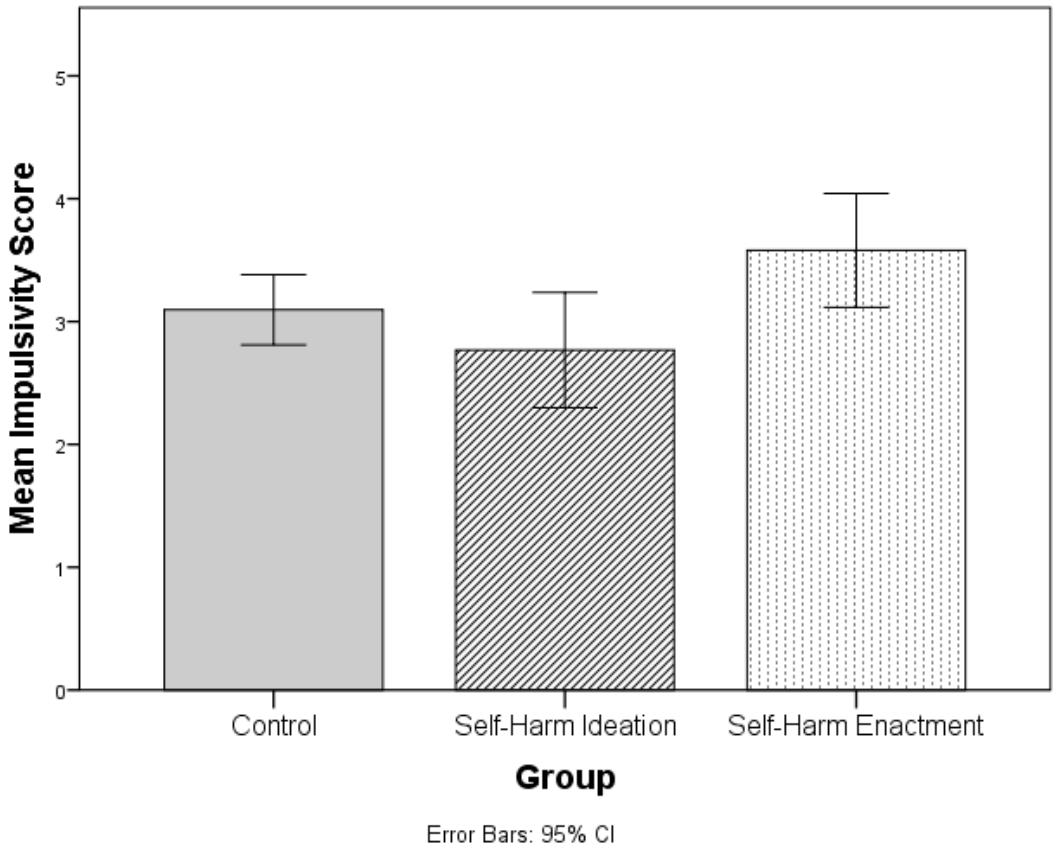

Figure 4.3. Mean impulsivity score, by group. Individuals in the self-harm enactment group were significantly more likely to have a high impulsivity score than those participants in the self-harm ideation group.

4.3.2 Laboratory study (Part 2) results

4.3.2.1 Relationship between psychological variables and physical pain threshold and tolerance

The psychological variables defeat, entrapment, humiliation, hopelessness, impulsivity and exposure to social modelling of self-harm behaviours, and the psychophysiological pain threshold and tolerance variables, were all entered individually into a series of univariate multinomial logistic regression analyses. Gender, age and depressive symptoms were also entered into univariate analyses in order to ascertain the need for their inclusion as control variables. Only depressive symptoms differed significantly between the groups and was, therefore the only variable to be controlled for in subsequent univariate analyses.

There were no significant differences between the groups for defeat, entrapment (including internal and external subscales), humiliation and hopelessness, *p*s all >.017. No significant differences emerged between the groups on any of the physical pain threshold or tolerance measures. The IMV volitional phase variable, exposure to social modelling of self-harm

behaviours, was the only variable to exhibit any significant difference between groups: Those in the self-harm enactment group were significantly more likely to know someone who had engaged in self-harm than individuals in the control group (OR: 4.16, 95% CI: 1.77 – 9.77, p = .001). Odds ratios, 95% confidence intervals and p values for motivational and volitional phase variables are given below in Tables 4.5 and 4.6, respectively.

Table 4.5

Univariate multinomial regression analyses of IMV motivational phase variables and their association with self-harm status (controlling for depressive symptoms) in laboratory study sample

Motivational phase variables	Self-harm status	OR	95% CI	*P*
Defeat				
Controls	Self-harm ideation	1.04	.960 - 1.12	.36
Controls	Self-harm enactment	1.00	.934 - 1.07	.96
Self-harm ideation	Self-harm enactment	.966	.903 - 1.03	.32
Entrapment				
Controls	Self-harm ideation	1.01	.951 - 1.08	.70
Controls	Self-harm enactment	1.05	.992 - 1.11	.09
Self-harm ideation	Self-harm enactment	1.04	.986 - 1.09	.16
Internal Entrapment				
Controls	Self-harm ideation	1.00	.877 - 1.15	.95
Controls	Self-harm enactment	1.10	.978 - 1.24	.11
Self-harm ideation	Self-harm enactment	1.10	.974 - 1.23	.13
External Entrapment				
Controls	Self-harm ideation	1.02	.930 - 1.12	.67
Controls	Self-harm enactment	1.06	.976 - 1.16	.16
Self-harm ideation	Self-harm enactment	1.04	.967 - 1.12	.28
Humiliation				
Controls	Self-harm ideation	1.01	.960 - 1.07	.66
Controls	Self-harm enactment	1.03	.985 - 1.08	.18
Self-harm ideation	Self-harm enactment	1.02	.975 - 1.07	.38
Hopelessness				
Controls	Self-harm ideation	.959	.788 - 1.17	.68
Controls	Self-harm enactment	1.06	.906 - 1.25	.45
Self-harm ideation	Self-harm enactment	1.11	.931 - 1.32	.25

Table 4.6

Univariate multinomial logistic regression analyses for the association between volitional phase variables and self-harm status (controlling for depressive symptoms) in laboratory study sample

Volitional phase variable	*Self-harm status*	*OR*	*95% CI*	*P*
Impulsivity				
Control	Self-harm ideation	.856	.566 - 1.3	.46
Control	Self-harm enactment	1.18	.832 - 1.69	.35
Self-harm ideation	Self-harm enactment	1.39	.936 - 2.04	.10
Social modelling				
Control	Self-harm ideation	1.91	.772 - 4.94	.16
Control	Self-harm enactment	4.16	1.77 - 9.77	.001
Self-harm ideation	Self-harm enactment	2.18	.969 - 4.88	.060
Physical pain threshold (time): stress				
Control	Self-harm ideation	.333	.048 - 2.31	.27
Control	Self-harm enactment	1.18	.231 - 6.08	.84
Self-harm ideation	Self-harm enactment	3.56	.539 - 23.47	.18
Physical pain threshold (time): no stress				
Control	Self-harm ideation	.591	.094 - 3.71	.56
Control	Self-harm enactment	1.98	.387 - 10.01	.41
Self-harm ideation	Self-harm enactment	3.34	.60 - 18.61	.17
Physical pain threshold (pressure): stress				
Control	Self-harm ideation	.754	.030 - 19.3	.86
Control	Self-harm enactment	4.74	.261 - 86.06	.29
Self-harm ideation	Self-harm enactment	6.29	.25 - 157	.26
Physical pain threshold (pressure): no stress				
Control	Self-harm ideation	1.00	.037 - 27.1	1.00
Control	Self-harm enactment	.874	.044 - 17.52	.93
Self-harm ideation	Self-harm enactment	.873	.036 - 21.2	.93
Physical pain tolerance (time): stress				
Control	Self-harm ideation	.413	.050 - 3.44	.41
Control	Self-harm enactment	3.67	.60 - 22.36	.16
Self-harm ideation	Self-harm enactment	8.84	1.13 - 69.17	.038

Physical pain tolerance (time): no stress				
Control	Self-harm ideation	.473	.076 - 2.95	.42
Control	Self-harm enactment	1.50	.292 - 7.74	.63
Self-harm ideation	Self-harm enactment	3.18	.552 - 18.25	.20
Physical pain tolerance (pressure): stress				
Control	Self-harm ideation	1.56	.070 - 34.59	0.78
Control	Self-harm enactment	2.41	.144 - 40.49	0.54
Self-harm ideation	Self-harm enactment	1.55	.090 - 26.7	0.76
Physical pain tolerance (pressure): no stress				
Control	Self-harm ideation	1.89	.076 - 47.08	0.7
Control	Self-harm enactment	2.44	.133 - 44.91	0.55
Self-harm ideation	Self-harm enactment	1.29	.059 - 28.15	0.87

4.3.2.2 The effect of stress upon physical pain threshold and tolerance

Both the time taken to terminate the task (response latency) and the maximum pressure exerted were recorded for pain threshold and tolerance following administration of the 'stress' and 'no stress' MAST conditions, in order to examine the effect of stress upon threshold and tolerance for physical pain. These data were then analysed using mixed-measures ANCOVA, with group (control; self-harm ideation; self-harm enactment) as the between-participants variable and experimental condition (stress; no stress) as the within-participants variable. A one-way ANOVA was conducted to investigate if there were any effects of gender upon pain threshold or tolerance variables. Gender was significantly associated with all four pain variables: $F(1, 98) = 14.08 – 28.10$ all *p*s <.001. Linear regressions were used to analyse the relationships between age, depressive symptoms and the pain threshold and tolerance variables. Age was significantly associated with pressure measures of pain threshold and tolerance under stress and no stress conditions, all *p*s <.004. Depressive symptoms were only significantly correlated with time measures of pain threshold in both the stress and no stress conditions, *ps* = .026 and .038, respectively. Given the association between pain variables, age and depressive symptoms, these were included as control variables within the main ANCOVA analyses.

4.3.2.2.1 Pain threshold following stress vs. no stress conditions

ANCOVA analysis for the main effect of stress upon the time taken for participants to reach pain threshold revealed that there was no significant difference between stress and no-stress conditions across any of the groups, F(1, 87) = .057, *ns.* There was also no significant difference in the maximum pressure participants reached during their threshold trials, between the stress and no stress conditions, F(1, 87)= .001, *ns*. There were no significant interactions between group, stress condition, gender, age, depressive symptoms and any of the pain threshold variables. Transformed means and standard deviations for pain threshold are given in Table 4.7.

4.3.2.2.2 Pain tolerance following stress vs. no stress conditions

No significant difference was found between the stress and no stress conditions in the time taken for participants to reach their pain tolerance level, F(1, 88) = .77, *ns.* Maximum pressure during the tolerance trials was also not significantly different between the stress and no stress conditions for any of the groups, F(1, 87) = .26, *ns*. No significant interactions emerged between any of the variables. Transformed means and standard deviations for pain tolerance are given in Table 4.7, below.

Table 4.7

Transformed Means and Standard Deviations for Physical Pain Threshold and Tolerance in Laboratory (Part 2) study

	Controls	Self-harm ideation	Self-harm enactment
No stress	*Mean (SD)*	*Mean (SD)*	*Mean (SD)*
Pain threshold time	3.83 (.31)	3.81 (.30)	3.97 (.42)
Pain threshold pressure	2.71 (.20)	2.68 (.17)	2.68 (.16)
Pain tolerance time	3.96 (.31)	3.95 (.36)	4.08 (.33)
Pain tolerance pressure	2.83 (.21)	2.85 (.17)	2.86 (.17)
Stress			
Pain threshold time	3.86 (.30)	3.81 (.47)	3.96 (.27)
Pain threshold pressure	2.69 (.21)	2.68 (.19)	2.75 (.17)
Pain tolerance time	4.01 (.25)	3.97 (.26)	4.15 (.35)
Pain tolerance pressure	2.85 (.20)	2.85 (.18)	2.86 (.20)

4.3.2.3 Mood

Participants' mood was assessed at multiple time-points throughout the laboratory visit: at baseline, post non-stress condition, post non-stress condition algometer task, post filler task, post stress condition and post stress condition algometer task. Of primary interest were the differences between mood at baseline, following administration of the stressful mood manipulation and following the stress condition algometer task.

4.3.2.3.1 Negative Mood

A series of mixed-measures ANOVAs were carried out, with group (control, self-harm ideation and self-harm enactment) as the between-participants variable and time (baseline vs. post-stress condition; post-stress condition vs. post-stress algometer task) as the within-participants variable.

Results revealed a significant main effect of time upon negative mood (baseline vs. post-stress condition), $F(1, 99) = 5.49$, p=.021, but no significant group x time interaction. There was also a significant main effect of time upon negative mood when comparing post stress condition and post stress condition algometer task mood, $F(1, 99) = 39.38$, $p < .001$. There was no significant interaction between time and group. A graphical representation of change in negative mood over the three time-points is shown in Figure 4.4. Means, standard deviations and 95% confidence intervals for negative mood are displayed in Table 4.8.

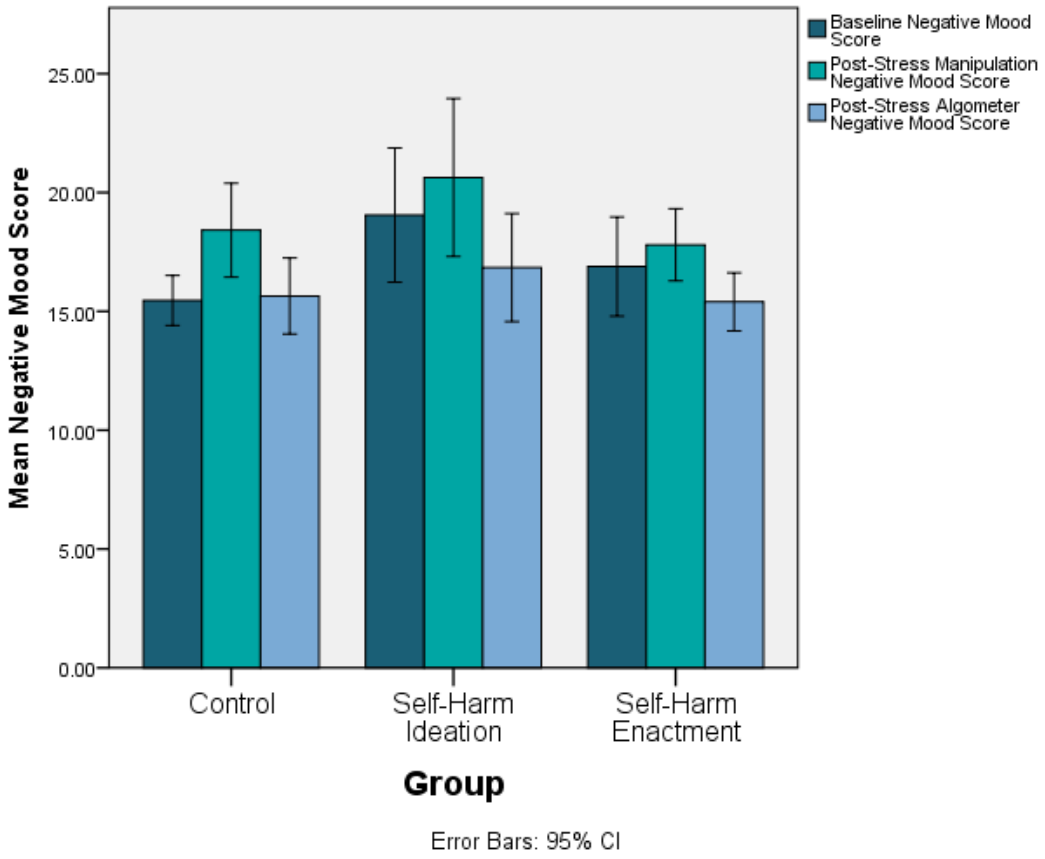

Figure 4.4. Mean negative mood scores by group for each of three time-points (baseline, post-stress manipulation and post-stress algometer task). There was no significant effect of group upon negative mood, but there were significant differences in mood between the three time-points.

4.3.2.3.2 Positive Mood

There was no significant effect of time upon positive mood for baseline vs. post stress condition comparison, F(1, 99)= 3.84, *ns.*, but there was a significant group x time interaction, F(2, 99)= 6.08, *p*= .003. This interaction effect is likely to be spurious, however, as none of the subsequent post-hoc tests emerged as significant. When comparing post stress condition positive mood with post stress algometer mood, there was no significant effect of time upon mood, F(1, 99)= 2.74, *ns.*, and no significant interaction between group and time. Change in positive mood across the three time-points is shown in Figure 4.5. Means, standard deviations and 95% confidence intervals for positive mood are given in Table 4.8.

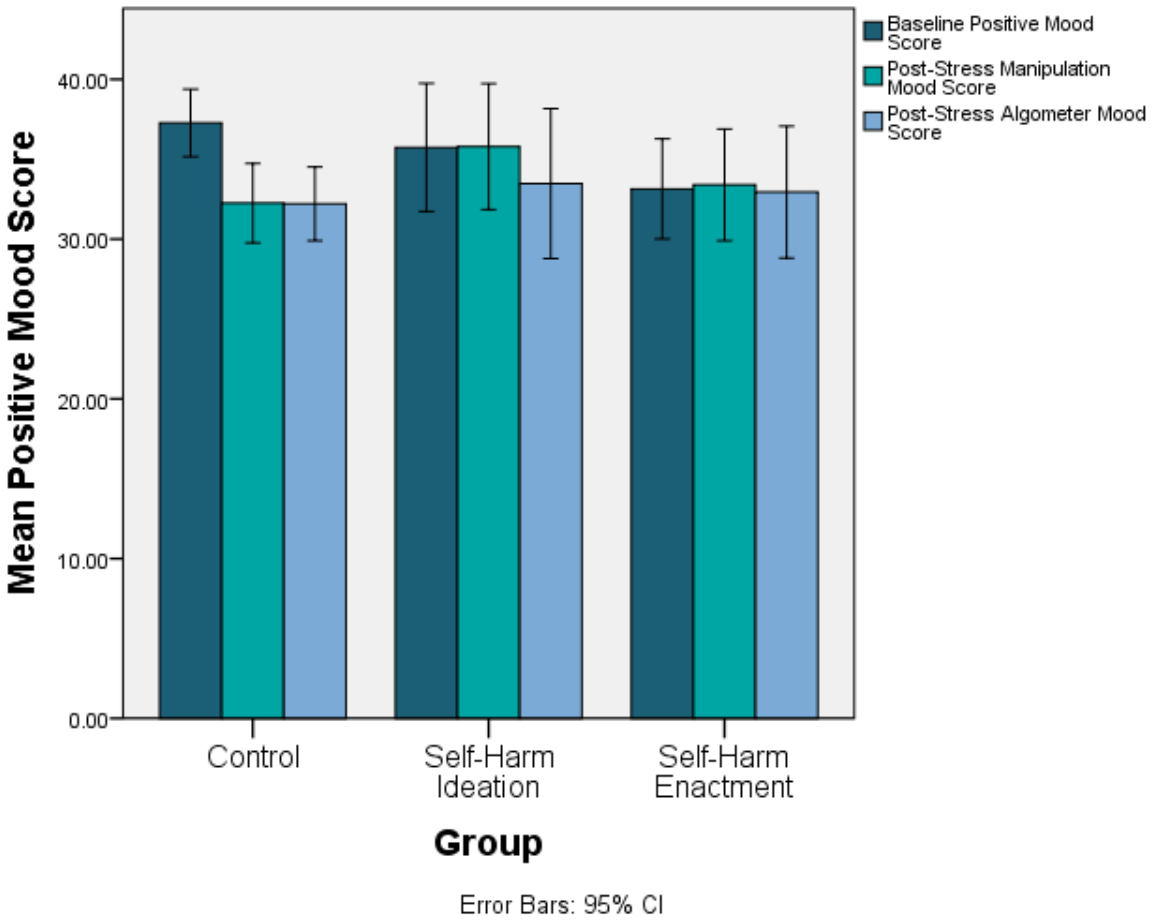

Figure 4.5. Mean positive mood scores by group for three time-points (baseline, post-stress manipulation and post-stress algometer task). There were no significant differences in positive mood as a function of time-point, but there was a significant interaction between group and time-point.

Table 4.8
Means, Standard Deviations and 95% Confidence Intervals for Positive and Negative Mood Scores During Laboratory Study

Baseline negative mood	*M*	*SD*	*95% CI*
Control	15.46	3.64	14.40 - 16.51
Self-harm ideation	19.05	5.85	16.23 - 21.87
Self-harm enactment	16.89	6.07	14.80 - 18.97
Post-stress manipulation negative mood			
Control	18.42	6.81	16.44 - 20.39
Self-harm ideation	20.63	6.9	17.31 - 24.00
Self-harm enactment	17.80	4.41	16.28 - 19.32
Post-stress algometer mood			
Control	15.65	5.51	14.05 - 17.25
Self-harm ideation	16.84	4.72	14.57 - 19.12
Self-harm enactment	15.40	3.56	14.18 - 16.62
Baseline positive mood			
Control	37.27	7.27	35.16 - 39.38
Self-harm ideation	35.74	8.33	31.72 - 39.75
Self-harm enactment	33.14	9.12	30.00 - 36.28
Post-stress manipulation positive mood			
Control	32.35	8.55	29.77 - 34.73
Self-harm ideation	35.79	8.18	31.85 - 39.73
Self-harm enactment	33.40	10.18	29.90 - 36.90
Post-stress algometer positive mood			
Control	32.21	7.94	29.90 - 34.51
Self-harm ideation	33.47	9.74	28.78 - 38.17
Self-harm enactment	32.94	12.02	28.81 - 37.07

4.4 Discussion

The current study is the first to directly compare the effect of stress upon threshold and tolerance for physical pain in self-harm ideation and enactment. It is also the first study of stress and pain in self-harm to employ a within-participants design, to investigate pain threshold and tolerance within the same group of individuals under both stressful and neutral conditions.

4.4.1 Effect of stress upon pain threshold and tolerance

Contrary to the findings of previous studies (Gratz et al., 2011; Hooley & St Germain, 2013), the current study found no significant effect of stress upon pain threshold or tolerance for any of the groups. There are a number of potential explanations for this finding, most obviously insufficient statistical power: there were only 19 individuals within the self-harm ideation group and 35 in the self-harm enactment group, compared to 48 controls. The disparity between group sizes for the control and self-harm enactment groups, however, was not as marked, so potentially suggests that a lack of statistical power alone is not a sufficient explanation for these null results.

This is the first study to have utilised a within-participants design when assessing the effect of stress upon pain threshold and tolerance; previous studies have employed between-subjects study designs, randomly allocating participants to receive either stressful or neutral conditions (e.g. Gratz et al., 2011; Hooley & St Germain, 2013) or exposing all participants to stress (Franklin et al., 2012). Previous studies therefore may have been confounded by effects of individual differences, with those within the self-harm enactment groups who were exposed to stress manipulations reacting more adversely. A more plausible explanation though, is that the choice of stress manipulation used in the current study caused it to become a 'victim' of its own within-participants design. The neutral condition of the MAST (Smeets et al., 2012) involves repeatedly counting 1-25, alternated with immersing one hand in lukewarm water. Whilst innocuous, this neutral condition also requires some degree of concentration and the resultant cognitive load may not have been sufficiently distinct from the negative condition to elicit a difference in the transmission of pain signals between conditions, as per Melzack and Wall's Gate Control Theory (Melzack & Wall, 1965); higher cognitive load is associated with a closing of the 'pain gates',

inhibiting transmission of noxious sensations from peripheral to central nervous system. Neutral tasks used in previous work have typically been passive in nature, e.g. listening to music; the MAST neutral task being comparatively active. Participants in the current study also demonstrated no significant differences in their perception of how stressful the neutral and stress conditions were, perhaps also implying that participants themselves perceived the stressful and neutral tasks to be equally cognitively demanding. Future studies of stress-dependent pain threshold and tolerance in self-harm should carefully consider the suitability of the neutral control task employed, and how cognitively demanding this is in comparison to the stress condition. A key further consideration of the efficacy of the MAST with individuals experiencing psychological distress, is that the type of 'stress' it is designed to induce is so far removed from that which the participants likely experience in their everyday lives. This, however, is true of the majority of laboratory stress paradigms, but is nevertheless an important methodological, and indeed ethical challenge, for research into mood-dependent outcomes of self-harm.

4.4.2 Effect of pain upon mood

By assessing participants' mood throughout the study, it was also possible to investigate the effect of pain upon mood by comparing pre and post algometer mood ratings. There was no significant effect of pain upon positive mood across any of the groups; however, there was a significant effect of pain upon negative mood. Negative mood increased significantly between baseline and immediately post stress manipulation, but then fell following administration of the algometer task. Particularly notable is that this effect was not group specific and was observed across the control, self-harm ideation and self-harm enactment groups. The reduction in negative mood following the algometer task supports previous studies that have found a 'universal', i.e. non self-harm specific, decrease in negative mood following administration of a painful stimulus (Franklin et al., 2010; 2013), and adds weight to the 'offset analgesia' theory of affect regulation in self-harm. See Chapter 1 section 1.6.1.2 and Chapter 7 section 7.2.3.1 for a full discussion of offset analgesia. The lack of significant change in positive mood observed in the current study, however, does contradict prior research that has found a simultaneous increase in positive affect and decrease in negative affect accompanying termination of a noxious stimulus (Franklin et al., 2013). Disparity in group sizes, and small overall sample size, are likely not an explanation for this, given that both are comparable to those used in previous studies finding differences in positive affect pre and post pain (Franklin et al, 2010; 2013; 2013). Previous research has demonstrated that positive attentional biases are less amenable than

negative attentional biases, to modification by mood manipulations (Morrison & O'Connor, 2008). It is possible then that the stress and neutral manipulations used within the current study were not sufficient to influence positive mood.

4.4.3 Pain threshold and tolerance in self-harm ideation

It was predicted that those in the self-harm enactment group would demonstrate a significantly higher threshold and tolerance for physical pain than individuals in the control group, and also that participants in the self-harm ideation group would exhibit similarly elevated pain threshold and tolerance. The results of the current study, however, do not support this hypothesis, with no significant differences found for any of the groups in either response latency or maximum pressure exerted between pre and post stress algometer tasks. No previous studies have explored pain threshold and tolerance in self-harm ideation, therefore these results may suggest that those who have thought about, but never engaged in, self-harm behaviour do not have higher levels of pain threshold and tolerance than healthy controls. Given the numerous studies that have found differences in pain threshold and tolerance between controls and those who have enacted self-harm behaviour, the lack of apparent differences between these groups in the current study is perhaps surprising. Unlike previous studies, our preliminary analyses revealed that gender, age and depressive symptoms were significantly associated with the pain variables, and consequently were included as covariates in subsequent analyses. Potentially, the combined effect of controlling for these variables and the small sample size masked any differences in pain threshold or tolerance that were due to self-harm status. A further possibility is that variation in the way that the algometer was used by participants may have introduced noise into the data. Despite the use of standardised instructions and a demonstration of the correct algometer procedure by the researcher, there were differences in the way that participants applied the algometer to their finger.

4.4.4 Commonalities and differences across self-harm ideation and enactment

The present study measured four variables from the motivational phase of the IMV (O'Connor, 2011); defeat, entrapment, humiliation and hopelessness. No significant differences in hopelessness or humiliation were found between any of the three groups, but defeat and entrapment differed significantly between the control and ideation, and control and enactment groups, respectively. Crucially, as predicted, none of the motivational phase variables differed between the ideation and enactment groups, supporting the validity of

the IMV and the findings of previous studies (Dhingra et al., 2015; O'Connor et al., 2012). Differences in defeat between control and enactment groups and differences in entrapment between control and ideation groups approached significance, $p = .057$ and .055, respectively, and had Holm's Sequential Bonferroni correction not been applied, humiliation would have differed between control and enactment groups with marginal significance, $p = .048$. Undoubtedly the size of the ideation group resulted in insufficient statistical power.

Two IMV volitional phase variables were also assessed: impulsivity and exposure to social modelling of self-harm behaviour, with the hypothesis that these would differ significantly between the ideation and enactment groups, as well as between controls and both self-harm groups. This hypothesis was supported with both impulsivity and exposure to social modelling being significant univariate and multivariate correlates of self-harm enactment, relative to self-harm ideation, consistent with the IMV prediction and previous research (Dhingra et al., 2015; O'Connor et al., 2012). Controls differed from individuals in the enactment group only in exposure to social modelling of self-harm and there were no significant differences between controls and either self-harm group for impulsivity. Exposure to social modelling of self-harm was associated with an increase in self-harm enactment odds ratio of 2.3 for every unit increase. The fact that this differentiated between the self-harm ideation and enactment groups is a key finding and could have significant potential for the development of interventions and treatments for self-harm behaviour. This promising result warrants further investigation; specifically, is it exposure to self-harm behaviours in others *per se* that increases risk, or is it in fact common exposure to variables that increase proximate risk, e.g. similar stressors or subjective behavioural norms around self-harm?

4.4.5 Limitations

The findings from the current study must be interpreted within the context of the study's limitations. There was no significant difference between the level of perceived stress experienced by participants during the stress and non-stress MAST conditions, so potentially the stress manipulation employed in this study did not elicit sufficient distress to have an effect upon pain threshold and tolerance. Furthermore, the non-stress neutral condition may have been too 'active', resulting in a similar cognitive load to that of the stress manipulation, rendering it an ineffective control condition. The MAST stress condition has been demonstrated to elicit measurably significant changes in salivary stress

biomarkers cortisol and alpha-amylase, relative to the MAST non-stress condition (Smeets et al., 2012). This effect has also been shown in a within-participants design (Meyer et al., 2013). Whilst significant differences in negative affect were demonstrated across all groups between baseline, post stress condition administration and post stress algometer task, these differences were small and with overlapping confidence intervals. The most likely potential reason for the non-effectiveness of the MAST within this population, is symptomatic of a wider limitation of laboratory stress paradigms; they are not an adequate proxy for the type of stress experienced in the daily lives of participants. Future research should aim to develop laboratory stress manipulations with greater salience for participants who are disproportionately likely to have experienced significant and traumatic stressful life events. It is, we recognise, a fine line for laboratory stressors between inducing sufficient distress as to elicit measurable changes in outcome variables, whilst balancing ethical responsibilities to protect participants' safety. The sample size for the laboratory section of the study was small and particularly so in the case of the self-harm ideation group, relative to the control and self-harm enactment groups. It is highly likely that this resulted in low statistical power and may have caused some masking of between-group differences in physical pain threshold and tolerance. However, the size of the control and enactment groups were comparable to those used in previous research (e.g. Franklin et al., 2013), therefore it is possible that the null results yielded in the current study represent a genuine lack of difference between the groups. Whilst this study presents data from only a small sample of individuals reporting ideation, without any behavioural enactment of self-harm, this is to our knowledge, the largest group of participants with self-harm ideation to be studied in relation to physical pain threshold and tolerance; previous studies, whilst working extremely hard to achieve sufficient numbers of individuals to make analysis of self-harm ideation viable, unfortunately were unable to do so (Hooley et al., 2010). We therefore feel that, despite the study's limitations, it makes a novel and timely contribution to the literature around pain and self-harm, as well as demonstrating the efficacy of the IMV for differentiating between individuals who think about self-harm and those who have gone on to engage in the behaviour.

4.5 Conclusion

In sum, the current study found no significant differences in physical pain threshold or tolerance as a function of self-harm enactment or ideation. Furthermore, there was interaction between stress and self-harm status, in relation to pain threshold and tolerance, contrasting with previous literature suggesting an association between reduced pain

tolerance and negative affect. We did, however, find a small but significant reduction in negative affect following participants' self-administration of a painful algometer stimulus, indicating that pain may reduce negative affect. Crucially though, this effect was not group specific, being found across self-harm ideation, self-harm enactment and control groups, and providing some support for offset analgesia theory (Franklin et al., 2010; 2013). Supporting the IMV model of suicidal behaviour (O'Connor, 2011), no significant differences in defeat, entrapment, hopelessness or humiliation (motivational phase variables) were found between the ideation and enactment groups. Lack of differences between the control and self-harm ideation groups, and the control and self-harm enactment groups on some of these variables are likely due to low statistical power. There were, however, significant differences between the ideation and enactment groups in impulsivity and exposure to social modelling of self-harm behaviour; the latter providing an important potential opportunity for intervention and treatment development. The current study also makes a unique contribution to the literature around pain and self-harm by measuring, for the first time, pain threshold and tolerance in self-harm ideation, and by direct comparison with individuals who have enacted self-harm behaviour.

The following chapter presents a self-report study investigating self-perceived sensitivity to physical pain and emotional pain in self-harm ideation and enactment.

Chapter 5: Self-Report Study of Reactivity to Physical and Emotional Pain in Self-Harm Ideation and Enactment

Introduction

Those who self-harm have been shown to be less sensitive to physical pain, but more sensitive to emotional pain, appearing to contradict social neuroscience research which suggests that individuals who are more sensitive to physical pain are also more sensitive to emotional pain. The current study investigated the relationship between self-reported emotional pain sensitivity and physical pain distress in those who think (ideate) about and engage in (enact) self-harm.

Methods

351 healthy adults completed a battery of anonymous online questionnaires assessing emotional sensitivity, physical pain distress and sensitivity, lifetime history of self-harm, as well as depressive symptoms, self-critical style, perfectionistic cognitions and perfectionistic self-presentation.

Results

Emotional sensitivity and physical pain distress were higher in both the self-harm ideation and enactment groups than in controls and there was a significant ordered effect, such that the enactment group was more sensitive to emotional and physical pain than the ideation group. A similar significant ordered effect in physical pain sensitivity was only observed when controlling for previous suicide attempt. Within the ideation group, physical pain distress and self-critical style were the only factors significantly associated with emotional pain sensitivity, but only presence of perfectionistic cognitions was significantly associated with emotional pain sensitivity in the enactment group.

Conclusion

The results of this study indicate that higher levels of emotional pain sensitivity and physical pain distress are present in self-harm, supporting the social neuroscience model of the relationship between emotional and physical pain sensitivity. The findings also suggest that cognitions around physical and emotional pain are altered in self-harm ideation, even before an individual engages in self-harm behaviour. These self-report results taken

together with findings from previous behavioural research, suggest an association between self-perceived emotional sensitivity and physical pain distress in self-harm ideation, but possibly a disconnection between self-perceived and behavioural sensitivity to physical pain in self-harm enactment. Contrary to one of our two competing hypotheses, those who ideate about, and engage in, self-harm behaviour are in fact more sensitive to emotional pain and physical pain distress; not less sensitive to physical pain. They are, however, more sensitive to emotional pain. Furthermore, self-criticism and perfectionism may be differentially associated with emotional sensitivity in self-harm ideation and enactment.

Sections of this Chapter appear in Kirtley, O. J., O'Connor, R. C. & O'Carroll, R. E., (2015). Hurting inside and out: The relationship between emotional and physical pain in self-harm ideation and enactment. *International Journal of Cognitive Therapy, 8*(2), 156-171. A full copyright wavier has been obtained from the *International Journal of Cognitive Therapy* for the inclusion of this work in this thesis.

5.1 Introduction

Self-harm, defined as "self-injury or self-poisoning irrespective of the apparent purpose of the act" (National Institute for Health and Care Excellence, 2004, p6)[3] is a context in which physical and emotional pain appears to be inextricably linked. Indeed many individuals describe self-harm as a way of escaping from a terrible state of mind (e.g. O'Connor, Rasmussen, Miles & Hawton, 2009). Over the last decade, a significant amount of research from the field of social neuroscience has focused on the relationship between emotional and physical pain perception within normative populations, positing that there is a shared common neural circuitry for physical and emotional pain (Eisenberger et al., 2003; Eisenberger et al., 2006), such that those who are more sensitive to one form of pain are also more sensitive to the other (e.g. Eisenberger, 2010). The social neuroscience model of the relationship between emotional and physical pain is shown below in Figure 5.1.

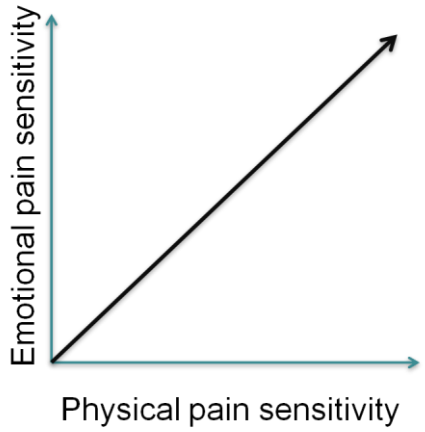

Figure 5.1. The social neuroscience model of the relationship between physical and emotional pain sensitivity.
Based upon this model, those who are more sensitive to physical pain should also be more sensitive to emotional pain and *vice versa*.

5.1.1 Emotional and physical pain: From brain imaging to behaviour

Subsequent to Eisenberger and colleagues' seminal (2003) paper outlining fMRI evidence that there are brain regions with shared functionality for processing emotional and physical

[3] We have employed the term self-harm as it is the most widely used term to describe self-injurious behaviour in the UK. However, we distinguish between self-harm with and without suicidal intent within the Statistical Analysis section of the paper.

pain, fMRI studies in this area of research have proliferated. However, several recent papers have questioned whether or not such a "perfect" linear relationship exists for emotional and physical pain sensitivity and also, using new methods of analysing fMRI data, whether there is common neural circuitry for these two types of pain at all (Iannetti et al., 2013; Wager et al., 2013). A recent quantitative meta-analysis of fMRI studies exploring this relationship did not support the theory that there is a shared neural circuitry for emotional and physical pain (Cacioppo et al., 2013), further calling into question this relationship.

Whilst functional neuroimaging studies of emotional and physical pain have burgeoned, self-report and behavioural studies have been scant. Consequently, if or how the relationship between emotional and physical pain translates into actual behaviour or altered perception of one's behaviour, is unknown and remains a neglected area of research. Furthermore, even fewer studies have investigated this posited relationship in clinical populations. There is some evidence to suggest that increased emotional pain sensitivity in the form of self-reported sensitivity to rejection is associated with increased reports of physical pain experiences, such as headaches and chest pain, in those with treatment-resistant depression (Ehnvall, Mitchell, Hadzi-Pavlovic, Malhi & Parker, 2009) and bipolar depression (Ehnvall et al., 2011). Reports of pain *experiences* are distinctly different from the *perception* of one's general sensitivity to physical pain; indeed the increase in physical pain reported in these studies could also be somatic manifestations of psychological distress, thus not an increase in pain sensitivity but rather an increase in symptomatology. Moreover, whilst sensitivity to rejection is undoubtedly an important facet of emotional pain sensitivity, there are other key elements that have yet to be explored. Sensitivity to feelings of humiliation and shame for example, as described in Shneidman's concept of "Psychache" (Shneidman, 1993; Shneidman, 1998), may perhaps be other important areas of emotional pain sensitivity for investigation.

5.1.2 The relationship between emotional and physical pain sensitivity in self-harm

The suggestion that those who are more sensitive to one form of pain are also more sensitive to the other is particularly intriguing when considered within the context of self-harm, where research using behavioural and self-report methods has found individuals who engage in non-suicidal self-injury (NSSI) to be *more* sensitive to emotional pain (Glenn, Blumenthal, Klonsky & Hajcak, 2011; Nock et al., 2008) and yet also *less* sensitive to

physical pain (Franklin, Aaron, Arthur, Shorkey & Prinstein, 2012; Gratz et al., 2011). This pattern of high emotional sensitivity and low physical pain sensitivity is also found in suicidal self-harm (Dour, Cha & Nock, 2011; Orbach, Mikulincer, King, Cohen & Stein, 1997). In short, the behavioural and self-report evidence from individuals who have engaged in self-harm would appear to contradict the linear relationship between emotional and physical pain proposed in the social neuroscience literature. See Figure 5.2 below for a graphical representation of how the evidence from the self-harm literature contradicts the social neuroscience model of the relationship between physical (a) and emotional (b) pain sensitivity.

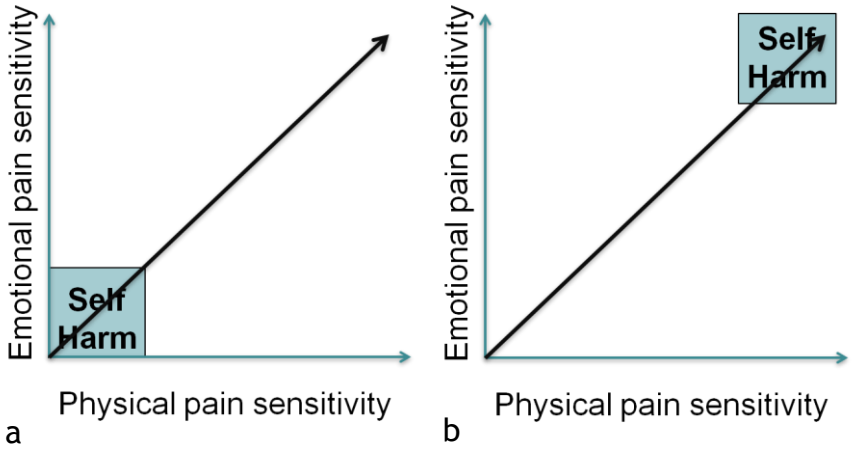

Figure 5.2. Integrating the social neuroscience model with evidence on physical pain sensitivity (a) and emotional pain sensitivity (b) from suicidal and non-suicidal self-harming populations.
Interpreting the evidence from studies exploring physical pain sensitivity in those who engage in suicidal and non-suicidal self-harm, within the context of the social neuroscience model (a), we would then expect those who self-harm to have a low sensitivity to physical pain and also a low sensitivity to emotional pain. Conversely, within the framework of the social neuroscience model (b), evidence on emotional pain sensitivity in self-harm would anticipate that sensitivity to both emotional and physical pain would be higher in those who have engaged in self-harm. Neither of these scenarios is consistent with the broader conclusions from studies of emotional and physical pain in self-harm, which appear to contradict the social neuroscience model.

5.1.3 From Thoughts to Acts of Self-harm

Only a proportion of those who have thoughts of self-harm (ideation) will go on to engage in (enact) the behaviour. The factors that differentiate someone who ideates from someone who enacts self-harm is something about which we know very little and has been identified as a priority area for future research (Klonsky & May, 2014; O'Connor, Rasmussen, & Hawton, 2012; O'Connor & Nock, 2014). The pathway from thoughts to behaviours is a complex and multifaceted process and has been characterised in the recently proposed Integrated Motivational Volitional (IMV) model of suicidal behaviour (O'Connor, 2011). The model is composed of three distinct phases: The pre-motivational phase includes variables such as social perfectionism which increase vulnerability to

psychological distress. This is followed by the motivational phase, which encompasses variables that are involved in self-harm ideation and in forming the intention to self-harm. Finally the volitional phase comprises factors that increase the likelihood of an individual making the transition from thinking about self-harm to enacting the behaviour. For a full discussion of the IMV, see section 1.3.1 of Chapter 1. To our knowledge, no study to date has explored either self-reported or behavioural sensitivity to, physical or emotional pain in individuals who ideate about, but have not engaged in self-harm. Hooley, Ho, Slater and Lockshin (2010) attempted to include an ideation group in their study of pain tolerance and NSSI, but unfortunately they were unable to recruit a sufficient number of individuals reporting ideation without enactment, to be statistically viable. We, therefore, do not know if physical pain sensitivity and greater emotional reactivity are uniquely associated with self-harm enactment or if they are also a feature of self-harm ideation. Such a comparison would go some way to answering the key question of whether or not these factors are a cause or a consequence of actual self-harm.

5.1.4 Recency of self-harm

Evidence would strongly suggest that those who have engaged in self-harm have a higher threshold and tolerance for physical pain; an effect which appears to be true for both clinical and non-clinical samples (Magerl, Burkart, Fernandez, Schmidt & Treade, 2012; St Germain & Hooley, 2013). It does appear, however, to be subject to temporal variation, with those who currently self-harm having a higher pain threshold than those who are not currently self-harming (Ludäscher et al., 2009), possibly suggesting that pain sensitivity may normalise following self-harm cessation. To date, no investigations have determined if or how emotional pain sensitivity may alter when an individual stops self-harming. It is also unknown if or how other psychological variables, such as perfectionism and self-criticism (see section 5.1.5 below for further discussion), may differ as a function of how recently individuals have self-harmed.

5.1.5 Psychological correlates of emotional and physical pain sensitivity in self-harm

Previous research has found robust and consistent associations between self-harm and certain psychological variables, e.g. social perfectionism, self-criticism, impulsivity, rumination and the "Big Five" personality traits (see O'Connor & Nock, 2014 for discussion). Curiously, few if any of these associations have been examined in studies of

physical pain and self-harm, thus potential psychological moderators and mediators of reduced pain sensitivity in this population remain unknown. Perfectionism, in particular, appears to be a pernicious correlate of self-harm, with the number and frequency of automatic thoughts about needing to be perfect (perfectionistic cognitions) being significantly associated with psychological distress (Flett, Hewitt, Whelan & Martin, 2007). Perfectionistic self-presentation, the degree to which one needs to appear perfect to others, has also been associated with higher levels of depression and anxiety (Hewitt et al., 2003). A number of recent studies have explored the relationship between self-criticism and physical pain sensitivity in self-harm, demonstrating that self-critical style appears to mediate the relationship between pain analgesia and NSSI in adolescents (Glenn et al., 2014) potentially because individuals who are extremely self-critical are more willing to endure pain as a method of self-punishment, feeling that they deserve the pain (Hamza, Willoughby & Armiento, 2014; Hooley et al, 2010). Furthermore, manipulating feelings of self-worth has been found to decrease sensitivity to pain in those who engage in NSSI (Hooley & St Germain, 2014). Whether or not a similar relationship exists between self-criticism and physical pain sensitivity in self-harm ideation, or in suicidal self-harm, remains to be seen. Pain specific cognitions (e.g. feelings of distress) have also received little attention within the extant corpus of research on pain and self-harm, although self-reported ratings of pain unpleasantness either during self-harm or a laboratory self-harm proxy (e.g. the cold pressor test) have been studied (e.g. Russ, Roth, Kakuma, & Harrison, 1994; Russ, Roth, Lerman, & Kakuma, 1992), revealing lower ratings of pain unpleasantness by those who self-harm than by controls. Again, no investigation has been made of pain cognitions in those who ideate about self-harm without engaging in the behaviour. For a full discussion of laboratory self-harm proxies and their validity see: Chapter 2 section 2.3.5.1; Chapter 3 section 3.1.6.1 and Chapter 7 section 7.3.1.3.1.

5.1.6 The Present Study

We therefore set out to conduct a self-report study of the relationship between emotional and physical pain sensitivity in self-harm and to investigate possible psychological correlates of sensitivity to emotional and physical pain; a previously neglected area of research. Additionally, we also sought to probe the potential temporal aspect of the relationship between self-harm and sensitivity to emotional and physical pain.

5.1.6.1 Hypotheses and research questions

1) What is the relationship between emotional and physical pain in self-harm enactment?

Our primary research question, regarding the nature of the relationship between self-reported emotional and physical pain sensitivity in self-harm ideation and enactment, was comprised of two competing hypotheses (1.1 and 1.2):

Hypothesis 1.1) Greater sensitivity to emotional pain is associated with greater sensitivity to physical pain (social neuroscience model consistent): If the linear relationship between emotional and physical pain, suggested by the social neuroscience literature, is valid for self-harm ideation and enactment, we would expect to find that reporting greater sensitivity to emotional pain would be associated with reporting greater sensitivity to physical pain.

Hypothesis 1.2) Greater sensitivity to emotional pain is associated with decreased sensitivity to physical pain (social neuroscience model inconsistent): Contrary to the relationship proposed by the social neuroscience model, we would expect that instead, relative to controls, we would find those in the self-harm enactment group to report greater sensitivity to emotional pain, but decreased sensitivity to physical pain.

2) What is the relationship between emotional and physical pain in self-harm ideation?

Hypothesis 2.1) Emotional pain sensitivity is similarly altered in self-harm ideation to self-harm enactment: We hypothesised that we also may see a similar pattern of emotional and physical pain sensitivity in the self-harm ideation group. It was our prediction, therefore, that we would observe an ordered effect for emotional pain sensitivity: self-harm enactment>self-harm ideation> controls.

Hypothesis 2.2) Physical pain sensitivity is similarly altered in self-harm ideation to self-harm enactment: Given previous research demonstrating lower levels of pain unpleasantness reported by those who have self-harmed, we also predicted that we would see a reverse of this ordered effect for physical pain distress and pain sensitivity, with pain sensitivity being highest in controls, followed by the self-harm ideation group and then lowest in the self-harm enactment group: controls>self-harm ideation>self-harm enactment.

3) *What is the effect of recency of self-harm upon emotional and physical pain sensitivity and their psychological correlates?*

Hypothesis 3.1) Recency of self-harm affects sensitivity to physical pain: We also hypothesised that self-reported physical pain sensitivity would be lower in those who had self-harmed more recently, compared to those who had self-harmed longer ago.

Hypothesis 3.2) Perfectionistic cognitions will differ as a function of recency of self-harm, however perfectionistic self-presentation will not: As perfectionistic cognitions- that is, thoughts, as distinct from attitudes and personality vulnerabilities- are posited to be a state, rather than trait dimension of perfectionism (Flett, Hewitt, Whelan & Martin, 2007), we hypothesised that we may see a difference in the presence of perfectionistic cognitions with recency of self-harm. We would not however expect to see such a difference in perfectionistic self-presentation, due to it being characterised as a stable trait manifestation of perfectionism. Self-criticism has been established as a robust correlate of self-harm behaviour, but if or how this varies with self-harm recency has, to our knowledge, never been explored. Thus we made no specific prediction about the effect of recency of self-harm upon self-criticism.

4) *How do emotional and physical pain sensitivity in self-harm relate to other factors associated with self-harm and psychological distress, specifically perfectionism and self-criticism?*

No research to date has investigated the relationship between perfectionism and emotional and physical pain in self-harm, therefore we made no specific predictions regarding this. Recent research (Glenn et al., 2014; Hooley et al., 2010) has suggested that being more self-critical is associated with increased tolerance for physical pain in non-suicidal self-harm, but the research evidence for this is sparse. Furthermore, there has been no research on this in individuals who have engaged in suicidal self-harm, therefore we did not formulate specific hypotheses relating to self-criticism and emotional and physical pain.

5.2 Methods

5.2.1 Participants

Three hundred and fifty-one healthy adults from a Scottish University took part in the study. The mean age of the participants was 19.8 (SD: 4.2) years and 70% of the sample was female. No data on the ethnicity of the sample were collected. The study was anonymous and conducted via the internet, therefore we cannot be sure of participants' ethnicity, however the majority of students within the university are White. A small percentage of the sample (13.4%) reported that they had a current or lifetime diagnosis of a mental health issue, 86% reported no current or lifetime diagnosis and 0.6% did not answer this question.

5.2.1.1 Procedure

The study received ethical approval from the University of Stirling Psychology Department Ethics Committee. Participants signed up for the study via the University's online experiment management system and all received course credit for their participation. Upon signing up, all participants were directed to a secure third-party website where they first gave written informed consent via computer and following this they were presented with a battery of online questionnaires to be answered anonymously.

5.2.2 Measures

5.2.2.1 Self-harm thoughts and behaviours

Four questions modified from the UK Adult Psychiatric Morbidity Survey (McManus, Meltzer, Brugha, Bebbington & Jenkins, 2009) were used. Two questions to assess non-suicidal self-harm thoughts and behaviours: "Have you ever thought about deliberately harming yourself in any way but not with the intention of killing yourself?" and "Have you ever actually deliberately harmed yourself in any way but not with the intention of killing yourself?" and two questions regarding suicidal self-harm thoughts and behaviours "Have you ever thought of taking your life, even though you would not actually do it?" and "Have you ever made an attempt to take your life, by taking an overdose of tablets or in some other way?". (A more detailed description of this measure is given in Chapter 3 section 3.1.7.1). No specific data were recorded on the type of self-harm behaviours participants had engaged in, or the frequency with which they had self-harmed.

5.2.2.2 Emotional pain sensitivity

The 21-item Emotional Reactivity Scale (ERS; Nock, Wedig, Holmberg and Hooley, 2008) was used as a measure of sensitivity to emotional pain. Example items include "my feelings get hurt easily" and "my emotions go from neutral to extreme in an instant". Internal consistency was very good (α= .95; A more detailed description of this measure is given in Chapter 3 section 3.1.4.3.3).

5.2.2.3 Physical pain distress and sensitivity

Physical pain distress was assessed by administration of the 26-item Pain Distress Inventory (PDI; Osman et al, 2003) and self-perceived sensitivity to physical pain was measured using the pain sensitivity subscale (e.g. "I have difficulty thinking straight when I am in pain" and "I am terrified about being in pain"). Overall internal consistency for this sample was very good (α= .95) as was the case for the sensitivity subscale (α=94; A more detailed description of this measure is given in Chapter 3 section 3.1.4.3.4).

5.2.2.4 Depressive Symptoms

The 21-item Beck Depression Inventory-II (BDI-II; Beck, Steer & Brown, 1996) was used to assess depressive symptoms (e.g. sadness and self-dislike). Due to a technical issue, 285 of the participants completed only 19 items of the BDI[4], whereas 66 completed the full 21-items. The 19 item version was used for all analyses and still demonstrated very good internal consistency (α = .92; a more detailed description of this measure is given in Chapter 3 section 3.1.3.1).

5.2.2.5 Perfectionistic Cognitions

Presence and level of perfectionistic cognitions were measured with the Perfectionistic Cognitions Inventory (PCI; Flett, Hewitt, Blankstein & Gray, 1998). Example items include "People expect me to be perfect" and "I should never make the same mistake twice". Internal consistency of the PCI was high in this sample (α= .95). (A more detailed description of this measure is given in Chapter 3 section 3.1.4.1.1).

[4] Items 3 (past failure) and 6 (punishment feelings) were the two missing items from the BDI-II.

5.2.2.6 Perfectionistic Self-Presentation

The extent to which dispositional perfectionism is expressed interpersonally was measured using the Perfectionistic Self-Presentation Scale (PSPS; Hewitt et al, 2003). Example items include "I try always to present a picture of perfection" and "Failing at something is awful if other people know about it". Internal consistency for the scale as a whole was very good (α= .94; a more detailed description of this measure is given in Chapter 3 section 3.1.4.1.1).

5.2.2.7 Self-Critical Style

The 8-item Self Rating Scale (SRS; Hooley, Ho, Slater & Lockshin, 2010) was used to measure feelings of self-criticism (e.g. "I am socially inept and socially undesirable" and "Others are justified in criticizing me."). Internal consistency was very good (α= .90). A more detailed description of this measure can be found in Chapter 3 section 3.1.4.1.1.

5.2.3 Statistical analyses

We employed a series of Jonckheere-Terpstra non-parametric trend tests to investigate the predicted ordered effects within the emotional and physical pain sensitivity and physical pain distress results: self-harm enactment> self-harm ideation> controls (O'Carroll, Drysdale, Cahill, Shajahan & Ebmeier, 1999). To examine the effect of recency of self-harm upon emotional and physical pain sensitivity, cases were selected if they had reported ever engaging in self-harm, then a dummy variable was created for recency and used in the linear regression. This was also the case when exploring the effect of self-harm recency upon presence of perfectionistic cognitions, perfectionistic self-presentation and self-criticism. Univariate linear regressions were conducted for each potential correlate of emotional or physical pain sensitivity and those that were significant were then entered into multivariate linear regressions. In order to probe whether or not there were differential findings between participants who endorsed having engaged in self-harm with suicidal intent, and those who reported never having suicidal intent during self-harm, analyses were also run excluding participants who reported a lifetime suicide attempt. In all but the following cases there were no changes in the significance or direction of the results: physical pain sensitivity, correlates of physical pain sensitivity, and the effect of recency of self-harm upon perfectionistic cognitions, perfectionistic self-presentation and self-criticism. Therefore, all other results reported here are irrespective of suicidal intent,

save for the Jonckheere-Terpstra analysis of physical pain sensitivity, the linear regression analyses of variables associated with pain sensitivity and the linear regressions analyses of recency of self-harm and its relationship to perfectionism and self-criticism. Data were analysed using SPSS v21 for Windows.

5.3 Results

Demographic and self-harm characteristics of the sample are reported in Table 5.1. Of the 351 individuals in the sample, 28% reported self-harm ideation (n=98), 28% reported self-harm enactment (n=97) and 44% endorsed no lifetime history of ideation or enactment (n=156). There were no significant differences between the groups in age, F (2, 338) = 1.79, *ns*, or gender, χ^2 (2) = 1.76, *ns*. Within the self-harm enactment group, 27% reported having made a previous suicide attempt with or without NSSI (n= 26) and 73% reported engaging only in NSSI (n=71). Only seven individuals reported having made a previous suicide attempt in the absence of NSSI behaviour. The majority of individuals within the self-harm ideation group reported experiencing only suicidal thoughts (n= 54), whereas only 15 individuals reported exclusively NSSI thoughts and 29 reported thoughts of both suicidal and non-suicidal self-harm.

Table 5.1

Demographic and self-harm characteristics

	Control *n*= 156	Self-harm ideation *n*= 98	Self-harm enactment *n*= 97
Gender			
Females	111	63	70
Males	44	34	26
Age *M*(SD)	15.50 (23.43)	18.77 (12.83)	16.63 (17.18)
Thoughts of suicide only (%)		55.1	
Thoughts of NSSI only (%)		15.3	
Thoughts of NSSI and suicide (%)		29.6	
Previous suicide attempt (%)			26.8

There were no significant differences between the groups in age F (2, 338) = 1.79, ns or gender χ2 (2)= 1.76, ns

In terms of the recency of participants' self-harm behaviours, most had self-harmed more than one year ago (n= 42), with the remainder having engaged in self-harm within the past year (n= 39) or the past week (n= 16).

5.3.1 Emotional pain sensitivity

In order to assess whether sensitivity to emotional pain exhibited an ordered effect, such that emotional pain sensitivity was greatest in the self-harm enactment group, followed by self-harm ideation and then controls, with the lowest sensitivity to emotional pain, a Jonckheere-Terpstra trend test was performed. Results showed a significant ordered effect: self-harm enactment>self-harm ideation>controls, Jonckheere-Terpstra Z= 5.98, *p*=.001. See Figure 5.3. Mean scores were 38.73 (SD 19.68), 35.06 (SD 15.26) and 26.07 (SD 16.06) for enactment, ideation and control groups, respectively.

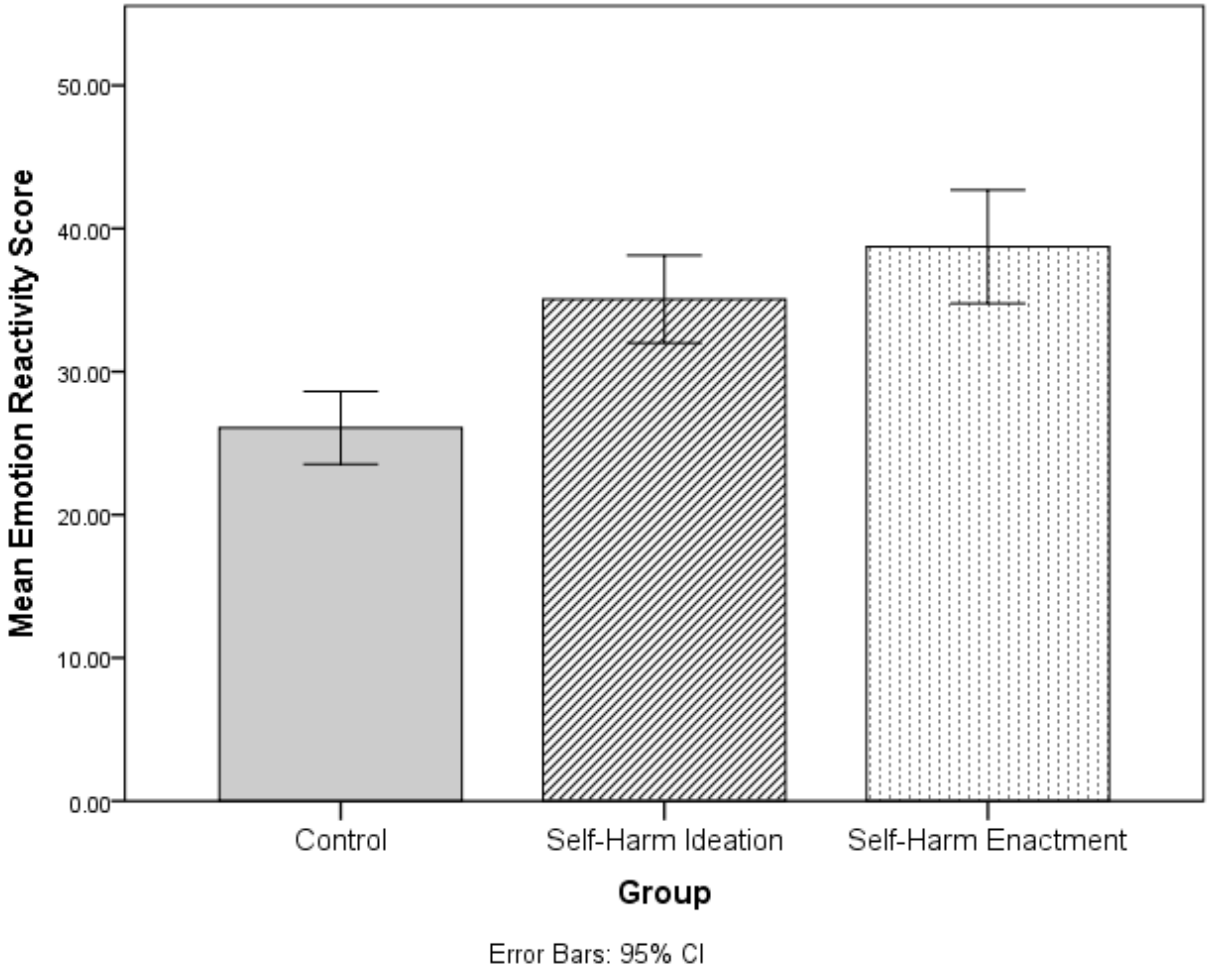

Figure 5.3. Emotion reactivity is higher in both the self-harm ideation and self-harm enactment groups relative to controls and demonstrates a significant ordered effect: self-harm enactment> self-harm ideation> controls.

5.3.2 Physical pain distress and sensitivity

Similar to the analysis for the effect of group upon emotional pain sensitivity, a Jonckheere-Terpstra trend test was employed. This demonstrated a significant ordered effect: the enactment group demonstrated the greatest self-reported physical pain distress, followed by the ideation group and then controls, with the least physical pain distress, Jonckheere-Terpstra Z= 4.10, *p*=.001. See Figure 5.4. Mean scores were 42.38 (SD 18.91), 39.88 (SD 20.99) and 31.95 (21.04) for enactment, ideation and control groups, respectively.

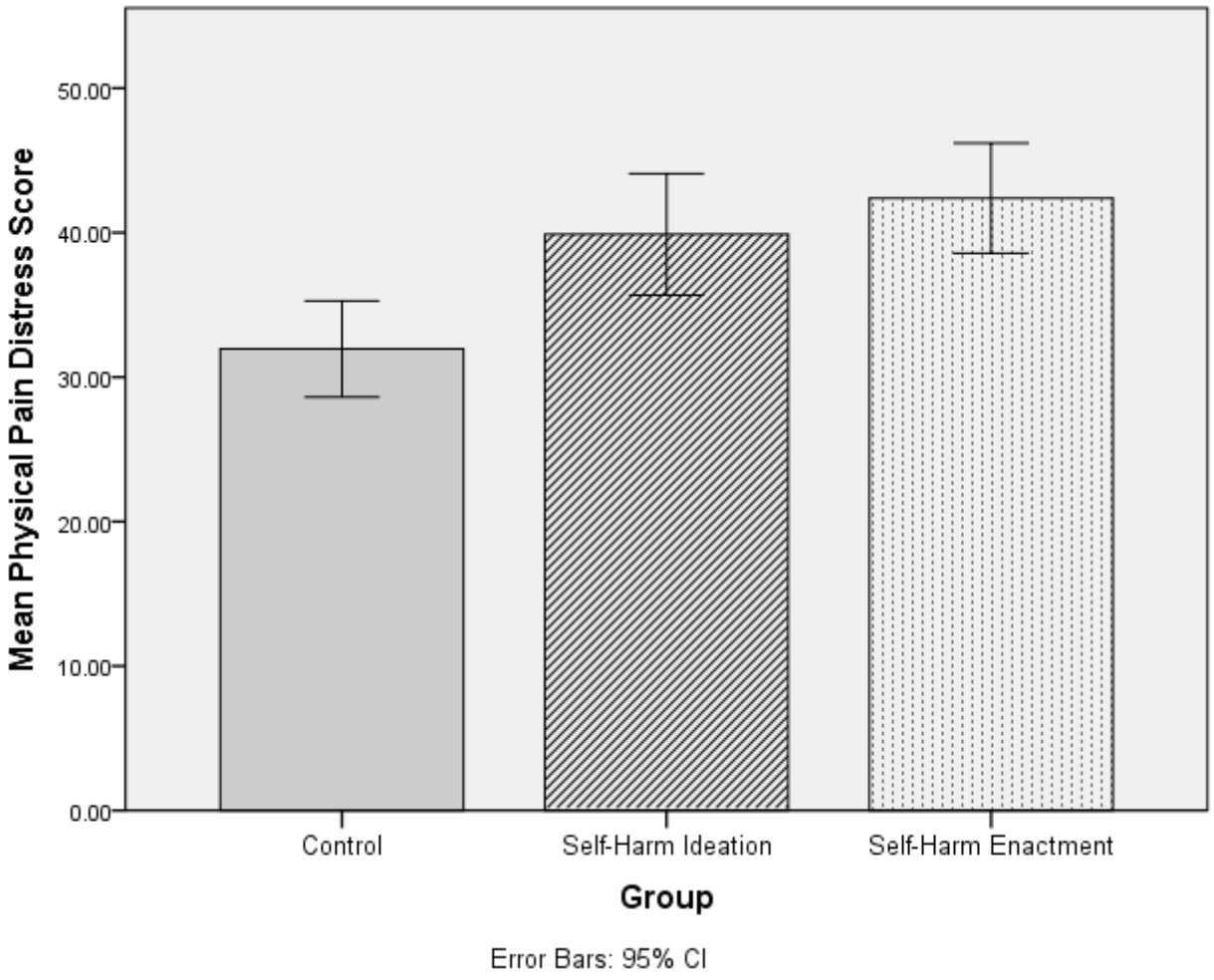

Figure 5.4. Physical pain distress is higher in both the self-harm ideation and self-harm enactment groups relative to controls and shows a significant ordered effect: self-harm enactment> self-harm ideation> controls.

Examination of the pain sensitivity subscale revealed that there was no significant ordered effect in pain sensitivity across the three groups, Jonckheere-Terpstra Z= 1.68, *ns*. However, when those reporting a previous suicide attempt were removed from the

analysis, a significant ordered effect emerged for physical pain sensitivity, with those in the self-harm enactment reporting greatest pain sensitivity, followed by the ideation group and then controls, Jonckheere-Terpstra Z= 2.09, *p*=.037. See Figure 5.5 below. Mean scores were 7.58 (SD 7.08), 7.41 (SD 6.45) and 5.75 (SD 5.85) for the enactment, ideation and control groups, respectively.

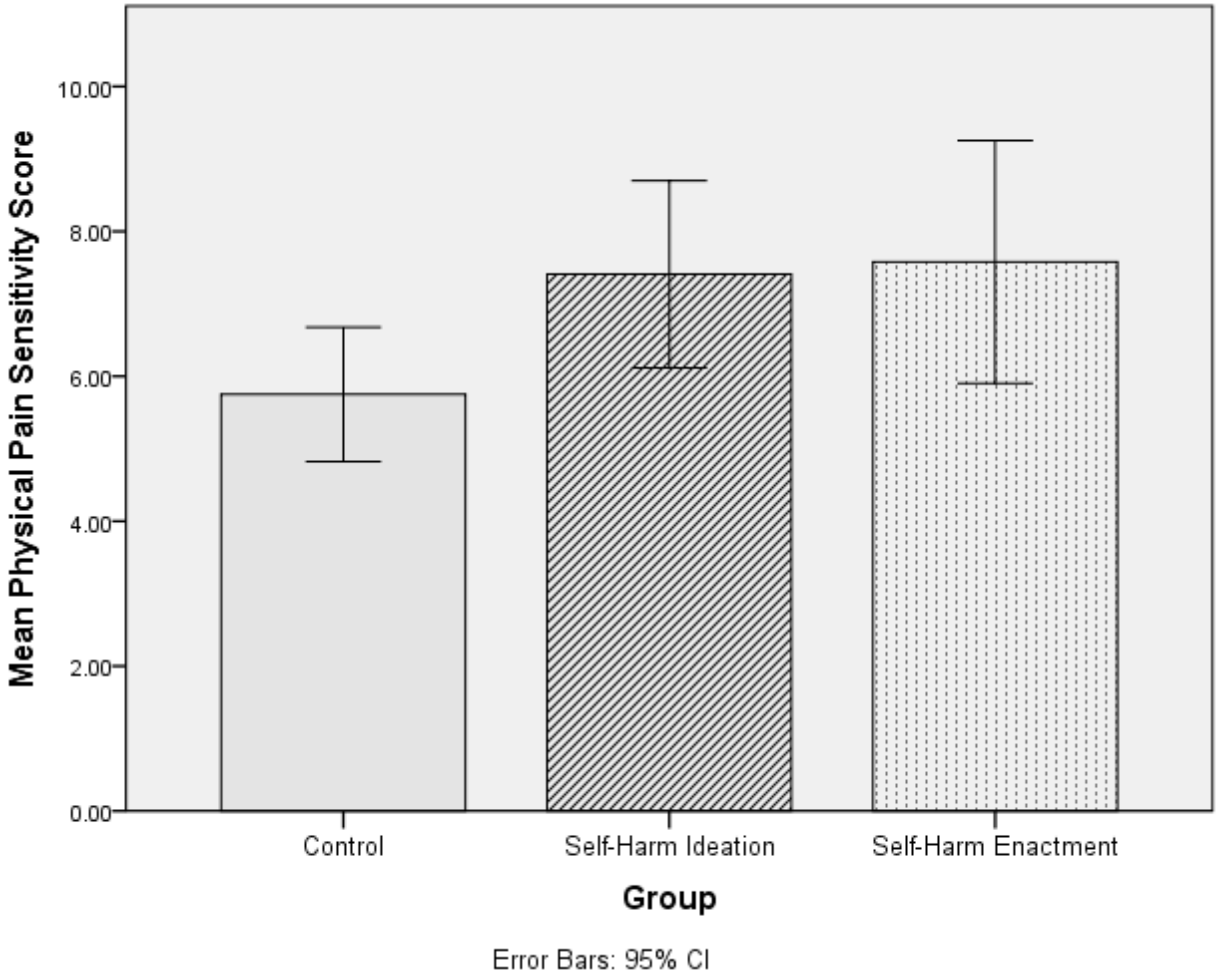

Figure 5.5. Physical pain sensitivity was significantly higher in the self-harm ideation and enactment groups relative to controls and there was a significant ordered effect (when controlling for past suicide attempt): self-harm enactment> self-harm ideation> controls.

5.4 Recency of self-harm

5.4.1 Emotional and physical pain sensitivity

Within the self-harm enactment group, a dummy variable was used to dichotomise recency of self-harm into recent (within the last year) or more distant (>1 year ago) and then entered into a linear regression. Recent self-harm was significantly associated with higher levels of emotional pain sensitivity, relative to previous self-harm, β= .299, t (94) = 2.98, *p*= .004 (95% CI: 3.99 – 19.88), see Figure 5.6. Such an association did not, however,

exist between recency of self-harm and physical pain distress, β= .200, t (94) = 1.84, *ns* (95% CI: -.629 - 15.9) or pain sensitivity, β=.-.099, t (94) = -.915, *ns* (95% CI: -4.32 – 1.60).

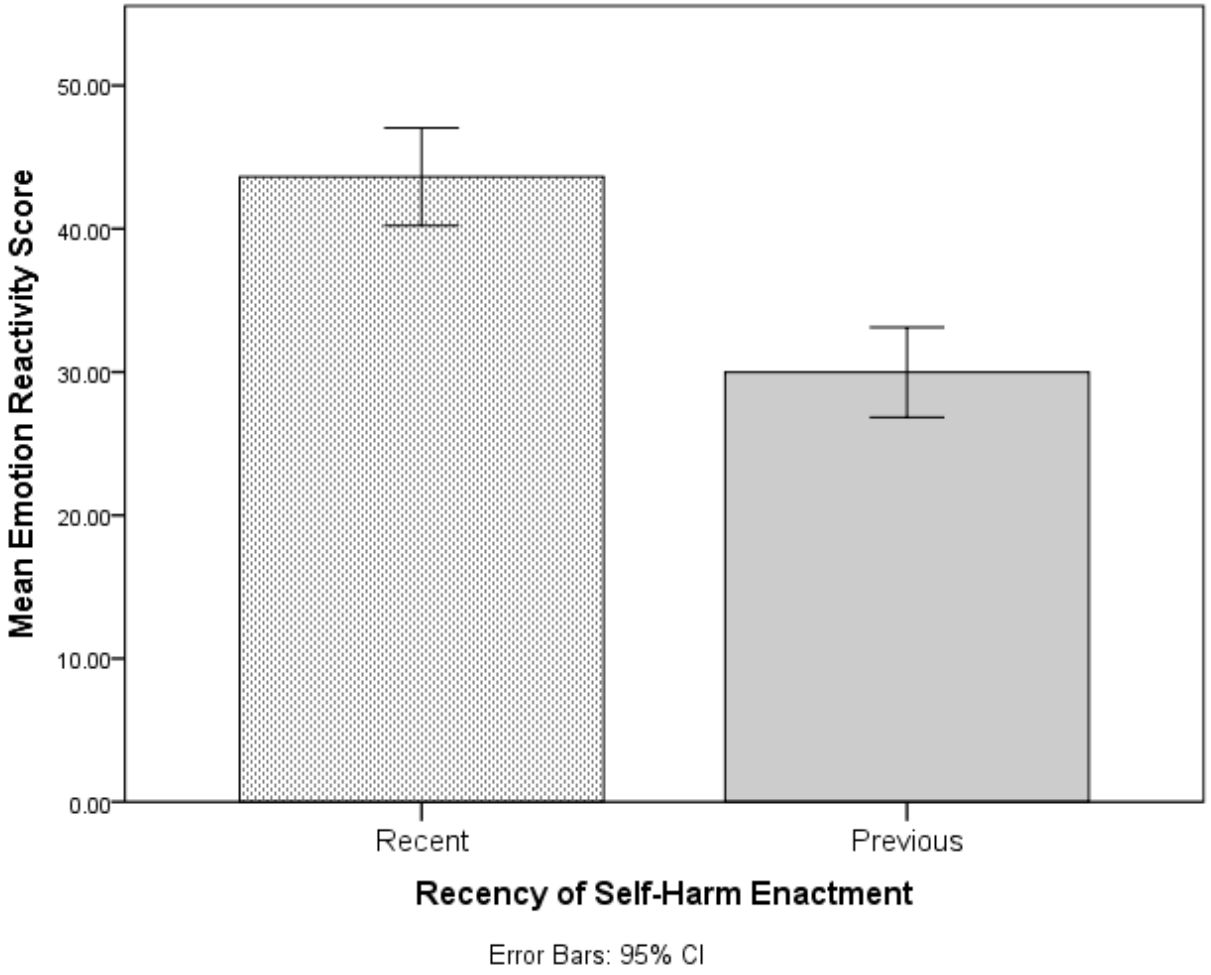

Figure 5.6. Higher emotional pain sensitivity was significantly associated with more recent self-harm enactment.

5.4.2 Perfectionistic cognitions

More recent self-harm was associated with greater presence of perfectionistic cognitions, with those who had self-harmed within the last week demonstrating higher scores on the perfectionistic cognitions inventory, relative to those who had self-harmed more than one year ago, β= .216, t(94)= 2.01, *p*=.048 (95% CI: .124 - 22.13. Those who had engaged in self-harm behaviour within the last month, demonstrated a trend towards higher levels of perfectionistic cognitions, although this was not statistically significant, β= .198, t(94) = 1.84, *p*= .069 (95% CI: -.609 – 16.05). When individuals reporting a previous suicide attempt were removed from the analysis, there was no significant effect of recency upon

presence of perfectionistic cognitions for either the past week β= .149, t(68)= 1.19, *ns* (95% CI: -6.48 – 25.55) or past year group β= .111, t(68)= .884, *ns*, (95% CI: -5.36 – 13.89), compared to those who had self-harmed longer ago.

5.4.3 Perfectionistic self-presentation

Those who had self-harmed within the last week scored significantly higher on perfectionistic self-presentation than those who had self-harmed more than one year ago and this difference was statistically significant, , β= .270, t(94)= 2.53, *p*= .013 (95% CI: 4.53 – 37.69). However there were no significant differences in perfectionistic self-presentation between those who had self-harmed within the last year and those who had self-harmed longer ago, β= 1.64, t(94) = 1.53, *ns* (95% CI: -2.86 – 22.24). Once again, when those who had reported a previous suicide attempt were removed, all differences were reduced to non-significance for the past week, β= .188, t(68) = 1.51, *ns* (95% CI: -5.68 – 40.67) and past year groups, β= .034, t(68) = .034, *ns* (95% CI: -12.04 – 15.82).

5.4.4 Self-criticism

Those who had self-harmed more recently were more self-critical; both for those who had self-harmed within the past week, compared to more than one year ago, β= .369, t(94) = 3.58, *p*= .001 (95% CI: 5.67 – 19.76) and those who had self-harmed within the last year, relative to longer ago, β= .272, t(94) = 2.64, *p*= .010 (95% CI: 1.77 – 12.43). This effect only remained significant for the past week group, when removing suicidal individuals from the analysis, β= .327, t(68) = 2.75, *p*= .008 (95% CI: 3.68 – 23.23. Differences in self-criticism as a function of self-harm recency were reduced to non-significance when controlling for past suicide attempts, β= .227, t(68)= 1.907, *ns* (95% CI: -.260 – 11.49).

5.4.5 Correlates of emotional pain sensitivity

Potential correlates of emotional pain sensitivity were investigated separately in the self-harm ideation and enactment groups. Intercorrelations between variables across all three groups are shown in Table 5.2. In univariate linear regression analyses, all variables, apart from gender and age were significantly associated with emotional pain sensitivity in the ideation group, all $p<.05$, and the enactment group, all $p<.01$. Higher emotional pain sensitivity score correlated with higher physical pain distress and sensitivity, greater

depressive symptoms, more perfectionistic self-presentation, greater presence of perfectionistic cognitions and higher levels of self-criticism/feelings of worthlessness (self-rating score).

Table 5.2
Intercorrelations between variables across all groups

	1	2	3	4	5	6	7	8	9
1. Gender	1								
2. Age	.034	1							
3. ERS	.007	.091	1						
4. PDI	.009	.042	.503**	1					
5. PDI-Sensitivity	-.009	.048	.345**	.779**	1				
6. SRS	.064	.066	.556**	.401**	.229**	1			
7. PCI	.102	.036	.354**	.279**	.210**	.334**	1		
8. PSPS	.158**	.058	.431**	.375**	.345**	.534**	.358**	1	
9. BDI-II	.091	.107*	.468**	.400**	.184**	.716**	.348**	.468**	1

ERS Emotional Reactivity Scale; *PDI* Pain Distress Inventory; *PDI-Sensitivity* Pain Distress Inventory- Sensitivity subscale; *SRS* Self-Rating Scale; *PCI* Perfectionistic Cognitions Inventory; *PSPS* Perfectionistic Self-Presentation Scale; *BDI-II* Beck Depression Inventory-II. *Correlation significant at .05 level. ** Correlation significant at .001 level.

All variables that emerged as significant in the univariate analyses were then entered into a multivariate linear regression (see Table 5.3). Within the ideation group, being more self-critical and having higher physical pain distress were the only variables significantly associated with higher emotional pain sensitivity. Greater depressive symptoms and presence of perfectionistic cognitions were the only variables associated with emotional reactivity in the enactment group.

Table 5.3

Regression coefficients, p values and 95% confidence intervals for multivariate linear regressions with emotional pain distress score as the outcome variable

	β	*p*	95% CI	
Ideation				
Perfectionistic cognitions	-.008	.157	-2.196	17.786
Self-rating	.339	.004*	-.140	.127
Physical pain distress	.399	.001*	.162	.418
Perfectionistic self-presentation	.004	.974	-.111	.115
Depressive symptoms	.078	.455	-.215	.475
Enactment				
Perfectionistic cognitions	.249	.004*†	.083	.424
Self-rating	.158	.229	-.154	.637
Physical pain distress	.065	.453	-.111	.248
Perfectionistic self-presentation	.125	.163	-.035	.204
Depressive symptoms	.311	.016*	.104	.997

**Significant at .05*

† Remained significant when those reporting a previous suicide attempt were removed from analyses.

5.4.6 Correlates of physical pain distress and sensitivity

For the ideation group, all variables except age and gender emerged from the univariate linear regressions as significantly associated with physical pain distress, all $p<.01$. When these variables were entered into a multivariate model however, only emotion reactivity remained significant, $\beta= .451$, $t(92) = 4.493$, $p= .001$, 95% CI: .346 - .895. No variables were significantly associated with physical pain sensitivity in either univariate or multivariate analyses for the ideation group. Within the enactment group, age was the only variable not associated with physical pain distress in the univariate analyses, all others were significant $p<.05$. None remained significant once entered into a multivariate model. For pain sensitivity, perfectionistic cognitions and self-criticism emerged as significant in the univariate analyses, both $p<.05$, however only presence of perfectionistic cognitions remained significant in multivariate analyses. When those participants reporting a previous suicide attempt were excluded, perfectionistic cognitions became non-significant, but self-criticism emerged as significantly associated with physical pain sensitivity.

5.5 Discussion

The current study is, to the best of my knowledge, the first investigation of the relationship between emotional and physical pain sensitivity in self-harm ideation and enactment. Our findings show that emotion reactivity is increased in those who have engaged in self-harm, relative to controls, consistent with previous research (Glenn et al., 2011; Nock et al., 2008). They also extend our knowledge by demonstrating that emotion reactivity is also elevated in those who have thought about, but never engaged in self-harm.

5.5.1 Emotional pain sensitivity

The predicted ordered effect (self-harm enactment> self-harm ideation> controls) for emotional pain sensitivity was significant and suggests that increasing sensitivity to emotional pain may accompany a transition from thinking about self-harm, to acting on those thoughts. However, the difference in mean scores between the ideation and enactment groups was small; therefore other factors may also be important in differentiating those who ideate, from those who enact. There were no significant differences in the pattern of emotional pain sensitivity across the three groups when

controlling for previous suicide attempts, suggesting that these findings may extend to suicidal self-harm as well as NSSI.

5.5.2 Physical pain sensitivity

A less clear picture emerges when trying to interpret the physical pain results. Once again we found a significant ordered effect (self-harm enactment>self-harm ideation>controls), however this was in the opposite direction to our prediction. The overall pain distress score was highest in the enactment group, then the ideation group and then controls. Upon closer examination of the subscale results, pain sensitivity did not differ significantly between any of the three groups, however, when those reporting a previous suicide attempt were removed from the analyses, a significant ordered effect emerged, but again, in the opposite direction to our prediction (self-harm enactment>self-harm ideation>controls). This is a particularly striking result because it contradicts the majority of previous behavioural research on physical pain sensitivity in self-harm, which has generally found that those who have engaged in NSSI or have made previous suicide attempts have a much *lower* sensitivity to physical pain than controls (Hooley & St Germain, 2014; Orbach et al., 1997). This suggests that there is a difference between self-perceived pain sensitivity and behavioural sensitivity in those who have engaged in self-harm. A number of previous studies have suggested that the majority of individuals report that they do not experience pain during self-harm (e.g. Kemperman et al., 1997; Russ et al, 1992). As the pain sensitivity scale did not assess participants' physical pain sensitivity during self-harm or during a behavioural self-harm proxy, this measure may in fact speak more to individuals' *anticipation* of pain rather than their experienced sensitivity. Additionally, the majority of questions that comprise the pain sensitivity subscale relate to fear of pain, e.g. "I am terrified of being in pain". We also urge caution when interpreting the ordered effect in the pain sensitivity results as the means for the enactment and ideation groups were similar and standard deviations were high.

5.5.2.1 Physical pain sensitivity in suicidal and non-suicidal self-harm

Given that the difference between groups for pain sensitivity only emerged when controlling for prior suicide attempts within the enactment group, it is perhaps therefore surprising in the initial analysis (including both NSSI and suicidal self-harm) that scores on this scale were not lower for the enactment group than for the ideation or control groups, given that decreasing fear of and aversion towards pain are said to be key components of

acquired capability for suicide (Joiner, 2005; Van Orden et al., 2010). This heightened self-reported fear of pain could potentially suggest that those who self-harm with suicidal intent are not necessarily aware of their increased capability. As these differences were small, it would seem then that differences in other types of pain cognitions may be driving the significant overall difference in pain distress between the control and self-harm groups. These results may be indicative that the difference in individuals' perception of their pain distress relative to their behavioural sensitivity, results from the altered cognitions that are present during psychological distress (Anestis et al., 2012). Those who think about and engage in self-harm may underestimate their own internal resources for coping with physical pain, thus leading to higher self-reported physical pain distress relative to behavioural sensitivity. The elevated levels of self-reported physical pain distress observed in the self-harm ideation group may support this, suggesting that cognitions regarding the ability to withstand physical pain begin to become distorted around the onset of self-harm ideation, before an individual has ever engaged in self-harm.

A previous study by Lightsey, Wells, Wang, Pietruszka, Ciftci and Stancil (2008) found that the relationship between pain distress and negative affect in female college students was mediated by emotion oriented coping, whereby an individual concentrates on the negative feelings associated with a situation, such that greater use of emotion oriented coping was related to higher levels of pain distress. Emotion oriented coping is generally regarded in the extant literature as being deleterious and indicative of poor emotion regulation (Karekla & Panayiotou, 2011). Whilst we did not measure emotion oriented coping or regulation, our finding that emotion reactivity was significantly higher in both self-harm ideation and enactment groups than in controls, could suggest that higher pain distress is the result of a generally more emotion oriented, reactive response to distress, whether physical or emotional. It would also be consistent with recent research which reported decreased emotion regulation in NSSI, independent of emotion reactivity (Davis et al., 2014).

5.5.3 Emotional pain sensitivity and self-harm recency

Emotional pain sensitivity appears to be subject to temporal variations, with those who had engaged in self-harm within the last year exhibiting higher emotion reactivity than those whose last episode of self-harm was longer ago; a similar pattern to that identified by Ludäscher and colleagues (2009) for physical pain sensitivity and self-harm cessation. Our findings also show that sensitivity to emotional pain is heightened in self-

harm ideation as well as enactment, although this is not significantly different between the two groups. Interpreting this within the context of the IMV (O'Connor, 2011), this potentially means that emotional pain sensitivity is a pre-motivational or motivational phase variable: conferring elevated risk for developing thoughts of self-harm, but not of translating those thoughts into actions. Additional support for this idea is that higher emotional pain sensitivity was also associated with being more self-critical and having greater presence of perfectionistic cognitions; self-criticism and perfectionism are both characterised as pre-motivational phase variables within the model.

5.5.4 Correlates of emotional pain sensitivity

The results that emerged from our analyses, however, did suggest that there were different correlates of emotional pain sensitivity for those who reported only self-harm ideation compared to those who had engaged in self-harm. Within the ideation group, higher emotional pain sensitivity was associated with higher physical pain distress and being more self-critical, but for the enactment group, only greater presence of perfectionistic cognitions and higher depressive symptoms were significantly associated with being more sensitive to emotional pain. Self-criticism has been characterised as a facet of evaluative concerns perfectionism (O'Connor, 2007); therefore these findings may suggest that particular elements of perfectionism, when combined with high emotional pain sensitivity, are differentially associated with either ideation or enactment.

5.5.5 Self-harm recency and psychological correlates of physical and emotional pain sensitivity

Greater presence of perfectionistic cognitions was significantly associated with recency of self-harm, but only for those who had self-harmed very recently (within the last week). However when individuals reporting a past suicide attempt were removed from the analysis, this effect was no longer statistically significant. Thus it would seem that in this case, any differences in perfectionistic cognitions with self-harm recency were being driven by the small number of individuals reporting either mixed-intent or exclusively suicidal self-harm. This may suggest that suicidal and non-suicidal self-harm are differentially associated with perfectionistic cognitions, and possibly that an increase in perfectionistic automatic thoughts occurs around times of peak psychological distress. Group sizes were small however and precluded a direct comparison between those reporting suicidal self-harm and others who reported exclusively NSSI.

Contrary to our hypothesis, the more stable, trait manifestation of perfectionism, perfectionistic self-presentation, also differed significantly as a function of self-harm recency, but again only for those who had self-harmed within the last week. As was the case for perfectionistic cognitions, when those who reported a past suicide attempt were removed from the analysis, this effect was no longer significant for the past-week group and remained non-significant for the past year group.

Self-criticism was significantly higher for both past week and past year groups relative to those who had self-harmed longer ago, potentially indicating that self-critical cognitions may decrease once individuals have ceased self-harming. When controlling for those with a past suicide attempt, only self-criticism differed between the past week and longer ago groups. Even though this difference remained significant, these results ought to be interpreted with caution due to the large confidence intervals. Research using larger samples, yielding greater group numbers and increased statistical power, would allow fuller exploration of subgroup variations in psychological correlates of self-harm behaviours. To our knowledge, there has been no previous research examining whether self-criticism differs as a function of self-harm recency and based upon these results, we would tentatively suggest that this warrants further exploration. Recent research has posited that self-worth can be increased following a brief laboratory mood-manipulation in those who have engaged in NSSI (Hooley & St Germain, 2014) and dynamic fluctuations in self-critical style as a result of how recently individuals have self-harmed could be a crucial factor to control for when assessing the efficacy of such an intervention.

5.5.6 Correlates of physical pain sensitivity

There were also differences in the correlates of physical pain sensitivity within the enactment group when controlling for previous suicide attempts. Being more self-critical was only associated with physical pain sensitivity when those with prior suicide attempts were excluded, whereas within the mixed intent (but predominantly NSSI) sample, only perfectionistic cognitions were associated with pain sensitivity. Potentially this suggests a differential association between dimensions of perfectionism and pain sensitivity, depending upon suicidal intent. This knowledge could be particularly useful when attempting to develop interventions aimed at managing perfectionism, as attention may be able to be focused upon regulating particular components of perfectionism that are more closely associated with self-harm enactment as opposed to ideation and also with suicidal self-harm relative to NSSI. Our findings also further highlight the need to take into account individually specific risk factors when deciding upon a treatment plan. Future

research should attempt to further probe the relationship between perfectionism and self-harm ideation and enactment.

5.5.7 Limitations

The current study must be interpreted within the context of its limitations. The design was cross-sectional, therefore no inferences can be made about how emotional and physical pain sensitivity relate to future self-harm thoughts or behaviours. Also, it used self-report data, these may be subject to recall bias or demand characteristics, however as the questionnaires were all anonymous, this could perhaps have reduced participants' wish to report more socially desirable answers. In fact online self-report measures have often been found to elicit more truthful answers, particularly when the research topic is sensitive (Tourangeou & Yan, 2007). Whilst we have discussed the potential relationship between self-report and behavioural measures, these are inferences based upon comparison of our self-report data to extant behavioural research. To make more meaningful comparison of these two types of measures, it would be necessary to directly compare both self-report and behavioural measures of emotional and physical pain sensitivity within a single study and future research should investigate this. Additionally, the measure employed to assess self-reported sensitivity to physical pain within the current study, the Pain Distress Inventory (PDI; Osman et al., 2003), may have been measuring anticipation of pain, as opposed to actual real-time sensitivity; This measure was not completed whilst participants were experiencing pain and therefore may be more speculative of their anticipated reaction to pain. The self-harm enactment group in the present study was comprised of those who had engaged in NSSI, with or without a previous suicide attempt. Even though we controlled for this in the analyses and found (albeit with some exceptions) no significant difference in the findings irrespective of whether those with a suicide attempt were included, such statistical controls are not necessarily an adequate substitute for design controls, i.e. directly comparing those who have attempted suicide to those who have not. Unfortunately the current study lacked the necessary statistical power to perform subgroup analyses, directly comparing those who have thought about or engaged in suicidal behaviour with those whose thoughts and behaviours are non-suicidal in intent. Whilst some of those who engage in NSSI will never make a suicide attempt, there is evidence to suggest that a disproportionate number of those who have engaged in NSSI, will have also made a suicide attempt at some point (Nock, Joiner, Gordon, Lloyd-Richardson & Prinstein, 2006). Therefore even with a sample weighted heavily towards NSSI, this study improves our understanding of the factors that may precede suicidal thoughts or

behaviours. Given the likely heterogeneity within the groups, it would be helpful to employ larger samples of those reporting ideation and enactment to ensure sufficient statistical power for analyses comparing variables as a function of suicidal intent.

Despite these limitations, we feel that this study makes a novel contribution to the literature on the relationship between emotional and physical pain sensitivity and for the first time, presents analyses of this relationship and its correlates in self-harm ideation and enactment.

5.6 Conclusion

This cross-sectional, self-report study tested two competing hypotheses regarding the relationship between emotional and physical pain: that greater sensitivity to emotional pain would be associated with greater sensitivity to physical pain, consistent with the social neuroscience model of emotional and physical pain sensitivity and contrastingly, that greater sensitivity to emotional pain would be associated with reduced sensitivity to physical pain (social neuroscience model inconsistent). The findings of this study supported the social neuroscience model that being more sensitive to physical pain is associated with being more sensitive to emotional pain. The study also demonstrated, for the first time, that both individuals who had thought about self-harm and who had engaged in self-harm were more sensitive to both physical and emotional pain, relative to controls. Furthermore, the more recently an individual had self-harmed, the greater their sensitivity to physical and emotional pain. These results suggest that the cognitions around physical and emotional pain begin to become distorted even before an individual has ever engaged in self-harm behaviour. Within the context of the IMV (O'Connor, 2011), the findings indicate that there may be a role for emotional and physical pain sensitivity in the pre-motivational and motivational phases of the model, not just in the final volitional phase. The psychological correlates of emotional and physical pain sensitivity investigated in the current study yielded mixed findings and several were reduced to non-significance when individuals reporting a past suicide attempt were excluded. This may speak to key differences in psychological correlates of emotional sensitivity between suicidal and non-suicidal self-harm and potentially different psychological intervention targets for individuals experiencing peak periods of distress. It may also suggest that different interventions may be required depending upon whether participants engage in NSSI or suicidal self-harm. In sum, this study is the first to demonstrate that differences in self-perceived emotional and physical pain sensitivity extend beyond self-harm enactment, to

self-harm ideation and furthermore, suggests that these factors are related to self-harm recency as well as other psychological correlates such as perfectionism and self-criticism.

A key empirical question that arose as a result of these findings, was how self-reported sensitivity to emotional and physical pain in self-harm ideation and enactment related to behavioural sensitivity to emotional and physical pain. The following chapter details an experimental study designed to answer this question by employing a combination of behavioural and self-report measures of emotional and physical pain sensitivity in individuals reporting self-harm ideation and self-harm enactment, compared to healthy controls with no history of self-harm thoughts or behaviours.

Chapter 6: Sensitivity to physical and emotional pain in self-harm ideation and enactment: Does self-report predict behaviour?

Background

Previous research has suggested that both self-reported and behavioural sensitivity to emotional and physical pain may be altered in individuals who ideate about or enact self-harm behaviour. Hypersensitivity to social evaluation has been posited as a key component of emotional pain sensitivity. To this end, we explored the association between sensitivity to emotional pain and personality factors that confer a high degree of sensitivity to the social evaluations of others: perfectionism. The current laboratory study investigated, for the first time, the relationship between self-reported and behavioural sensitivity to emotional and physical pain in self-harm ideation and enactment, along with an exploration of the association between perfectionism and emotional pain sensitivity.

Methods

88 healthy adults took part in the laboratory study. During their lab visit, participants completed a battery of online questionnaires assessing self-reported emotional and physical pain sensitivity, physical pain distress, self-harm thoughts and behaviours, depressive symptoms, suicidality and three different measures of perfectionism: perfectionistic cognitions, perfectionistic self-presentation and socially prescribed perfectionism. Participants completed an impossible card-sort task as a measure of behavioural emotional pain sensitivity and also self-administered a pressure algometer to their finger, in order to assess behavioural physical pain threshold and tolerance.

Results

A significant predicted ordered effect for self-reported emotional pain sensitivity and physical pain distress was observed, self-harm enactment group > ideation group > controls. No significant between-group differences were found in behavioural measures of emotional or physical pain sensitivity, and the self-report and behavioural measures of these constructs did not exhibit a significant association with one another. All types of perfectionism were significantly correlated with self-reported, but not behaviourally indexed, emotional pain sensitivity.

Conclusions

Self-reported emotional and physical pain sensitivity are elevated in those who have engaged in self-harm behaviour and also those with self-harm ideation. Self-perceived sensitivity to both physical and emotional pain may be part of a wider pattern of cognitive distortions that occur before an individual ever engages in self-harm behaviour. The results do not, however, support the idea of elevated physical pain threshold and tolerance in self-harm, nor do they support heightened behavioural sensitivity to emotional pain in self-harming individuals. All three types of perfectionism were significantly correlated with self-reported emotional pain sensitivity, potentially indicating that perfectionism may play a key role in individuals' sensitivity to emotional pain.

6.1 Introduction

As discussed in the previous chapter, there have been a huge number of studies conducted testing the relationship between emotional and physical pain in past 10 years, contending that those who are more sensitive to physical pain are also more sensitive to emotional pain (Eisenberger et al., 2003). The vast majority of these studies have employed fMRI methods, with only a handful of behavioural studies investigating this relationship (Eisenberger et al., 2006). Previous work exploring emotional and physical pain sensitivity has almost exclusively focussed upon non-clinical populations and has included either self-report or behavioural measures of emotional and physical pain, but not both. In recent years the relationship between emotional and physical pain has garnered an increasing amount of attention within the field of self-harm research, where individuals who engage in self-harm behaviour frequently report that self-harm reduces the level of emotional pain that they are experiencing (e.g. Gratz, 2003; O'Connor, Rasmussen, Miles & Hawton, 2009). Thus the intersection between these two types of pain appears to be important and fertile ground for exploration when attempting to better understand how self-harm may bring about relief from unbearable psychological pain.

6.1.1 The relationship between emotional and physical pain in self-harm

The relationship between emotional and physical pain in self-harm is underexplored and indeed the study described in the previous chapter of this thesis represented the first attempt to directly explore the link between self-reported emotional and physical pain sensitivity in both self-harm ideation and enactment. The results of this study found a significant ordered effect for both emotional and physical pain sensitivity, such that both were highest in the self-harm enactment group, followed by the ideation group and then lowest in controls. These findings supported the social neuroscience model of emotional and physical pain sensitivity, demonstrating that those that were more sensitive to emotional pain were also more sensitive to physical pain. Within the context of previous research on emotional and physical pain in self-harm however, these results were in part contradictory. Behavioural studies have found physical pain tolerance to be elevated in self-harm (e.g. Franklin et al., 2013; Hooley, Ho, Slater & Lockshin, 2010), contrary to the finding that self-reported sensitivity to physical pain was in fact highest in the self-harm enactment group. Both behavioural and self-report studies, however, have found that sensitivity to emotional pain is heightened in those who engage in self-harm behaviours,

supporting the findings reported in the previous chapter (Nock & Mendes, 2008; Nock et al., 2008). The relationship between self-reported emotional and physical pain sensitivity was explored in the previous chapter (Chapter 5). Amongst those reporting self-harm ideation, physical pain distress and emotional pain sensitivity were significantly associated. However, within the self-harm enactment group, only presence of perfectionistic cognitions was associated with emotional pain sensitivity (Kirtley, O'Carroll & O'Connor, 2015; Chapter 5). The relationship between self-reported emotional and physical pain does appear to support the social neuroscience model, however the relationship between behavioural, emotional and physical pain has yet to be explored. Furthermore, how self-report and behavioural measures of emotional and physical pain relate to one another in individuals who think about or engage in self-harm, is as yet unknown.

6.1.2 Self-report and behavioural measures: How well do they relate to one another?

To my knowledge, no previous studies have examined the relationship between self-report and behavioural measures of emotional and physical pain in self-harm. Investigations of correlations between behavioural and self-report measures of emotional and physical distress tolerance in other populations have yielded mixed results. Anestis et al. (2012) found significant positive correlations between self-report and behavioural measures of physical pain tolerance, and between self-report measures of emotional and physical pain tolerance, in a non-clinical sample of individuals with disordered eating symptoms. No correlation, however, was found between self-report and behavioural measures of emotional pain tolerance, although the behavioural measure of pain tolerance was found to correlate with self-report measures of both emotional and physical pain tolerance (Anestis et al., 2012). Other studies have found that self-report measures of emotional and physical distress tolerance relate positively to one another, as is the case for behavioural measures of emotional and physical distress tolerance, however only modest correlations exist between self-report and behavioural measures (Bernstein, Marshall & Zvolensky, 2011). Comparatively, whilst previous research reported within this thesis has found the pattern of elevated self-reported emotional pain sensitivity to be broadly convergent with behavioural evidence of reduced distress tolerance (Gratz et al., 2011; Nock & Mendes, 2008), other studies have found there to be little relation between these two types of measure (Anestis et al., 2012; Bernstein et al., 2011). A further issue in the relationship between self-report and behavioural measures of distress tolerance is shared variance, i.e. the extent to which behavioural and self-report measures are assessing the same construct. An extensive

analysis by McHugh et al. (2011) compared numerous frequently employed self-report and behavioural measures of distress tolerance, and found that self-report measures correlated well with each other, and similarly for behavioural measures, however, behavioural and self-report measures exhibited no significant relationship with each other. Furthermore, the absence of a significant relationship between affective (e.g. social stress) and somatic (e.g. pain) behavioural measures of distress tolerance may suggest that distress tolerance measures are highly domain specific (McHugh et al., 2011). How self-report and behavioural measures of emotional and physical pain in self-harm ideation and enactment may relate to one another, if indeed at all, is therefore highly uncertain and is clearly a key area for future research to explore.

6.1.3 Correlates of emotional pain sensitivity

In addition to the key question of how self-reported and behavioural sensitivity to emotional and physical pain may relate to one another, there is also the question of whether or not there are other psychological correlates of emotional and physical pain sensitivity within this population. The study reported in Chapter 5 (Kirtley et al., 2015) detailed how higher levels of self-criticism and pain distress were associated with higher emotional pain sensitivity in the ideation group. Greater presence of depressive symptoms and perfectionistic cognitions however were the only variables associated with emotional pain sensitivity in the enactment group. Presence of perfectionistic cognitions were significantly associated with physical pain sensitivity in the enactment group, but when individuals reporting a previous suicide attempt were removed from the analysis, the correlation between physical pain sensitivity and perfectionistic cognitions was reduced to non-significance. Thus it would appear that individuals' history of suicide attempts may impact upon the strength of the relationship between perfectionism and physical pain sensitivity. Perfectionism in various operationalisations (self-criticism and perfectionistic cognitions) also seems to be a key correlate of emotional pain in self-harm ideation and enactment, respectively.

6.1.3.1 Emotional pain and perfectionism

Social neuroscience evidence suggesting a common neural circuitry for emotional and physical pain has raised questions regarding how such a shared mechanism may have come to exist. Eisenberger (2010) has posited that common neural mechanisms for emotional and physical pain may have evolved due to the threat that social rejection posed to survival in humans' early evolutionary history. Furthermore, Eisenberger suggests that hyper-

sensitivity to social evaluation may be a key component of emotional pain sensitivity. A particularly pernicious manifestation of high sensitivity to social evaluation is socially prescribed perfectionism, where one constantly feels as though one is failing to meet others' (often very unrealistic) high standards (Hewitt & Flett, 1991). Socially prescribed perfectionism has been consistently associated with psychological distress and particularly with self-harm (O'Connor, 2007). It has also been implicated in reducing individuals' stress thresholds, with highly socially perfectionistic adolescents exhibiting a greater likelihood of engaging in self-harm even when their perceived acute stress levels were low, relative to those with low levels of social perfectionism (O'Connor, Rasmussen & Hawton, 2010). The previous chapter explored emotional and physical pain sensitivity and their relation to two types of perfectionism: perfectionistic automatic thoughts (perfectionistic cognitions) and the need to constantly display oneself as perfect (perfectionistic self-presentation). In the present study, these investigations are extended to include socially prescribed perfectionism.

6.1.4 Emotional and physical pain sensitivity within the IMV

The Integrated Motivational-Volitional model of suicidal behaviour (IMV; O'Connor, 2011) is a recently proposed tripartite framework that characterises suicide as a process, from thoughts (ideation) to behaviours (enactment). The model is comprised of pre-motivational, motivational and volitional phases, relating, respectively, to predisposing triggering factors for suicidal ideation, the period of intention formation and lastly, behavioural enactment. For a full discussion of the IMV, see Chapter 1 section 1.3.1. Variables within the pre-motivational and motivational phases are not expected to differ between those who ideate about self-harm and those who enact self-harm behaviour, and it is factors within the final volitional phase of the model that are hypothesised to differentiate between those who will have only thoughts of self-harm and those who will go on to translate those thoughts into self-harm behaviour. The study presented in the previous chapter (Chapter 5; Kirtley et al., 2015) found no significant differences between the ideation and enactment groups in either self-reported emotional or physical pain sensitivity. Based upon this, it is suggested that self-perceived sensitivity to emotional and physical pain may be a pre-motivational or motivational phase variable within the IMV. The position of emotional pain sensitivity as a pre-motivational phase variable is further supported by its relation to perfectionism, another pre-motivational phase variable (O'Connor et al., 2012)

6.2 The Present Study

The current study aimed to ascertain the relationship, if any, between behavioural and self-report measures of emotional and physical pain sensitivity in self-harm ideation and enactment. The study also sought to test behavioural tolerance for physical and emotional pain, and to explore potential correlates of both self-reported and behavioural sensitivity to emotional and physical pain in self-harm ideation and enactment, specifically three different facets of perfectionism.

6.2.1 Research questions and hypotheses

1) *What is the relationship between physical pain sensitivity in self-harm ideation and enactment?*

Hypothesis 1.1: Behavioural threshold and tolerance for physical pain will exhibit an ordered effect, such that self-harm enactment> self-harm ideation> controls (greatest in the self-harm enactment group, then the self-harm ideation group, and least in the control group). It is predicted that behavioural pain threshold and pain tolerance will be significantly different between the three groups, such that pain threshold and tolerance will be higher in the self-harm enactment group, followed by the ideation group and then controls.

Hypothesis 1.2: Self-reported physical pain sensitivity and distress will demonstrate an ordered effect: self-harm enactment> self-harm ideation> controls. Consistent with the findings from the previous study of self-reported sensitivity to physical and emotional pain in self-harm ideation and enactment (see Chapter 5), it was hypothesised that self-reported physical pain sensitivity and distress would exhibit the reverse effect to behavioural pain sensitivity: that those in the self-harm enactment group would be most sensitive to physical pain and pain distress, followed by the self-harm ideation group and then controls.

2) *What is the relationship between emotional pain sensitivity in self-harm ideation and enactment?*

Hypothesis 2.1: Behavioural sensitivity to emotional pain will be highest in the self-harm enactment group, followed by the self-harm ideation group and lowest in the control group. Based upon previous literature (e.g., Nock & Mendes, 2008) describing reduced tolerance

of distress in individuals who self-harm, it was predicted that a lower level of distress tolerance would be observed in both the self-harm ideation and enactment groups.

Hypothesis 2.2: Self-reported sensitivity to emotional pain will exhibit a significant ordered effect, self-harm enactment> self-harm ideation> controls. This would be consistent with previous evidence demonstrating that emotional pain sensitivity was highest in the self-harm enactment group, followed by the ideation group and lowest in controls (Chapter 5).

3) *Do self-report and behavioural sensitivity to emotional and physical pain relate to one another in self-harm ideation and enactment?*

There has been little investigation of the relationship between behavioural and self-reported sensitivity to emotional and physical pain in self-harm enactment and no investigation of this whatsoever in self-harm ideation. Thus, no specific hypothesis was formulated regarding the relationship between behavioural and self-report measures of emotional pain sensitivity.

6.3 Methods

6.3.1 Participants

Eighty-eight healthy adults (mean age: 24.39 years old; SD: 8.46) recruited from the Greater Glasgow area took part in the study. Females comprised 61.4% (n= 54) of the sample, males, 34.1% (n= 30) and transgender/non-binary individuals (identifying as neither male nor female), 2.3% (n=2). One participant declined to state their gender/gender identity and one participant did not answer the question. Most individuals within the sample were students (75%), with the remainder being in employment (20.5%). One participant also fell into each of the following categories: retired; unemployed due to disability/incapacity; unemployed for 1-6 months; and unemployed for more than 6 months. The majority of participants were White (86.4%). A further 6.8% of the sample identified themselves as mixed race, 3.4% as Indian and one person in each of Chinese, other Asian and Black groups respectively. Within the sample, 39.8% had a lifetime diagnosis of a mental health condition, but the remaining 59.1% had no lifetime history of a mental health condition and one person declined to answer. This was in response to a "Yes/No" general health screening question for the pain tolerance task, regarding lifetime mental health diagnoses that asked about "depression; anxiety; borderline personality

disorder (BPD); eating disorder (anorexia/bulimia); other mental health problem". The majority of participants who endorsed a lifetime mental health diagnosis were in the enactment group (n= 24 vs. 15 without a lifetime diagnosis). An equal number of participants within the ideation group reported having a lifetime mental health diagnosis, as reported not having a lifetime diagnosis (n=9). Most of the participants in the control group reported no lifetime history of a mental health condition (n=28 vs. 2 with a lifetime diagnosis). Only participants who underwent a suicide risk assessment during the telephone screening interview or whilst in the lab were asked specifically about current mental health conditions. Of these participants, mental health diagnoses were: major depression (n=2); mild depression and anxiety (n=1); major depression and anxiety (n=4); major depression and PTSD (n=1); bipolar disorder (n=1); and borderline personality disorder (BPD; n=1). One participant reported a provisional diagnosis of major depression and anxiety, but was awaiting a final diagnosis from their clinician.

6.3.2 Procedure

The study received ethical approval from the College of Medicine, Veterinary and Life Sciences Ethics Committee at the University of Glasgow. Potential participants responded to study adverts posted online on community message boards and via social media, emailed out to members of the university subject pool and displayed on flyers around the university. Interested participants were asked to contact the researcher by telephone or email. The researcher then conducted a telephone screening interview with potential participants to ascertain their history of self-harm thoughts and behaviours and also to assess participants' current degree of suicide risk. For further details of the suicide risk assessment protocol, see Chapter 3 section 3.1.2.1 and Appendix B. Individuals who reported a lifetime history of self-harm thoughts, but who had never engaged in self-harm behaviour were recruited to the self-harm ideation group. Those who reported a lifetime history of self-harm behaviour were recruited to the self-harm enactment group and individuals who endorsed no lifetime history of self-harm thoughts or behaviours were recruited to the control group. Participants were invited to attend a one-hour lab session with the researcher where they would be asked to complete some questionnaires and brief problem-solving tasks. All participants gave written informed consent. They were informed that one of the tasks was a puzzle task that would involve matching cards based on different characteristics and that the other task would involve applying a small pressure device to one of their fingers. The order in which participants completed the distress tolerance task (DTT) and the pressure pain (algometer) task was counterbalanced within

each of the three groups: some individuals completed the DTT first, whereas others completed the algometer task first, and this order was varied on an alternate basis across participants. See Figure 6.1 below for flowchart of procedure. For all participants, the questionnaire battery was completed in between the other two tasks in order to prevent any carry-over effects from either the algometer task or the DTT. Once all experimental tasks had been completed, participants were asked "what did you think the solution was to the puzzle task?" in order to ascertain if they had guessed the task had no solution. This manipulation check question was only introduced once data collection had already begun, when the researcher observed that some participants seemed unconvinced that the task had a solution, and thus only 75/88 participants completed this question. If necessary, the researcher then completed a suicide risk assessment with the participant once the experimental protocol was complete and took steps to increase participant safety. All participants received a full debrief once the lab session had concluded and they were provided with a support sheet providing the contact details of local and national support organisations. Participants were paid £20 in cash for their time and travel expenses.

All participants consented to be contacted again one month after their lab visit for a follow-up telephone interview. Collection and analyses of these follow-up data were still ongoing at the time of thesis submission.

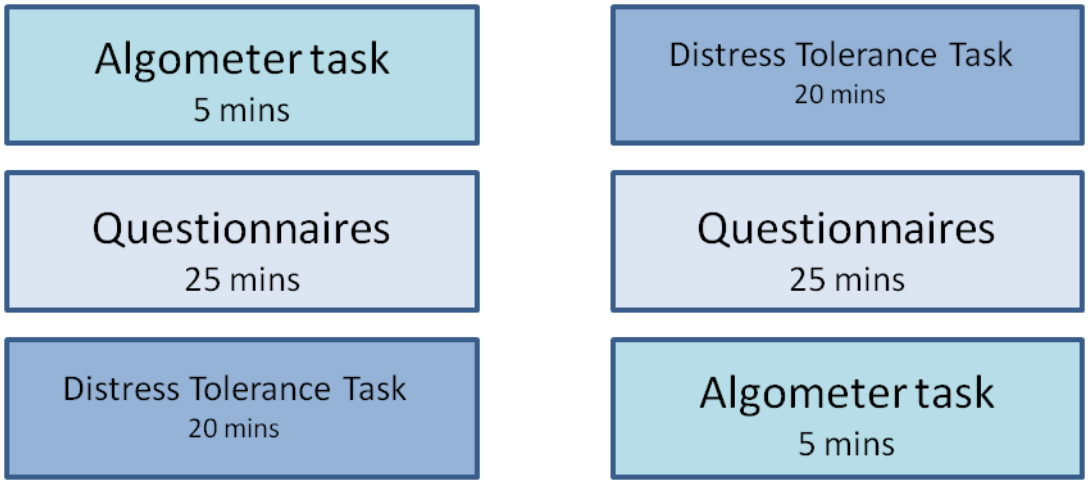

Figure 6.1. Procedure flowchart. Within each of the three groups: controls, self-harm ideation and self-harm enactment, participants were randomly allocated to receive one of two task presentation orders.

6.3.3 Measures

6.3.3.1 Self-report measures

A variety of self-report measures were used to assess participants' own evaluation of their emotional and physical pain sensitivity, as well as to collect information regarding participants' self-harm, suicidal ideation, depressive symptoms and scores on measures of perfectionism.

6.3.3.1.1 Self-harm

Self-harm thoughts and behaviours were assessed using four modified questions from the Adults Psychiatric Morbidity Survey (APMS: McManus et al., 2009). Presence of self-harm thoughts was confirmed by answering yes to one of two questions: "Have you ever thought about deliberately harming yourself in any way but not with the intention of killing yourself?" or "Have you ever thought of taking your life, even though you would not actually do it?" Individuals indicated that they had engaged in self-harm behaviour by answering yes to the questions "Have you ever actually deliberately harmed yourself in any way but not with the intention of killing yourself?" or "Have you ever made an attempt to take your life, by taking an overdose of tablets or in some other way?" A more detailed description of this measure can be found in Chapter 3 section 3.1.7.1.

6.3.3.1.2 Suicidal Ideation

Suicidal ideation was measured by administration of the 21-item Beck Scale for Suicide Ideation (SSI: Beck, Steer & Ranieri, 1988). Participants were asked to endorse one item from each of 21 groups of statements, e.g. "I have a moderate to strong wish to live; I have a weak wish to live; I have no wish to live". All participants answered the first five items and if they scored zero on questions regarding desire to live and taking steps to save their life, then proceeded to answer the following 16 questions. Further details of this measure are available in Chapter 3 section 3.1.7.1.

6.3.3.1.3 Emotional pain sensitivity

Self –reported sensitivity to emotional pain was measured using the 21-item Emotional Reactivity Scale (ERS; Nock, Wedig, Hooley & Holmberg, 2008). Example items include: "I experience emotions very strongly" and "my emotions go from neutral to extreme in an instant". Participants are asked to endorse the extent to which each item is "like them" on

a 0-4 scale from “not at all like me” to “completely like me”. Internal consistency for the ERS was very good, Cronbach’s α = .95. Further details about this scale can be found in Chapter 3 section 3.1.4.3.3.

6.3.3.1.4 Physical pain distress and sensitivity

The 26-item Pain Distress Inventory (PDI; Osman et al., 2003) was employed to measure participants’ pain distress and the sensitivity subscale was used to assess self-reported sensitivity to general physical pain, i.e. pain not specific to episodes of self-harm. Items from the PDI include: “When I am in pain, I feel more dizzy or lightheaded than usual” and from the pain sensitivity subscale, “I am terrified about being in pain”. Internal consistency for the PDI was high, Cronbach’s α = .95, as was the case for the pain sensitivity subscale, Cronbach’s α = .95. For further details of this measure, please see Chapter 3 section 3.1.4.3.4.

6.3.3.1.5 Pain during self-harm

One “yes/no/sometimes” question from the Inventory of Statements About Self-Injury (ISAS; Klonsky & Glenn, 2008) was included in order to assess whether or not participants experienced physical pain during self-harm. Further details about this measure can be found in Chapter 3 section 3.1.4.3.4.

6.3.3.1.6 Socially prescribed perfectionism

Social perfectionism was measured by administration of the 15-item Social subscale from the Multidimensional Perfectionism Scale (MPS-Social; Hewitt & Flett, 1991). Participants are asked to endorse the extent to which they agree or disagree with each statement on a 1-7 Likert-type scale. The MPS-Social includes items such as “the better I do, the better I am expected to do” and “people expect more from me than I am capable of giving”. Cronbach’s α for the MPS-Social was good (.87). Further details of this measure are provided in Chapter 3 section 3.1.4.1.1.

6.3.3.1.7 Perfectionistic cognitions

The presence of perfectionistic cognitions was measured by the 25-item Perfectionistic Cognitions Inventory (PCI; Flett, Hewitt, Blankstein & Gray, 1998). Participants are asked to indicate the frequency with which they have experienced the thoughts described in each statement, using a 0-4 scale. The inventory includes statements such as “I should be doing

more" and "I can't stand to make mistakes". The PCI exhibited a high level of internal consistency, Cronbach's α = .96. For more details about this measure, refer to Chapter 3 section 3.1.4.1.1.

6.3.3.1.8 Perfectionistic self-presentation

Perfectionistic self-presentation was assessed by means of the 27-item Perfectionistic Self-Presentation Scale (PSPS; Hewitt et al., 2003). The scale is composed of three subscales; Perfectionistic self-promotion, Nondisplay of imperfection and Nondisclosure of imperfection. Example items from each subscale include "I try always to present a picture of perfection", "I will do almost anything to cover up a mistake" and "I should always keep my problems to myself", respectively. Participants respond on a 1-7 scale, endorsing the extent to which they agree or disagree with each statement. Internal consistency was high, Cronbach's α = .95. Further details of this measure may be found in Chapter 3 section 3.1.4.1.1.

6.3.3.1.9 Depressive symptoms

The 21-item Beck Depression Inventory (BDI-II; Beck, Steer & Brown, 1996) was used to measure participants' depressive symptoms over the previous two weeks. Participants were presented with 21 groups of statements relating to domains of depressive symptoms, e.g. changes in sleeping pattern or loss of pleasure. Items from the BDI-II include: "I am not discouraged about my future", "I feel more discouraged about my future than I used to be", "I do not expect things to work out for me" and "I feel my future is hopeless and will only get worse. Within this study, the BDI-II demonstrated high internal consistency, Cronbach's α = .93. More detailed information about this measure is provided in Chapter 3 section 3.1.3.1.

6.3.3.1.10 Mood

Mood was measured using six items from the Positive and Negative Affect Scale (PANAS; Watson, Clark & Tellegen, 1988): interested, alert, irritable, distressed, ashamed and upset. Participants rated each item on a 1-5 scale from very slightly/not at all to extremely in relation to their feelings "right now, at the present moment". Mood was assessed at four points during participants' lab visit: baseline, post-questionnaire completion, post-distress tolerance task and post-algometer pain task. Assessments did not necessarily take place in this order however, due to the block randomisation of the distress tolerance task and

algometer task presentation. A detailed description of this measure is given in Chapter 3 section 3.1.7.2.

6.3.3.2 Behavioural measures

In addition to the self-report measures of emotional and physical pain sensitivity detailed in the previous subsections, the current study also included behavioural measures for comparison with their self-report counterparts.

6.3.3.2.1 Emotional pain sensitivity

In order to measure participants' sensitivity to emotional pain, the Distress Tolerance Task (DTT; Nock & Mendes, 2008) was employed. Participants were informed that they would be asked to complete a "brief problem-solving puzzle task" and were presented with four key cards laid upon the desk in front of them and a deck of 64 cards to be matched to the four key cards. The cards used in the DTT are the stimuli cards from the Wisconsin Card Sort Test (WCST) and depict four different shapes, in different colours and numerical arrangements. The experimenter reads out the task instructions from a script and then following commencement of the task, answers only "correct" or "incorrect" in a fixed order to participants' placement of the cards from the deck. Participants who terminate the task earlier are said to be less tolerant of distress than those who persist with the task for longer (Nock & Mendes, 2008). This task has been used in a number of previous studies investigating self-harm (e.g. Anestis & Joiner, 2012; Nock & Mendes, 2008) and disordered eating (Anestis et al., 2012). For further details of the DTT, see Chapter 3 section 3.1.4.3.3.

6.3.3.2.2 Physical pain threshold and tolerance

As for Study 1 (Chapter 4), pain threshold and tolerance were measured by means of a pressure algometer; a computer-linked pressure-meter that recorded the force exerted by the participants upon the end of a spring-loaded plunger. Response latency for both time (milliseconds) and pressure (kPA) were recorded for pain threshold and tolerance. Participants self-applied the algometer to the medial phalanx (middle joint) of their non-dominant hand and were asked to indicate the point at which they first felt the algometer as painful (pain threshold) and then the point at which they felt the pressure was too painful to continue (pain tolerance). At the pain threshold and pain tolerance points, participants were asked to "say now" and to "immediately remove the device from their finger". The

pressure and time for each trial were then recorded by the computer. Varying kinds of pressure algometers have been employed in numerous studies investigating pain and self-harm (e.g. Glenn et al., 2014; Hooley, Ho, Slater & Lockshin, 2010; McCoy et al., 2010). Further details of the pressure algometer are given in Chapter 3 section 3.1.4.3.4.

6.3.4 Statistical analysis

A range of statistical tests were employed in the current study. A series of nonparametric Jonckheere-Terpstra tests were used in order to investigate the predicted ordered effects for both behavioural and self-reported emotional and physical pain sensitivity. Jonckheere-Terpstra tests were employed due to their suitability for investigating trends where the specific order of the groups is expected to be meaningful (Field, 2013), such as when emotional pain sensitivity is anticipated to be highest in the self-harm enactment group, followed by the ideation group and then lowest in controls. Pearson's *r* correlations were used to assess the relationship between behavioural and self-report measures of emotional and physical pain sensitivity. The magnitude of these correlations was interpreted according to Evans' (1996) guidelines: .20 –.39 is weak, .40 - .59 is moderate, .60 - .79 is strong, and greater than .80 is very strong. It should be noted, however, that categorisation of linear relationships in this way is largely arbitrary and caution should be exercised in such interpretations. Linear regression analyses were used to explore the relationship between the three facets of perfectionism measured within this study (perfectionistic cognitions, perfectionistic self-presentation and socially prescribed perfectionism) and emotional pain sensitivity. Each variable was first entered individually into a univariate regression and those that emerged as significant were then included within a multivariate linear regression analysis. Behavioural physical pain data were positively skewed, therefore a log transformation was applied (Tabachnick & Fidell, 2014) and the results subsequently reported are from analyses of these transformed data. It should be noted, however, that there was no change in the pattern of statistical significance between the transformed and untransformed data, rather the transformations were applied in order that the data would better meet the assumptions of normality. Mixed measures ANOVA were employed to analyse the mood data, with time-point (baseline; post algometer task; post questionnaires; and post DTT) as the within-participants variable and group (control; self-harm ideation; self-harm enactment) as the between-participants variable. Post-hoc Bonferroni tests were used in order to further probe the results, and to reduce the likelihood of Type I error arising from multiple comparisons. Mauchly's test of sphericity was significant for both positive and negative mood, indicating that the assumption of

sphericity had been violated, and a Greenhouse-Geisser correction was applied. There has been some debate regarding the effect of violating sphericity assumptions upon the validity of post-hoc tests in repeated and mixed measures designs (Field, 2013), however, extensive investigation of this by Maxwell (1980) determined that Bonferroni was the most robust and reliable post-hoc test to use in such circumstances, comparing favourably to other tests.

Target sample size was determined using the 'pwr' package for R (Champely et al., 2015). A sample size of 135 (45 in each of the three groups) was determined to be adequate to detect a medium effect size (.30) at 80% power and an alpha level of .05. Difficulties in recruitment meant that unfortunately, the target sample size was not achieved, and therefore the results of this study should be interpreted within the context of this important limitation. Recruitment issues are discussed extensively in section 7.3.1.1 of the following chapter.

6.4 Results

Demographic and self-harm characteristics of the sample are provided in Table 6.1. The total sample size was 88, of which 30 were controls. There were 18 individuals in the self-harm ideation group and 40 in the self-harm enactment group. The final distribution of participants across the groups was slightly different to the group numbers derived from the initial phone screen interviews: 32 controls; 20 self-harm ideation and 36 self-harm enactment. This is something that the researcher and also other lab members have previously encountered, whereby some participants report additional self-harm thoughts or behaviours to that which they reported in the phone screen interview. Half of those in the ideation group reported mixed thoughts of both suicide and NSSI. Just under 40% reported experiencing only thoughts of suicide and a minority (11.1%) endorsed only thoughts of NSSI. 37.5% of individuals within the enactment group reported having made a previous suicide attempt. The majority of participants endorsed that they experienced pain during self-harm (45%) or that they sometimes experienced pain (47.5%). Only 7.5% of participants reported feeling no pain during self-harm.

Table 6.1

Participants' demographic and self-harm characteristics

Gender	Controls n= 30	Self-harm ideation n= 18	Self-harm enactment n= 40
Male	15	7	8
Female	15	11	28
Transgender/non-binary gender identity			2
Age M(SD)	22.10 (3.37)	27.94 (13.28)	24.60 (8.21)
Thoughts of suicide only (%)		38.9	
Thoughts of NSSI only (%)		11.1	
Thoughts of NSSI and suicide (%)		50	
Previous suicide attempt (%)			37.5
Feel pain during self-harm (%)			
No			7.5
Sometimes			47.5
Yes			45.0

In the enactment group, 1 individual did not indicate their gender/gender identity and another declined to state. There were no significant differences in age between the groups, $F(2, 82) = 2.65$, *ns*, or in gender. Two chi-square analyses were employed for this, a 2x3 using only male and female gender identity categories, $\chi^2(4)= 6.90$, *ns*, and a 3x3 using male, female and transgender/non-binary gender identity categories, $\chi^2(4)= 9.40$, *ns*. For the 3x3 analyses, one cell count was less than 5.

6.4.1 Self-reported emotional pain sensitivity

A Jonckheere-Terpstra test was employed to investigate the trend in self-reported emotional pain sensitivity for the control, self-harm ideation and self-harm enactment groups. A significant ordered effect was found across the three groups for self-reported emotional pain sensitivity, such that self-harm enactment> self-harm ideation> controls, Jonckheere-Terpstra Z = 5.23, p<.001. See Figure 6.2. Mean scores were 21.43 (SD: 12.14), 35.5 (SD: 12.92), 43.86 (SD: 17.52) for control, self-harm ideation and self-harm enactment groups, respectively.

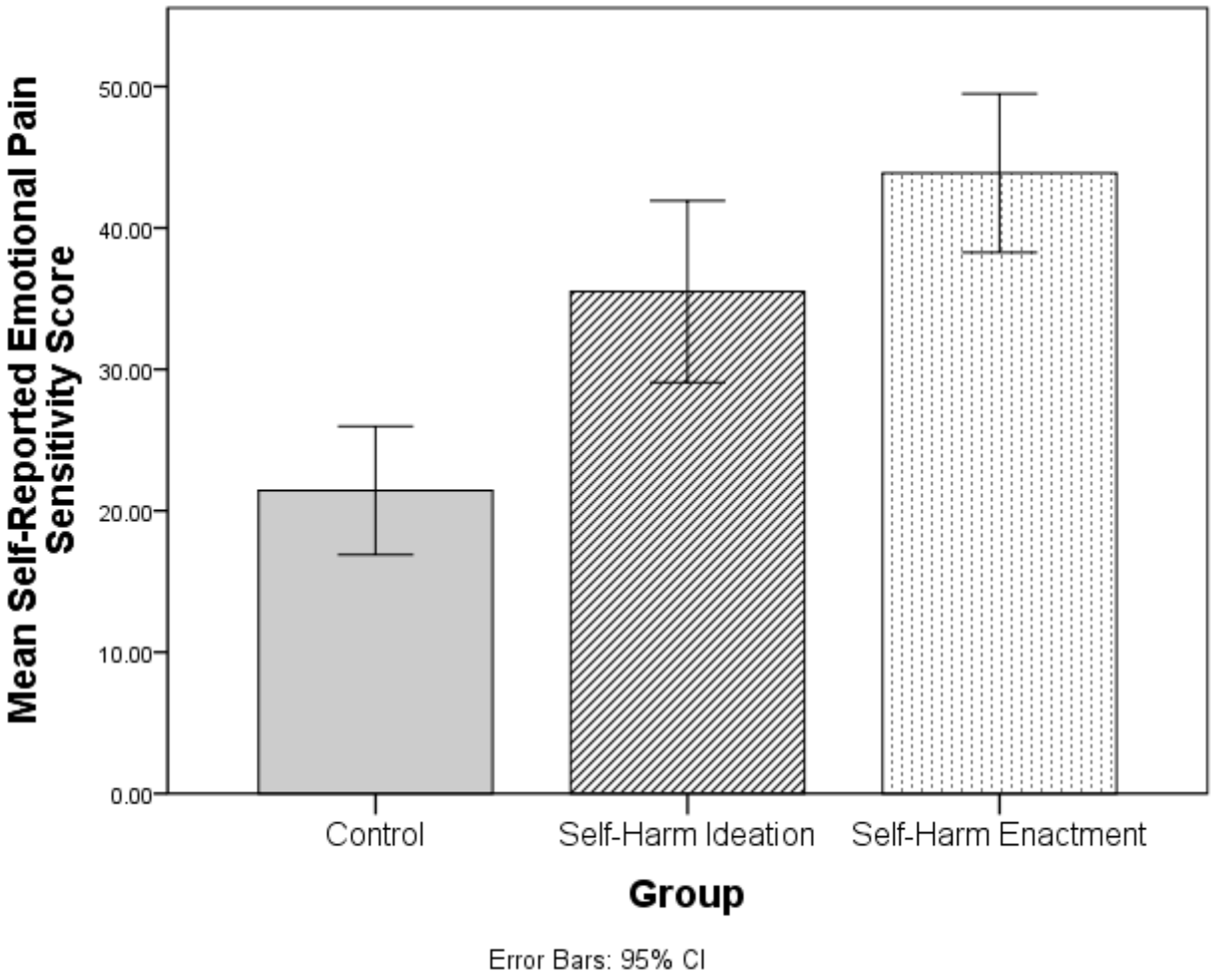

Figure 6.2. A significant ordered effect was found across the three groups for self-reported emotional pain sensitivity: self-harm enactment> self-harm ideation> controls.

6.4.2 Behavioural emotional pain sensitivity

No significant ordered effect was found for behavioural emotional pain sensitivity scores across the three groups, Jonckheere-Terpstra Z= .252, *ns*. Mean scores were 54.07 (SD:

16.29), 47.67 (SD: 17.87) and 54.38 (SD: 16.42) for the control, self-harm ideation and self-harm enactment groups, respectively. See Figure 6.3 below.

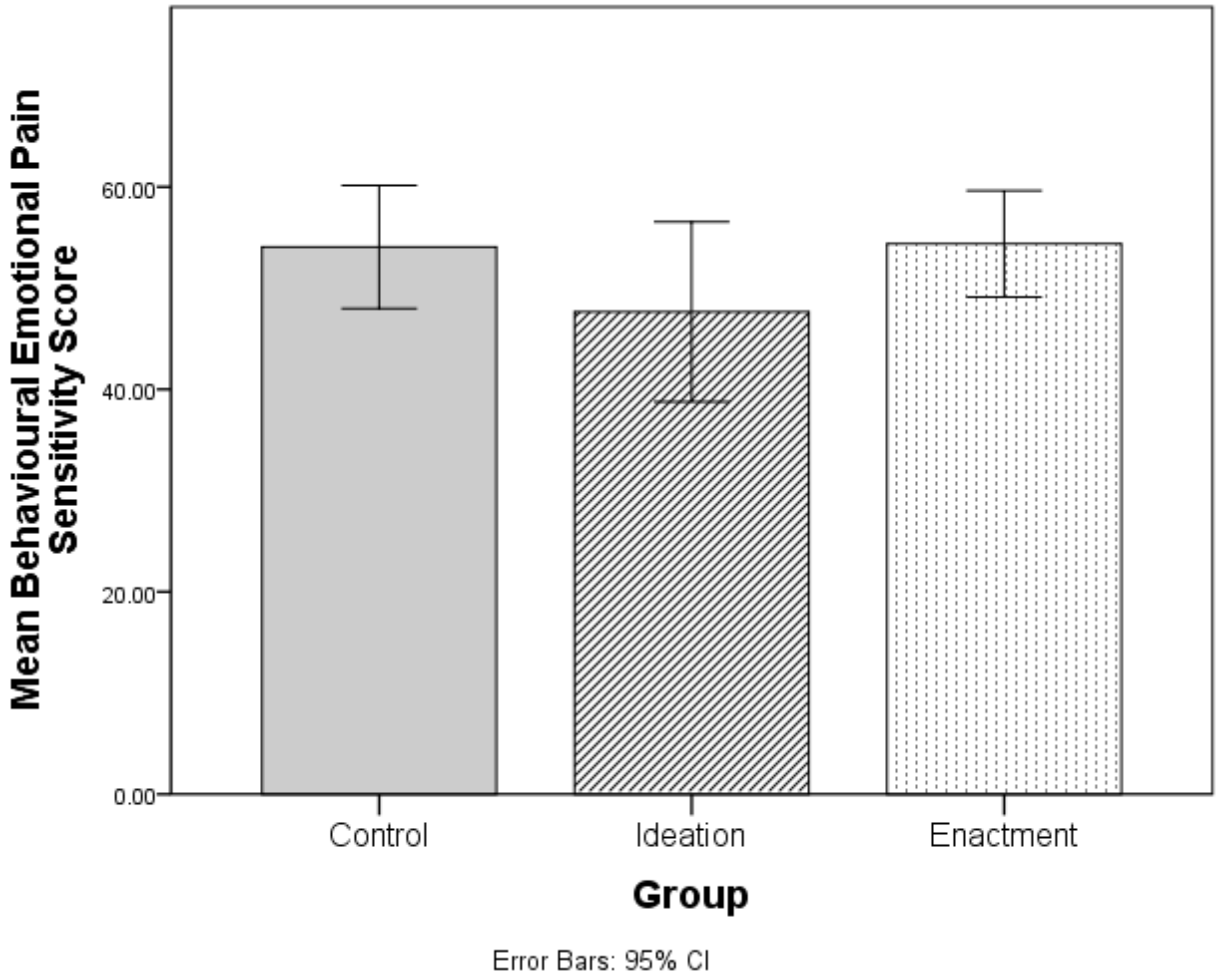

Figure 6.3. No significant ordered effect was found for behavioural emotional pain sensitivity.

6.4.3 Self-reported physical pain distress and sensitivity

The results for self-reported physical pain distress demonstrated a significant ordered effect, with self-harm enactment> self-harm ideation> controls, Jonckheere-Terpstra Z = 4.37, p<.001. See Figure 6.4. Mean pain distress scores were 23.03 (SD: 18.16) for controls, 30.33 (SD: 15.51) for the ideation group and 41.53 (SD: 18.98) for the enactment group. No significant ordered effect was found for physical pain sensitivity, Jonckheere-Terpstra Z= 1.34, *ns*.

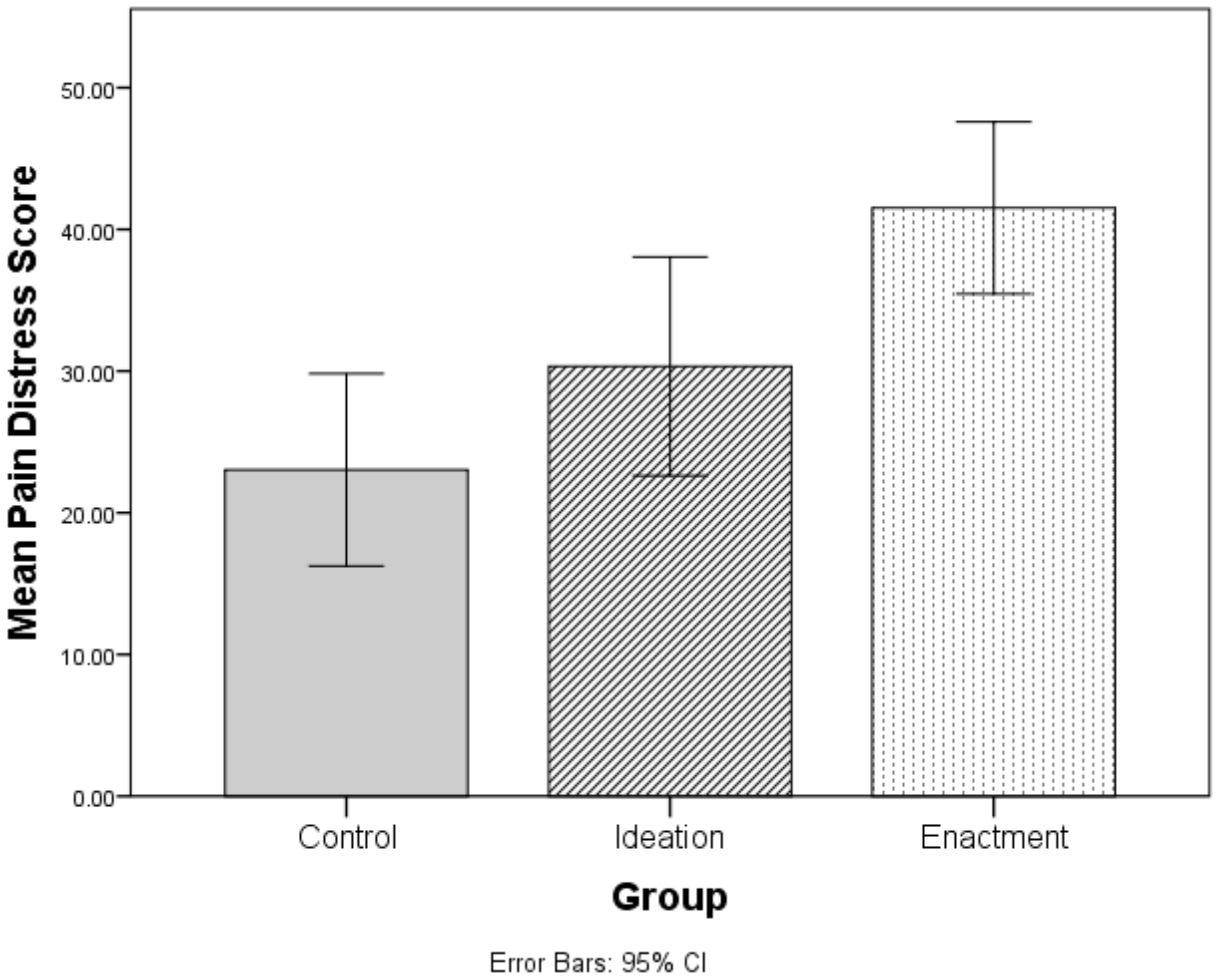

Figure 6.4. The results of a Jonckheere-Terpstra trend test revealed a significant ordered effect for pain distress: self-harm enactment> self-harm ideation> controls.

6.4.4 Behavioural sensitivity to physical pain

Jonckheere-Terpstra tests were conducted upon pressure and time scores for both behavioural physical pain threshold and tolerance. No significant ordered effects were observed for any of the four behavioural physical pain sensitivity measures, Jonckheere-Terpstra Z = -.298, -.692, .156 and -1.40 for pain threshold pressure, pain threshold time, pain tolerance pressure and pain tolerance time, respectively. See Figures 6.5 – 6.8.

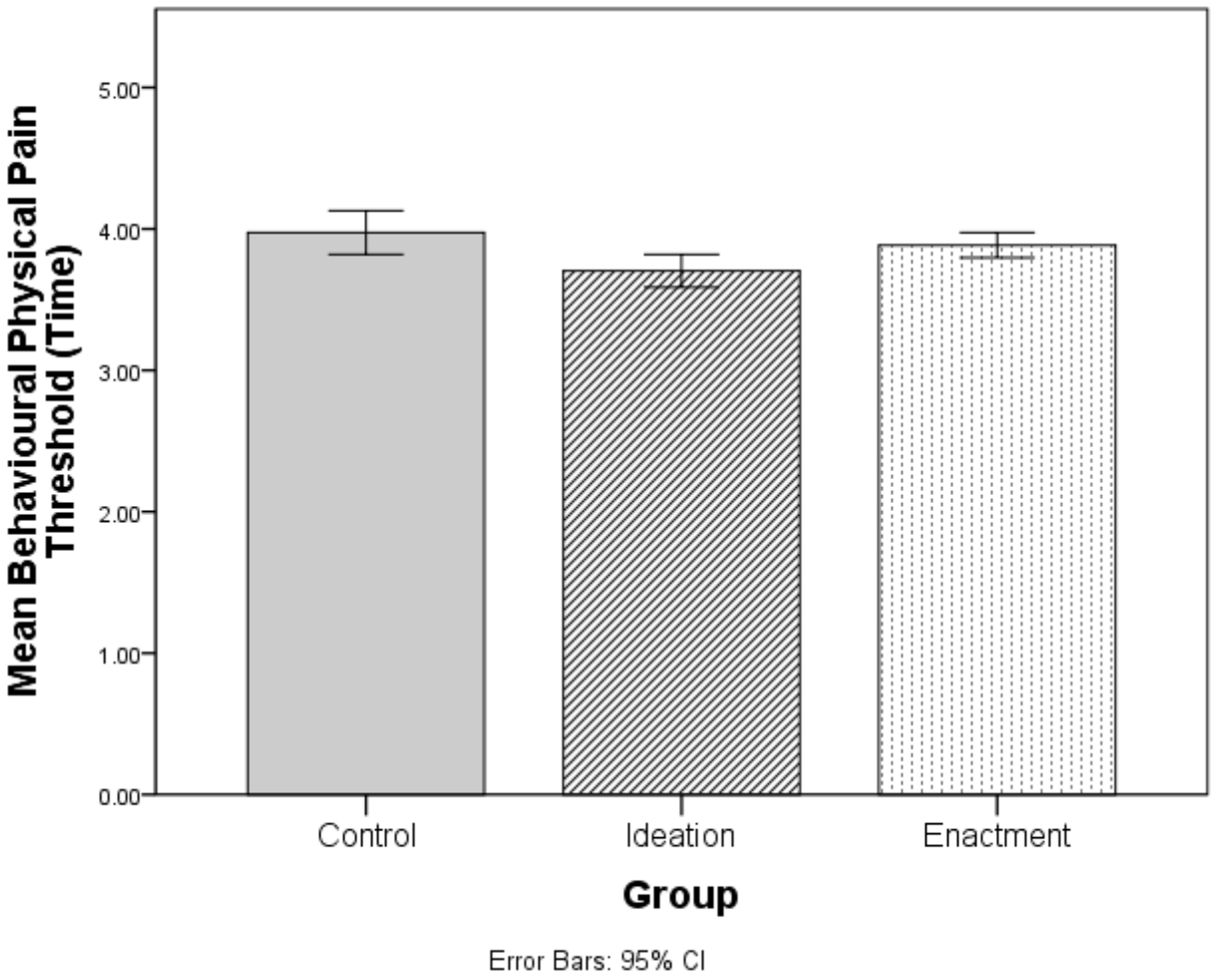

Figure 6.5. No significant ordered effect was found for behavioural physical pain threshold (time) across the three groups.

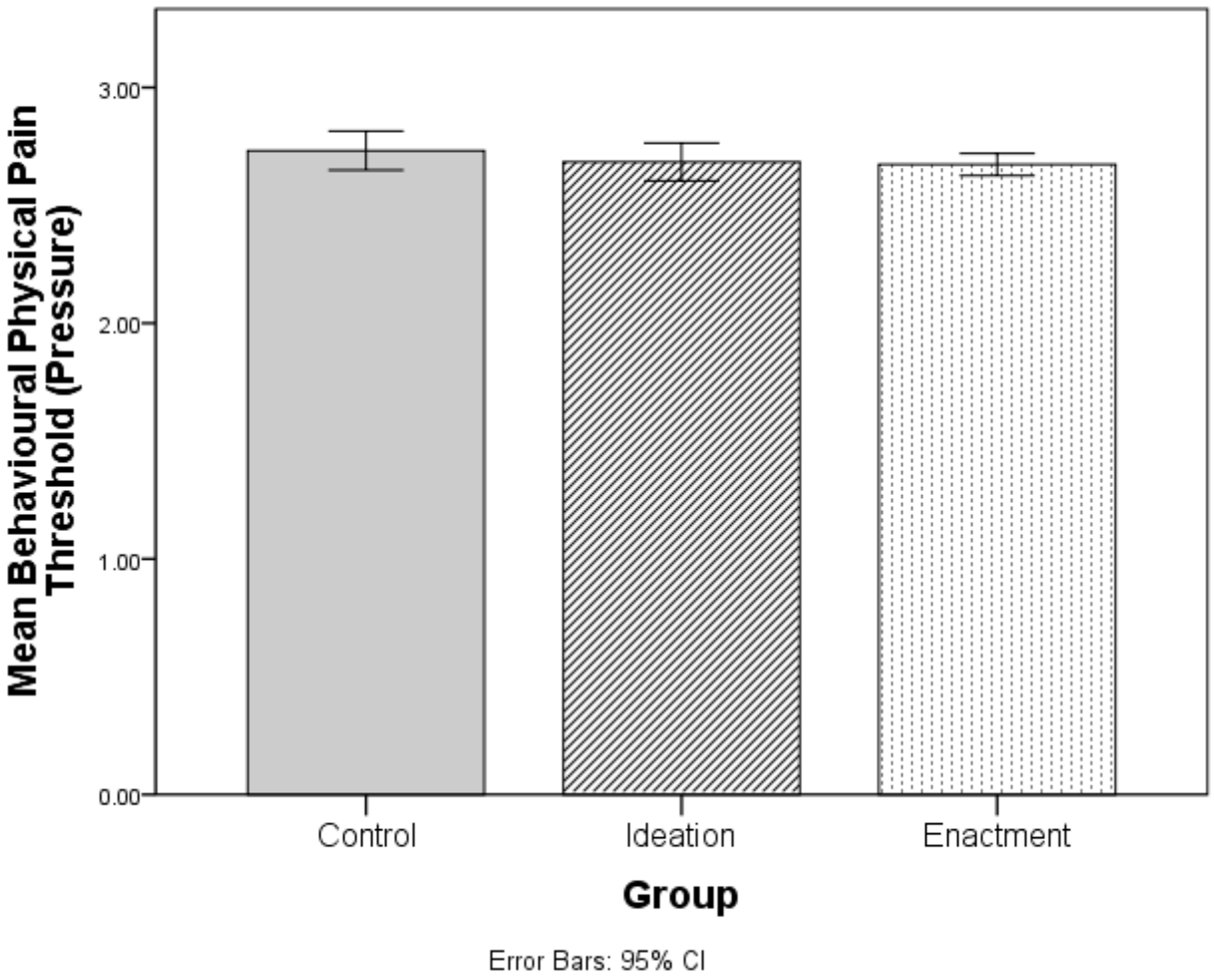

Figure 6.6. No significant ordered effect was found for behavioural physical pain threshold (pressure) across the control, self-harm ideation and self-harm enactment groups.

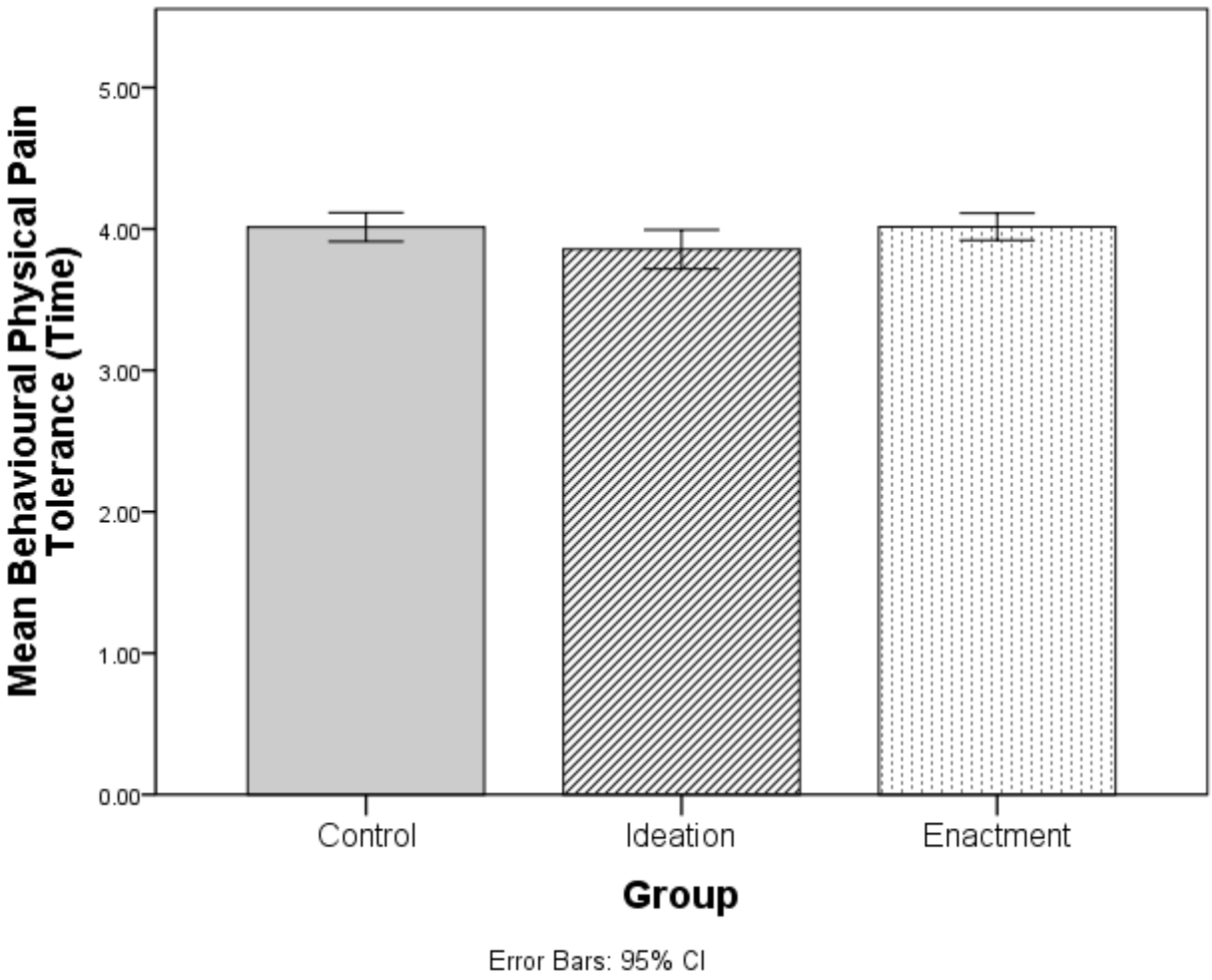

Figure 6.7. There was no significant ordered effect for behavioural physical pain tolerance (time) across the three groups.

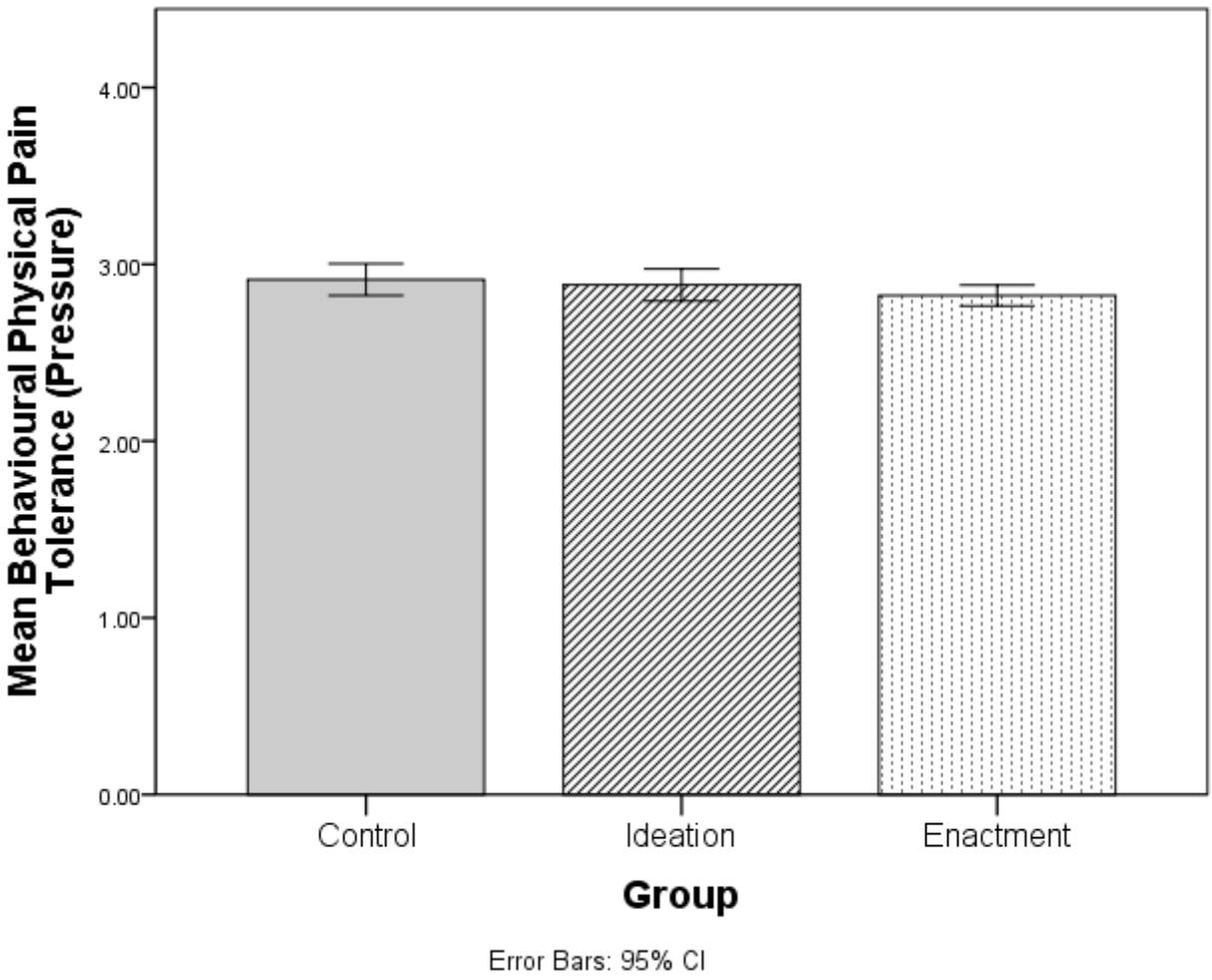

Figure 6.8. A Jonckheere-Terpstra trend test revealed no significant ordered effect for behavioural physical pain tolerance (pressure) across the control, self-harm ideation and self-harm enactment groups.

6.4.5 Correlation between emotional and physical pain sensitivity measures

A series of Pearson's correlations were performed to assess the relationship between the self-reported and behavioural measures of emotional and physical pain tolerance. The results of these analyses are reported in Table 6.2, below. A significant but moderate positive correlation was found between the two self-reported measures of physical pain distress and emotional pain sensitivity, $r = .534$, $p < .001$. Self-reported physical pain sensitivity was significantly, although weakly, positively correlated with self-reported emotional pain sensitivity, $r = .342$, $p < .001$. Behavioural sensitivity to emotional pain was found to be very weakly and negatively correlated with participants' visual analogue scale pain unpleasantness ratings, $r = -.238$, $p = .026$. There were no significant correlations between the behavioural emotional and physical pain measures, nor were the behavioural

measures correlated with the self-report measures of emotional and physical pain sensitivity.

Table 6.2

Intercorrelations between variables across the total sample

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Gender	1														
2. Age	-.147	1													
3. ERS	.084	.097	1												
4. PDI	-.013	-.026	.534**	1											
5. PDI-Sensitivity	-.034	-.085	.342**	.734**	1										
6. MPS-Social	-.084	.008	.394**	.428**	.311**	1									
7. PCI	.095	-.060	.490**	.525**	.351**	.486**	1								
8. PSPS	.105	-.197	.437**	.487**	.396**	.652**	.640**	1							
9. VAS	-.097	.164	-.009	.056	.134	.084	.038	.065	1						
10. DTT	-.267*	.134	-.027	.104	.120	.163	.148	.115	-.238*	1					
11. BDI-II	.063	.054	.593**	.431**	.278**	.550**	.397**	.626**	-.003	-.004	1				
12. Pain threshold – time	-.107	.062	.051	-.095	.015	-.047	-.138	-.061	-.122	.046	-.068	1			
13. Pain threshold – pressure	-.272*	.130	.030	-.178	-.245*	-.257*	-.268*	-.139	-.224	.058	.018	.004	1		
14. Pain tolerance – time	.135	-.069	.160	.048	.095	.047	-.032	.087	.017	.020	-.040	.475**	-.080	1	
15. Pain tolerance – pressure	-.187	.106	.053	-.210	-.207	-.243	-.223*	-.178	-.062	.050	-.048	-.099	.685**	.095	1

BDI-II Beck Depression Inventory-II*; DTT* Distress Tolerance Task; *ERS* Emotional Reactivity Scale; *MPS-Social* Multidimensional Perfectionism Scale- Social subscale; *PDI* Pain Distress Inventory; *PDI-Sensitivity* Pain Distress Inventory- Sensitivity subscale; *PCI* Perfectionistic Cognitions Inventory; *PSPS* Perfectionistic Self-Presentation Scale; *VAS* Visual analogue scale- physical pain. *Correlation significant at .05 level. ** Correlation significant at .001 level.

6.4.6 The relationship between perfectionism and emotional pain sensitivity

The relationship between perfectionism and self-reported sensitivity to emotional pain was explored separately in the ideation and enactment groups using a series of univariate and multivariate linear regression analyses.

6.4.6.1 Perfectionistic self-presentation

Within the ideation group, there was no significant association between self-reported emotional pain sensitivity and perfectionistic self-presentation, β= .167, *ns.* This was also the case for the self-harm enactment group, β= .153, *ns*.

6.4.6.2 Perfectionistic cognitions

No significant correlation was found between presence of perfectionistic cognitions and self-reported emotional pain sensitivity within the ideation group, β= .102, *ns*. For the self-harm enactment group though, there was a significant association between perfectionistic cognitions and emotional pain sensitivity, β= .304, t(38)= 2.38, *p*=.022, 95% CI: .045 - .562.

6.4.6.3 Socially-prescribed perfectionism

There was no significant association found between socially-prescribed perfectionism and self-reported emotional pain sensitivity within the self-harm ideation group, β= .335, *ns.* Within the self-harm enactment group, however, there was a significant association between social perfectionism and emotional pain sensitivity, β= .407, t(38)= 2.51, *p*= .016, 95% CI: .079 - .734.

6.4.6.4 Multivariate analyses of perfectionism and emotional pain sensitivity

For the self-harm ideation group, no significant associations were revealed between any of the three perfectionism variables and self-reported emotional pain sensitivity. Both presence of perfectionistic cognitions and socially prescribed perfectionism, however, emerged from the univariate analyse as significantly associated with emotional pain sensitivity within the enactment group. Thus, these two variables were entered into a multivariate linear regression model in order to ascertain which of these manifestations of

perfectionism was more strongly associated with emotional pain sensitivity. However, neither socially prescribed perfectionism nor perfectionistic cognitions were significantly associated with emotional pain sensitivity in the multivariate analysis within the self-harm enactment group, β= .282 and β= .191, *ns*, respectively.

6.4.7 Mood

Mixed measures ANOVA were employed to investigate changes in positive and negative mood as a function of time-point (baseline; post algometer task; post questionnaires; and post DTT), and group (control; ideation; enactment).

6.4.7.1 Positive mood

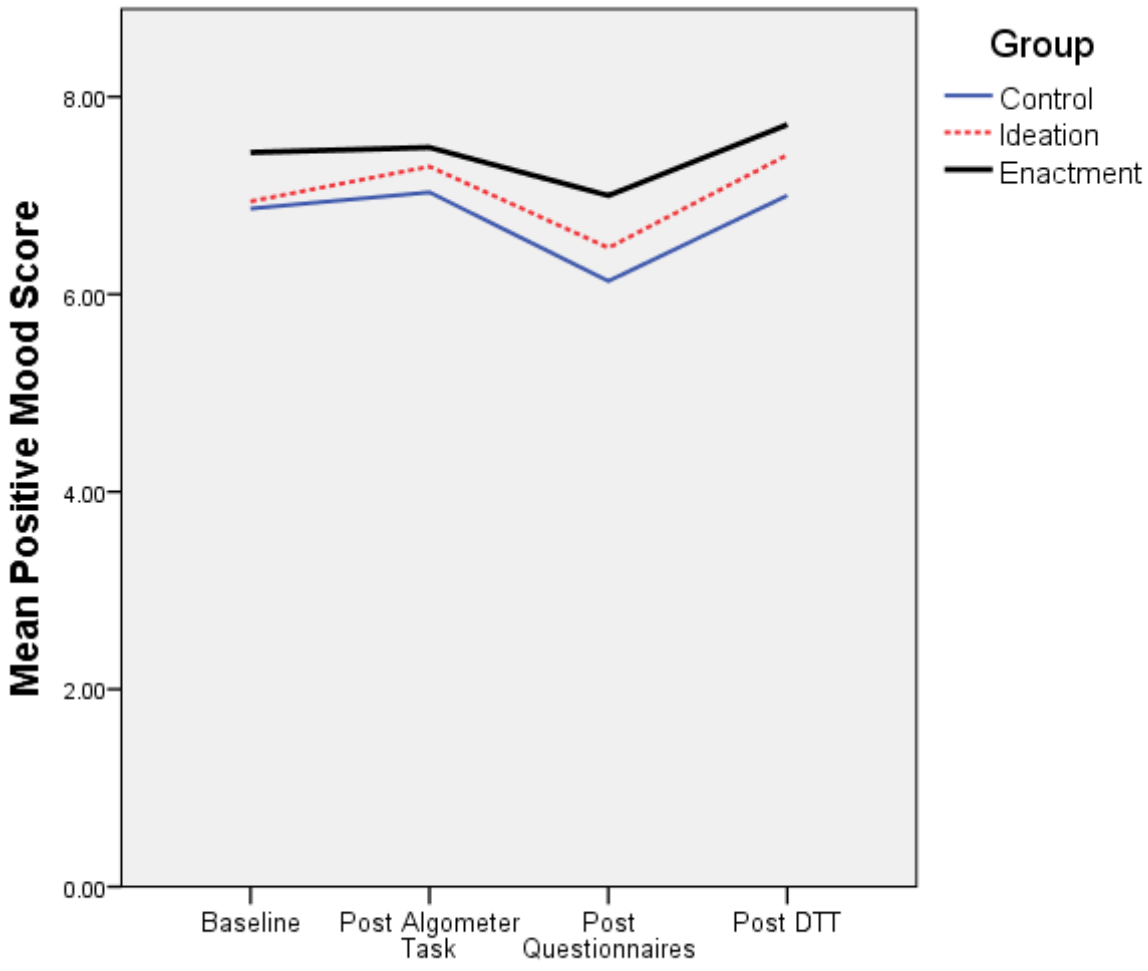

Figure 6.9. Mean positive mood over baseline, post algometer task, post questionnaires and post DTT time-points, across control, self-harm ideation and self-harm enactment groups.

A 4x2 mixed measures ANOVA, with Greenhouse-Geisser correction applied, revealed a significant effect of time upon mood, F(2.69, 223.43)= 13.03, $p < .001$. However, none of the *post-hoc* tests emerged as significant and all of the 95% confidence intervals included zero. There was no significant interaction between time and group, F(5.38, 223.43)= .460, *ns*. A graphical representation of mood over the four time-points for each group is displayed in Figure 6.9 above. Means and standard deviations for positive mood can be found in Table 6.3 below.

Table 6.3

Means and standard deviations for positive mood for baseline, post algometer task, post questionnaires and post DTT time-points

Baseline	Mean	*SD*
Control	6.87	1.17
Ideation	6.94	1.30
Enactment	7.44	1.35
Post algometer		
Control	7.03	1.45
Ideation	7.29	1.69
Enactment	7.50	1.43
Post questionnaires		
Control	6.13	1.59
Ideation	6.47	1.59
Enactment	7.00	1.45
Post DTT		
Control	7.00	1.66
Ideation	7.41	1.33
Enactment	7.72	1.45

6.4.7.2 Negative mood

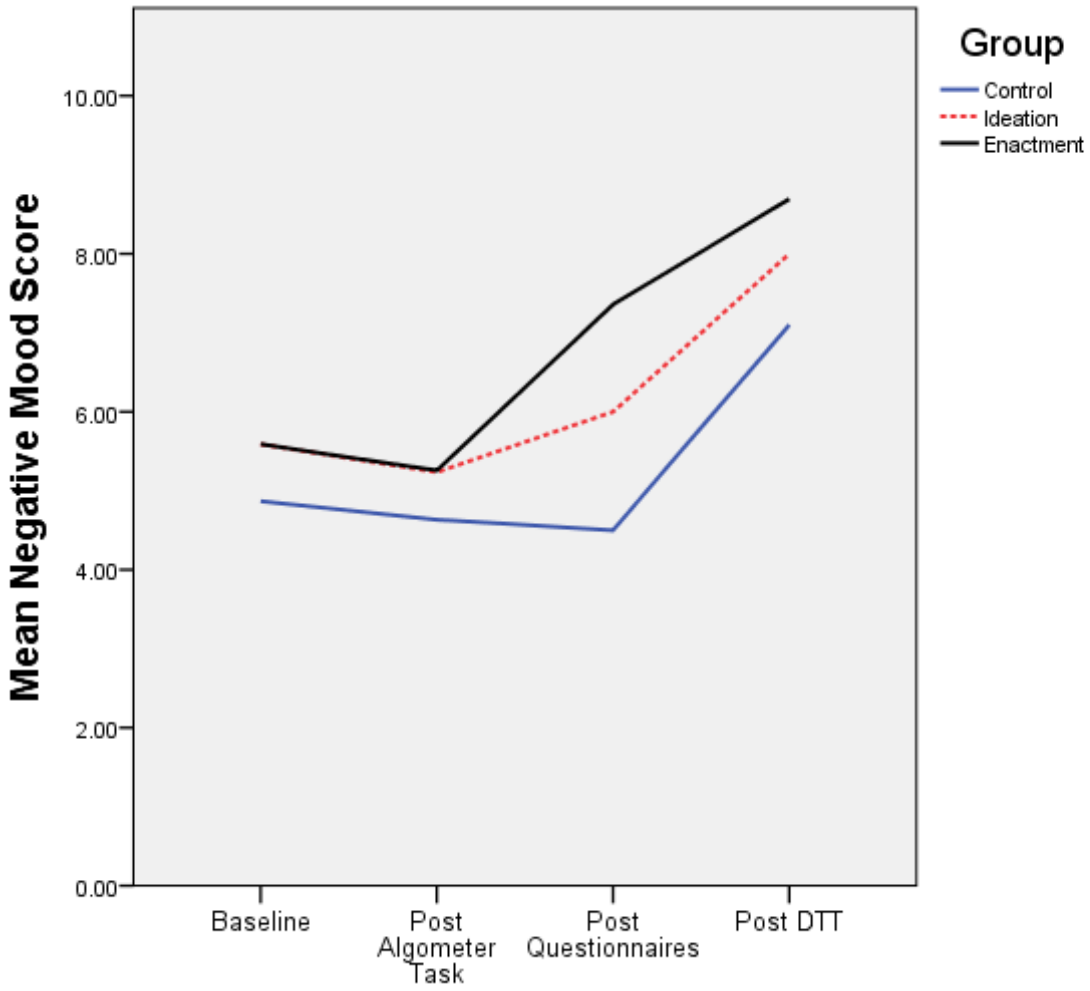

Figure 6.10. Mean negative mood over baseline, post algometer, post questionnaire and post DTT time-points, across control, self-harm ideation and self-harm enactment groups.

A 4x2 mixed measures ANOVA was employed, with Greenhouse-Geisser correction applied, showing a significant main effect of time, $F(1.94, 160.91) = 40.71$, $p < .001$. A graphical representation of negative mood over time for the three groups is shown in Figure 6.10 above. There was also a significant interaction between group and time, $F(3.88, 160.91) = 2.97$, $p = .023$, such that those in the self-harm enactment group exhibited significantly greater negative mood scores than the control group, mean difference = -1.45, (95% CI: -2.47 - -.432), $p = .002$. Means and standard deviations for negative mood are given in Table 6.4 below.

Table 6.4

Means and standard deviations for negative mood for baseline, post algometer task, post questionnaires and post DTT time-points

Baseline	Mean	*SD*
Control	4.87	1.55
Ideation	5.59	1.91
Enactment	5.59	1.98
Post algometer		
Control	4.63	1.03
Ideation	5.24	1.95
Enactment	5.26	1.65
Post questionnaires		
Control	4.50	.82
Ideation	6.00	2.67
Enactment	7.36	2.94
Post DTT		
Control	7.10	1.95
Ideation	8.00	3.69
Enactment	8.69	3.63

6.5 Discussion

This is the first study to investigate the relationship between self-reported and behavioural sensitivity to emotional and physical pain in self-harm ideation and enactment. Furthermore, this study is also the first exploration of the relationship between perfectionism and both self-reported and behavioural emotional pain sensitivity.

6.5.1 Emotional pain sensitivity

6.5.1.1 Self-reported emotional pain sensitivity

The findings supported the initial hypothesis that a significant ordered effect would be found for self-reported emotional pain sensitivity, such that emotional sensitivity would be greatest in the self-harm enactment group, followed by those in the self-harm ideation group and then controls would have the lowest emotional pain sensitivity. This supports previous research that has found elevated emotional pain sensitivity in individuals who have engaged in self-harm behaviour (Glenn, Blumenthal, Klonsky & Hajcak, 2011; Nock, Wedig, Hooley & Homberg, 2008) and also in those who have thoughts of self-harm, but who have never engaged in the behaviour (Kirtley et al., 2015: see previous chapter). Potentially these results suggest that heightened sensitivity to emotional pain may precede an individual actually engaging in self-harm behaviour, although within the scope of the current cross-sectional study, this cannot be definitively determined.

6.5.1.2 Behavioural emotional pain sensitivity

Contradicting previous research conducted with individuals who have enacted self-harm behaviour (Nock et al., 2007), the results of the current study did not support the predicted ordered effect for behavioural sensitivity to emotional pain across the three groups. Whilst the lack of difference between the ideation group and the other two groups could have been the result of low statistical power (n=18 for the ideation group), the absence of difference between the control and enactment groups is surprising. Indeed, the vast majority of participants across all three groups continued with the task until the maximum score of 64 cards was reached. One potential reason for the lack of variation in behavioural emotional pain sensitivity scores is that many participants reported that they thought early on in the task that there was no solution to the card puzzle. When it became apparent that some

participants were guessing the task was impossible, I introduced a manipulation check question which I asked at the end of the experiment (see section 2.2). Of the 75 participants that completed the manipulation check question, 75% reported guessing that the task had no solution. If participants believed that the task was designed to be impossible, the ability of the task to elicit and thus measure emotional distress, was clearly compromised.

Given the overwhelming proportion of participants who endorsed awareness of the task's impossibility, the fact that 67% of participants persisted with the task until the very end is particularly intriguing. When participants were questioned about their reasons for continuing with the task, even with the knowledge that it was impossible, their answers were highly varied. One participant said "I thought it would be rude not to [continue the task]", whereas another said "I didn't want to let you [the researcher] down". It appeared for the majority of participants that speaking out to the researcher and terminating the task before the end, was in fact more stressful than the prospect of being continually told that their answers were incorrect.

The DTT was chosen for several reasons. One is that it is a measure as opposed to a manipulation, of emotional distress sensitivity with an obvious outcome metric of the number of cards for which participants persist, which gives an emotional pain tolerance score. This is in contrast to other emotional stress tasks, e.g. the Trier Social Stress Test (Kirschbaum, Pirke & Hellhammer, 1993) or Cyberball (Williams & Jarvis, 2006) for which there are only measures of the tasks effect upon participants, e.g. change in mood score. Another reason is that in contrast to other distress tolerance measures such as the Mirror Tracing Persistence Task (MTPT-C; Strong et al., 2003), the DTT includes an interpersonal component; interpersonal problems and stress being a frequently reported concern of individuals who engage in self-harm (Brown, Comtois & Linehan, 2002). The DTT has previously demonstrated reliability in differentiating between healthy controls and individuals who have engaged in self-harm (Nock & Mendes, 2008).

The validity of certain distress tolerance measures, including the DTT, has recently been called into question (Ameral et al., 2014), querying whether such paradigms are actually measuring ability to withstand emotional stress. Whilst the DTT may elicit feelings of frustration, the type of stress experienced during the task and the stress that precedes an episode of self-harm ideation or behaviour, may well be quite different. This may represent a key finding from this research project and calls into question the interpretation of

previous studies (Anestis et al., 2012; Nock & Mendes, 2008). The extent to which any laboratory measure or manipulation of emotional pain is an adequate proxy for the real-life emotional pain experienced by those who self-harm, is questionable. When attempting to assess individuals' sensitivity to, as opposed to level of, emotional pain, a good laboratory proxy is essential, and the development of such should be a key focus for future research. See section 7.3.1.3.3 of Chapter 7 for further discussion.

6.5.2 Physical pain sensitivity

6.5.2.1 Self-reported physical pain distress and sensitivity

Self-reported physical pain distress exhibited the predicted significant ordered effect, with pain distress being highest in the self-harm enactment group, followed by the ideation group and then controls with the lowest pain distress. The hypothesis for pain distress was therefore supported, however, the predicted ordered effect for physical pain sensitivity was not found. The self-reported pain distress results diverge considerably from the behavioural physical pain sensitivity results generally found within the self-harming population (Glenn et al., 2014; Hooley et al., 2010). See Chapter 2 for a detailed review of the literature in this area. The present results are, however, consistent with previous research on self-reported physical pain sensitivity and distress within this population (Kirtley et al., 2015; see Chapter 5). The measure employed to assess physical pain distress and sensitivity, the PDI (Osman et al., 2003), pertains to participants' general experiences of pain and not specifically to the pain of self-harm. Behavioural tests of physical pain sensitivity are, however, no more specific to the pain of self-harm than the PDI, and it is perhaps more likely that self-perception of increased physical pain sensitivity is one element within a set of cognitive distortions occurring during psychological distress.

Participants who endorsed a lifetime history of self-harm behaviour were also asked a question regarding their experiences of physical pain during self-harm and contrary to previous studies (e.g. Kemperman et al., 1997; Russ et al., 1992), the majority of participants reported that they experienced pain during self-harm 'sometimes' or more frequently. It is a possibility then, that the sample used within the current study was idiosyncratic in terms of their pain experiences and maybe more sensitive to pain than individuals in other samples. Given that a previous study conducted on a much larger sample also found a similar pattern of elevated self-reported pain distress in self-harm ideation and enactment (Kirtley et al., 2015; see previous chapter), it is perhaps more likely that the results are indicative of a genuine divergence between self-harming individuals'

experiences of pain more generally and those occurring during self-harm behaviour, as opposed to an artefact of the sample. Moreover, the differences between self-reported physical pain distress and previous work focussing on behavioural physical pain tolerance, may also speak to a more generalised lack of consonance between self-reported and behavioural measures; an important methodological consideration discussed in more detail in section 6.5.3 of this chapter.

6.5.2.2 Behavioural physical pain threshold and tolerance

Time taken to terminate the task and maximum pressure for each trial were both used as behavioural outcome measures for physical pain threshold and tolerance. None of the findings from the behavioural physical pain outcome measures supported the hypothesis that physical pain threshold and tolerance would be elevated in the self-harm ideation and enactment groups, relative to controls. Indeed, between-group differences in pain threshold and tolerance were barely discernible, with all three groups performing almost equivalently. There have been many previous studies that have shown physical pain threshold and tolerance to be increased in self-harm enactment (Franklin et al., 2013; Gratz et al., 2011; Hooley et al., 2010), and yet the physical pain threshold and tolerance results from this study do not support these prior research findings. There were no significant differences in gender composition of the groups, thus it is unlikely that gender differences in pain threshold and tolerance were responsible for these null results.

The pressure algometer has been employed as a measure of physical pain threshold and tolerance in numerous recent studies of pain and self-harm in community samples (e.g. Glenn et al., 2014; Gratz et al, 2011; Hooley & St Germain, 2014), and was thus considered a suitable method for use in the current study. Furthermore, I felt that the algometer achieved a balance of being a good approximation of the localised and rapid nature of the pain one may experience during self-harm, whilst also ensuring participant safety; other rapid type pain, e.g. thermal, laser, and pinprick pain may be unsuitable for use with individuals who have very high pain tolerance due to the risk for inflicting actual harm and tissue damage. See section 7.3.1.3.1 of Chapter 7 for further discussion of this.

6.5.3 Relationship between behavioural and self-reported emotional and physical pain sensitivity

A major, although exploratory aim of this study, was to investigate the relationship between behavioural and self-report measures of physical and emotional pain sensitivity.

This relationship had not previously been explored in self-harm ideation and enactment and studies conducted with other populations had produced mixed results; sometimes a high level of agreement between self-report and behavioural measures (e.g. Anestis et al., 2012), and in other cases a marked lack of convergence between the two types of measures (e.g. Bernstein et al., 2011). In this study, no significant association between the self-report and behavioural measures of emotional pain sensitivity was observed. Only one of the behavioural physical pain measures correlated with self-reported physical pain sensitivity, exhibiting a weak negative relationship with pain threshold pressure. Consistent with the previous study (Kirtley et al., 2015; Chapter 5), there was a significant positive association between self-reported emotional pain sensitivity and self-reported physical pain sensitivity and distress, although these correlations were only weak to moderate in strength. Low statistical power may have been an issue, given the small sample size (n=88), however the lack of agreement between self-report and behavioural measures of distress tolerance is well documented, even in large samples (e.g. Anestis et al., 2012; McHugh et al., 2011). In short, these results are suggestive of a poor convergence between self-report and behavioural measures of emotional and physical pain within the self-harming population.

6.5.3.1 Implications for the social neuroscience model of emotional and physical pain sensitivity

The social neuroscience model of emotional and physical pain sensitivity contends that individuals who are more sensitive to one form of pain are also more sensitive to the other, and *vice* versa (Eisenberger et al., 2003; 2006). The correlation between self-report measures of emotional and physical pain sensitivity, but lack of agreement between the self-report and behavioural measures within this study, may indicate that the social neuroscience model only applies to self-perceived pain sensitivity and not to behavioural sensitivity. Most of the studies conducted within this area have been fMRI studies, linking neural activity to self-reported emotional and physical pain sensitivity, with a significant dearth of studies employing behavioural measures. It warrants consideration, however, that the overwhelming majority of evidence supporting the social neuroscience model has been conducted with the same emotional pain sensitivity measure; the computerised virtual ball throwing game, Cyberball (see Williams & Jarvis, 2006 for full discussion of Cyberball). The present study utilised a different measure, the DTT, and did not find this to relate to either behavioural or self-reported physical pain sensitivity. There is a significant dearth of behavioural research exploring the relationship between emotional and physical

pain, with an overreliance on correlational neuroimaging studies that employ small samples and disproportionately focusing on adolescent populations. Whilst the current study is small, the results reported do not rely on self-report alone, pairing these with behavioural data, and therefore make a valuable contribution to our knowledge in this area. We strongly advocate that future investigations should embrace the diverse range of emotional pain sensitivity measurement paradigms available, particularly behavioural measures, in order to explore whether the emotional and physical pain relationship posited by the current body of social neuroscience literature is indeed generalisable. We further question if the effects observed in previous studies are specific only to the Cyberball paradigm and to the adolescent populations in which this measure has almost exclusively been employed.

6.5.4 Perfectionism and emotional pain sensitivity

Hyper-sensitivity to social evaluation has been put forward as a potential explanation for the shared relationship between emotional and physical pain sensitivity (Eisenberger, 2010). To this end the association between three different manifestations of perfectionism and behavioural and self-reported emotional pain sensitivity was investigated; perfectionistic individuals being acutely sensitive to social evaluation and to meeting the perceived expectations of others. The results demonstrated no significant correlation between behaviourally indexed emotional pain sensitivity and any of the perfectionism measures. There were, however, significant correlations between all three perfectionism measures and self-reported emotional pain sensitivity. Whilst these correlations were weak to moderate in strength, they do suggest that greater perfectionism is associated with greater sensitivity to emotional pain. Of the three types of perfectionism assessed here, the correlation was strongest between emotional pain sensitivity and perfectionistic cognitions. These types of automatic perfectionistic thoughts have been shown to explain variance in psychological distress in excess of that accounted for by socially prescribed perfectionism alone and are characterised as more of a ‘state’, rather than ‘trait’, manifestation of perfectionism (Flett et al., 2007). Particularly given the ‘state-like’ nature of perfectionistic cognitions and that these data are correlational, the directionality and causality within this relationship is uncertain. Presence of perfectionistic automatic thoughts may increase the likelihood that an individual will be more sensitively attuned to emotional information, and that in the presence of poor emotion regulation abilities, this may lead to becoming overwhelmed by their emotions. Alternatively, elevated sensitivity to emotional pain could provide the backdrop of psychological distress against which automatic perfectionistic

thoughts flourish. Experimental research to determine the directionality of the perfectionism – emotional pain relationship could bear considerable fruit in identifying potential targets for intervention development.

6.5.5 Limitations

The current study adds to the burgeoning literature on the relationship between emotional and physical pain in self-harm ideation and enactment, by providing the first investigation of self-reported and behavioural sensitivity to emotional and physical pain within this population. It is also the first study to investigate the association between behavioural and self-reported emotional pain sensitivity and perfectionism. It is, however, important to consider the study within the context of its limitations. The cross-sectional design means that the role of emotional and physical pain sensitivity in future self-harm ideation and enactment cannot be determined within this study. There is a pressing need for prospective work in this area and also more broadly within the field of suicidological research. The measure of behavioural emotional pain sensitivity used within this study may also have resulted in some confounding of the results. As discussed extensively in section 6.5.2.2 of this chapter, there was a marked lack of variation in DTT scores across the groups and the most likely reason for this was that the vast majority of participants guessed the purpose of the task and that there was no solution. Furthermore, the social-evaluative component of the task actually appeared to deter participants from quitting before the maximum possible score was reached, as opposed to stimulating them to cease the task. The way in which emotional pain and distress tolerance are assessed experimentally has come under increasing scrutiny in recent times and the validity of existing measures has been questioned (Ameral et al., 2014). Thus, a different behavioural measure of emotional pain sensitivity may yield different results, for example, the Mirror Tracing Persistence Task (MTPT-C; Strong et al., 2003), during which participants must move a cursor over the outline of a shape displayed on a computer screen, with their performance influencing participation payment. The cursor, however, always moves in the opposite direction to the participant's movement, and distress tolerance is indexed as task persistence. Newer versions of the MTPT-C include variations according to participant skill, which may further improve validity.

The study may have suffered from low statistical power, particularly for the self-harm ideation group (n=18), although the sample size is comparable to other behavioural studies of emotional and physical pain sensitivity (e.g. Eisenberger et al., 2006) and the group

sizes for the control and enactment groups were well matched. Recruiting sufficient numbers of individuals who have had thoughts of self-harm, but who have never enacted the behaviour, is a significant methodological challenge and one encountered by many researchers in this area (e.g. Hooley et al., 2010). This is further complicated by the fact that individuals sometimes report different self-harm experiences in their initial telephone screening interview to those which they subsequently report during their lab session. Many individuals feel more comfortable completing measures online via computer as they perceive their answers as more private than giving answers directly to the researcher in an interview (Tourangeu & Yan, 2007). Deciding whether or not to group participants according to their phone interview responses or those of their computer lab measures is a matter of judgement, but given individuals' comparative comfort in disclosing personal information more anonymously via computer, the researcher and her supervisors felt that grouping participants by their lab responses was likely to be the most reliable method. Despite these limitations, this study makes an important and novel contribution to the literature around emotional and physical pain in self-harm ideation and enactment.

6.6 Conclusions

The current study explored, for the first time, the relationship between behavioural and self-report measures of emotional and physical pain in self-harm ideation and enactment. It was also the first study to investigate the association between perfectionism and emotional pain sensitivity. The results echo those from previous research demonstrating a relationship between self-reported emotional and physical pain in self-harm ideation and enactment. Importantly, these data are not supportive of behavioural emotional and physical pain being altered in those who ideate about and enact self-harm behaviour. Presence of perfectionistic cognitions, perfectionistic self-presentation and socially prescribed perfectionism were all associated with self-reported emotional pain sensitivity, but the relationship was strongest between sensitivity to emotional pain and the presence of perfectionistic automatic thoughts. In sum, our results indicate a poor level of convergence between self-report and behavioural measures of emotional and physical pain within this population. Additionally they show an important disparity between individuals' self-perceived sensitivity to emotional and physical pain and their behavioural sensitivity. A potential explanation for this may be that divergence between behavioural and self-perceived sensitivity to emotional and physical pain are the result of a wider pattern of cognitive distortions around coping ability and self-efficacy that occur during acute psychological distress. Future research should employ a more diverse array of behavioural

measurement paradigms for emotional pain sensitivity, as the current study found the Distress Tolerance Task to elicit no measurable variation in scores across the self-harm ideation, self-harm enactment and healthy control groups.

Chapter 7: General Discussion

Background

This chapter provides a synthesis of the results of the three empirical studies presented within this thesis and integrates evidence from these studies with findings from previous research and relevant theoretical perspectives.

Methods

Evidence from across the three studies within this thesis is critically discussed. The findings are summarised and interpreted within the context of the three overarching research questions set out at the beginning of this thesis: 1) What factors differentiate those who ideate about self-harm from those who go on to enact the behaviour? 2) What is the relationship between emotional and physical pain in self-harm ideation and enactment? And 3) How do established psychological variables associated with self-harm and suicide relate to emotional and physical pain? These findings are also explored within the context of the Integrated Motivational-Volitional model of suicidal behaviour (IMV; O'Connor, 2011). Limitations of the studies presented within this thesis are examined and future directions for research are discussed.

Results

Using self-report and behavioural methods, the studies within this thesis have yielded a number of important findings in relation to self-harm research. No evidence was found to support the idea that threshold and tolerance for physical pain are elevated in individuals who have thought about or engaged in self-harm behaviour. Furthermore, there does not appear to be a significant effect of stress upon pain tolerance, as has been suggested by previous research. Self-reported emotional and physical pain sensitivity were both found to be highest in the self-harm enactment group, followed by the ideation group and then lowest in the control group. No significant association was found between behavioural and self-report measures of emotional and physical pain sensitivity. IMV predictions regarding greater impulsivity and exposure to social modelling of self-harm (volitional variables) in those in the self-harm enactment group, relative to the ideation group, were supported.

Conclusions

The three studies within this thesis have made a significant and timely contribution to the literature around emotional and physical pain sensitivity in self-harm enactment, and for the first time investigated these variables in self-harm ideation. The similarity in levels of self-reported emotional pain sensitivity across the ideation and enactment groups suggest this may be a pre-motivational phase variable within the IMV. Additionally, the emergence of exposure to social modelling of self-harm as a variable that differentiates between individuals with thoughts (only) of self-harm, and those who have engaged in the behaviour, may provide a key target for the development of treatments and interventions for self-harm.

This chapter outlines the main findings of the studies presented within this thesis, discussing these findings within the context of the three overarching research questions that this thesis set out to answer. The implications of these findings are examined, along with key issues raised in this thesis, and a critical review of the limitations of the studies included herein.

7.1 Main findings

The studies within the current thesis contribute to the answering of three overarching research questions defined in Chapter 1 (section 1.8). Here, the findings of the three studies are summarised with reference to each research question.

7.1.1 What factors differentiate those who ideate about self-harm from those who go on to enact the behaviour?

Study 1 found that only exposure to social modelling of self-harm, and impulsivity, were differentially associated with self-harm ideation and enactment, such that those who had engaged in self-harm behaviour were more likely to score more highly on impulsivity and also to have a friend or family member who had self-harmed.

Studies 2 and 3 found that contrary to initial predictions, neither self-reported nor behavioural physical pain sensitivity differed significantly between ideation and enactment groups. Self-reported and behavioural sensitivity to emotional pain also did not differ significantly between the ideation and enactment groups.

7.1.2 What is the relationship between emotional and physical pain in self-harm ideation and enactment?

In Study 2, self-reported emotional pain sensitivity was associated with physical pain distress, and when controlling for previous suicide attempt, it was also correlated with self-reported physical pain sensitivity. Similarly, Study 3 also found self-report measures of emotional and physical pain sensitivity, and physical pain distress, to inter-relate. Both of these studies revealed that greater self-reported emotional pain sensitivity is related to greater self-reported physical pain sensitivity and pain distress. Self-harm recency was also significantly associated with differences in self-reported sensitivity to emotional pain, with those who reported self-harming within the past year endorsing greater sensitivity to

emotional pain, relative to those who reported their last episode of self-harm as being more than one year ago.

There were, however, no significant associations between self-report and behavioural measures of emotional and physical pain sensitivity (Study 3).

7.1.2.1 Physical and emotional pain sensitivity: Mood and stress effects

All three studies examined different facets of the relationship between emotional and physical pain. Study 1 revealed no significant effect of stress upon behavioural physical pain threshold or tolerance across self-harm ideation, self-harm enactment and healthy control groups. There was, however, a marginally significant effect of pain upon mood, such that negative mood decreased following administration of the pain stimulus (pressure algometer). Crucially though, this was not specific to individuals who had ideated about or enacted self-harm, and this effect was evident across all the groups, suggesting that pain influences negative affect irrespective of self-harm status.

7.1.3 How do established psychological variables associated with self-harm and suicide relate to emotional and physical pain?

In individuals reporting self-harm ideation only, greater self-reported emotional pain sensitivity was significantly associated with higher levels of self-criticism, but for those reporting self-harm enactment, only greater presence of perfectionistic cognitions was significantly associated with greater sensitivity to self-reported emotional pain (Study 2). Higher levels of socially prescribed perfectionism, higher perfectionistic self-presentation and greater presence of perfectionistic cognitions were all significantly associated with greater sensitivity to self-reported emotional pain, but only for those reporting self-harm enactment (Study 3).

There were no significant associations between behavioural measures of emotional and physical pain sensitivity, and any of the other psychological variables assessed (Study 1).

7.2 Implications

7.2.1 Altered behavioural physical pain threshold and tolerance in self-harm

The results of the studies presented in this thesis challenge existing evidence that suggests individuals who have engaged in self-harm behaviour have a higher threshold and tolerance for physical pain, than those with no history of self-harm thoughts and behaviours (e.g. Franklin et al., 2012; Glenn et al., 2014; Hooley et al., 2013). The empirical studies within the current thesis have also extended the extant research knowledge in this area by, for the first time, directly comparing individuals who have ideated about self-harm, but never engaged in the behaviour, with individuals who have enacted self-harm behaviour; previous studies have attempted to recruit sufficient numbers of individuals who have ideated about self-harm, in the absence of behavioural enactment, but unfortunately have not succeeded (Hooley et al., 2010). Although Studies 1 and 3 used a widely employed method of assessing behavioural threshold and tolerance for physical pain, the pressure algometer (Glenn et al., 2014; Hooley et al., 2010), the results diverged considerably from those of previous studies. Based upon the results of our studies, from two separate groups, we find no evidence to support the idea that individuals who have enacted self-harm behaviour have a greater threshold and tolerance for physical pain than those with no history of self-harm thoughts and behaviours. Gratz and colleagues (2011) proposed that pain tolerance was only elevated in self-harm during periods of acute distress, however, we did not find pain threshold or tolerance to differ as a function of stress. The results of the studies presented in this thesis should be interpreted with caution though, as sample sizes were small for both Studies 1 and 3, potentially resulting in low statistical power and consequently a greater likelihood of Type II error. Issues of low statistical power and participant recruitment are discussed further in section 7.3.1.2 of this chapter. A further consideration with regard to the effect of stress on pain tolerance is the choice of stress manipulation employed in the current study. The type of 'stress' it is designed to induce is considerably removed from that which may be experienced in the everyday lives of participants experiencing psychological distress, such that even stressful tasks may seem trivial. The manipulation check did, however, demonstrate an effect of the stress manipulation, thus it may be that there is a 'critical level' of stress that must be experienced before it is possible to observe a measurable effect upon pain tolerance. The neutral comparison condition for the MAST (Smeets et al., 2012) requires a greater degree of active concentration and task engagement than that of other stress manipulations,

whereby participants may be asked to passively listen to music for a short period of time (e.g. Glenn et al., 2014). It is possible that there was not enough of a disparity in the cognitive load between the stressful and neutral tasks to elicit a measurably significant difference in pain tolerance. Further discussion of the challenges of employing stress manipulations within psychologically distressed populations can be found in section 7.3.1.4 of this chapter.

That the results of the studies presented within this thesis contradict those of previous research is most likely the result of methodological factors. There were marked variations in participants' technique of applying the algometer to themselves, potentially meaning that both the pressure exerted and time for which they could tolerate the algometer were more reflective of the way in participants' technique with the algometer rather than their actual pain threshold and tolerance. Whilst a better approximation of the pain of self-harm in terms of its localised and rapid onset nature than, for example, the cold pressor test, the algometer may still lack ecological validity as a proxy for self-harm. The stress manipulation employed in Study 1 may not have been sufficiently stressful- in comparison to real-life stress experienced by participants- in order to elicit a measurable change in stress, and consequently in pain threshold and tolerance.

7.2.2 The relationship between emotional and physical pain sensitivity

Our findings also make a significant contribution to research around the relationship between emotional and physical pain sensitivity. The overwhelming majority of existing research in this area has relied upon neuroimaging, using a single emotional pain testing paradigm; Cyberball (e.g. Eisenberger et al., 2003; 2006). It has also disproportionately focussed upon small samples drawn from non-clinical and adolescent populations, possibly resulting in low statistical power, a frequent affliction of neuroimaging research (Button et al., 2013). Within self-harming populations, the social neuroscience theory that being more sensitive to emotional pain also means being more sensitive to physical pain, appears paradoxical; research has demonstrated that individuals who have engaged in self-harm are much *more* sensitive to emotional pain (Nock et al., 2008; Nock & Mendes, 2008), and yet much *less* sensitive to behavioural physical pain (Franklin et al., 2012; Hamza et al., 2014). Self-reported sensitivity to emotional and physical pain, and physical pain distress, do appear to relate to each other, and those who report greater sensitivity to emotional pain also report greater sensitivity to physical pain. Whilst these self-report data support the

social neuroscience viewpoint, the behavioural data do not; indeed, we found no significant relationship between behaviourally indexed emotional and physical pain sensitivity across any of the groups. Potentially, these results signify that it is *self-perceived* sensitivity to emotional and physical pain, but not actual behavioural sensitivity, that exhibit this relationship. The divergence between self-perceived and behavioural sensitivity to emotional and physical pain may be indicative of a broader 'suite' of cognitive distortions that occur during psychological distress (Anestis et al., 2012), whereby individuals underestimate their own capacity for tolerating both physical and emotional distress. Such a divergence between self-reported and behavioural sensitivity may also be an artefact of a lack of shared variance between self-report and behavioural measures of distress tolerance; the dearth of agreement between affective and somatic behavioural measures of distress has been noted in other studies (e.g. McHugh et al., 2011). For a further discussion of this, see section 7.3.1.3.4 of this chapter.

In contrast to previous work exploring emotional pain sensitivity in self-harm (Nock & Mendes, 2008), Study 3 found that scores on the Distress Tolerance Task were virtually equivalent across all three groups. A likely explanation for this is that for the adult participant group in which the task was employed, it was too far removed from participants' real-life experiences of distress to be a valid measure of emotional pain sensitivity. The majority of participants reported they had guessed at an early stage that the task had no solution and that the researcher was answering "correct" or "incorrect" to their card placement in a pre-defined sequence. The equivalent scores across groups therefore do not necessarily signify emotional pain sensitivity, but are perhaps rather a reflection of perseverance.

7.2.3 Theories of affect regulation in self-harm

7.2.3.1 Offset analgesia

In Chapter 1 (section 1.6.1), different theories of affect regulation in self-harm were discussed. The data from Study 1 demonstrated that negative affect was (minimally) reduced following pain, but that this effect was not group specific and could be seen across the control, ideation and enactment groups. There was no effect of pain upon positive affect. Tentatively, these results may offer some support for the theory of offset analgesia (Chapter 1, section 1.6.1.2), posited by Franklin et al (2012; 2013) as an explanation for how self-harm fulfils its function as a method of affect regulation. Franklin and colleagues (2013) found that pain reduced negative affect, but also simultaneously increased positive

affect, across all groups irrespective of self-harm status. They contend that this is a universal effect arising from the relief that individuals feel when a noxious stimulus is terminated, citing the work of Grill and Coghill (2002) as the underlying theoretical precedent for this theory. Grill and Coghill's (2002) seminal investigation of the offset analgesia phenomenon involved participants receiving three painful stimuli, trial one and three being of the same intensity and trial two being of a greater intensity. For example, taking the 'range' of intensity of a given painful stimulus from zero (no intensity) to 10 (maximum intensity), an experimenter administers painful heat stimuli to a participant; Trial 1 intensity is at level 3, Trial 2 intensity is at level 7 and Trial 3 intensity is at level 3 again. After each stimulus, participants are asked to rate their level of pain. What may be expected is that the participant's pain ratings will increase over the course of the three trials, with the stimulus becoming more painful the more times it is applied. What Grill and Coghill (2002) observed is that pain ratings increase between Trial 1 and Trial 2, but decrease for Trial 3; indeed, participants will rate the second application of a level 3 intensity stimulus to be less painful than the first application of the stimulus, even though it is at exactly the same intensity. More recent work by Derbyshire and Osborn (2009) has found that this effect may be the result of increasing endogenous opioid activity across the three trials, such that an analgesic effect is experienced by participants during the final stimulus, inhibiting pain perception. There are marked and fundamental differences in Franklin's and Grill and Coghill's conceptualisation of 'offset analgesia'; for Franklin, offset analgesia refers simply to termination of a noxious stimulus, but for Grill and Coghill, offset analgesia refers to the change in *perception* of pain brought about by comparing at least two painful stimuli of different intensities. The offset analgesia theory proposed by Franklin and colleagues is not the offset analgesia theory proposed by Grill and Coghill.

7.2.3.2 Gate Control Theory

Melzack and Wall (1965) contended that high cognitive load had the ability to inhibit the transmission of pain signals between the peripheral and central nervous systems. Here we investigated this as a possible mechanism for elevated pain threshold and tolerance in self-harm, hypothesising that the higher cognitive-affective load induced by the MAST stress manipulation in self-harming individuals would result in pain inhibition and consequently, an increased threshold and tolerance for physical pain. We did not find evidence to support this hypothesis, potentially because the concentration required by participants for the neutral control task was too great, meaning that cognitive load was not sufficiently

different between the two tasks to elicit measurably significant differences in pain threshold and tolerance. Equally, the stress manipulation may not have produced any significant feelings of distress in self-harming participants. Laboratory stress manipulations have often been criticised for their lack of realism (e.g. McHugh et al, 2011), particularly compared to the types of stressors experienced by psychologically distressed participants; giving a brief speech to a group of researchers is a world away from the stress of volatile interpersonal relationships or experiences of trauma. Without further research, we cannot say with any certainty which explanation is the most likely for the results we observed.

7.2.3.3 Emotional Analgesia

Incorporating elements of Grill and Coghill's offset analgesia theory (2002) and Melzack and Wall's Gate Control Theory (1965), we propose an alternative mechanism for affect regulation and pain insensitivity in self-harm; emotional analgesia. The vast majority of individuals that have engaged in self-harm report that they did so in order to relieve unbearable emotional pain (Gratz, 2001; O'Connor et al., 2009). We suggest that, within the framework of Grill and Coghill's model, the acute emotional distress that precipitates an episode of self-harm, acts as the higher level painful stimulus. Indeed, the endogenous opioid system is activated not only by physical, but also by emotional challenge (Prossin, Love, Koeppe, Zubieta & Silk, 2010). When an individual then engages in self-harm, there is a dual analgesic effect of increased endogenous opioid activity and inhibition of pain signal transmission by the high cognitive-affective load of their acute distress. The physical pain of the self-harm is offset by comparison with the extreme emotional pain the person is currently experiencing. Such an emotional analgesia hypothesis is empirically testable, by experimentally manipulating cognitive-affective load and measuring differential effects upon participants' threshold and tolerance for physical pain. Future research should attempt to determine the mechanism by which self-harm regulates affect, as this could provide a key target for intervention and treatment development.

7.2.4 The IMV

There is a significant dearth of knowledge regarding the factors that differentiate individuals who will ideate about self-harm from those who will go on to act upon their thoughts of self-harm, and this has been identified as a critically important area for research focus (Klonsky & May, 2014; O'Connor & Nock, 2014).

The studies reported in this thesis investigated commonalities and differences between those who ideate about self-harm and those who have enacted self-harm behaviour, for a variety of different variables. The IMV model (O'Connor, 2011) posits that variables within the pre-motivational (vulnerability components) and motivational phases are not the key factors that distinguish between those individuals who have thoughts of self-harm only and those who have engaged in the behaviour. Variables within these phases, however, should differ between healthy controls and those who have thought about or engaged in self-harm. It is variables within the volitional phase that O'Connor (2011) contends will be key to differentiating between self-harm ideation and enactment. For a full list of variables explored within this thesis, and their position within the IMV, see Chapter 3 section 3.1.1.

7.2.4.1 Pre-motivational phase

Perfectionism as a pre-motivational phase variable has been previously explored (O'Connor et al., 2012), and within Studies 2 and 3, we were specifically interested in the relationship between perfectionism and emotional pain sensitivity. Thus, we did not compare perfectionism across the three groups, instead exploring the differing relationship between perfectionism and emotional pain sensitivity within each group. As a result of this we cannot comment on whether or not the evidence from this thesis supports perfectionism as a pre-motivational phase variable.

Consistent with previous studies (Glenn et al., 2011; Nock et al., 2008), self-reported emotional pain sensitivity was significantly higher in the self-harm enactment group, relative to controls, in both Study 2 and Study 3. The pattern of self-reported emotional pain sensitivity was similar in the self-harm ideation and enactment groups, suggesting that this may be a pre-motivational phase variable within the model, and does not differentiate between individuals who will ideate about self-harm, and those who will translate those thoughts into self-harm behaviour. Its association with another established pre-motivational phase variable, perfectionism, gives additional weight to this suggested placement within the IMV. Study 2 found that the more recently an individual had engaged in self-harm behaviour, the greater their self-reported sensitivity to emotional pain. Therefore, whilst heightened emotional pain sensitivity is potentially a key marker of acute psychological distress in self-harming populations, it may not be useful as a risk marker to determine which of the individuals who ideate about self-harm will go on to act on their thoughts (i.e., enact self-harm).

A similar ordered effect (self-harm enactment> self-harm ideation> controls) also emerged for physical pain distress and sensitivity. Physical pain tolerance has been hypothesised to reside within the volitional phase of the IMV, a nested component of 'acquired capability', and is one of the three pillars of the IPT model of suicidal behaviour (Joiner, 2005; Van Orden et al., 2008; 2010). Given this contention, it is perhaps surprising that self-perceived tolerance of physical pain appears to be divorced from behavioural tolerance for physical pain. Indeed, the pattern of the ordered effect would suggest that self-perceived sensitivity to physical pain may lie within the pre-motivational or motivational phase of the IMV. This raises a potentially important clinical hypothesis: that individuals who engage in self-harm may be unaware of their own increased capability for harming themselves, and this divergence between self-perception and behaviour warrants further investigation. There is, however, a caveat; lack of agreement between self-report and behavioural measures of emotional and physical pain sensitivity may be a function of the lack of shared variance between self-report and behavioural measures, as opposed to genuine differences between self-perception and behaviour. See section 7.3.1.3.4 of this chapter for further consideration of this. Anestis et al. (2012) discuss the apparent disparity between self-reported and behavioural measures of distress tolerance (including physical pain) as potentially the result of cognitive distortions occurring during psychological distress. One explanation for the results seen in Study 2 therefore, may be that beliefs about the ability to withstand both emotional and physical pain are subordinate components of more generalised higher-level cognitions regarding coping, resilience and self-efficacy that are affected during acute psychological distress. A further consideration is that the self-report measure of physical pain sensitivity employed within Studies 2 and 3, the Pain Distress Inventory (PDI; Osman et al., 2003) is assessing latent constructs other than pain sensitivity, for example, pain anticipation or fear of pain. See Chapter 5, section 5.5.2 for further discussion of this.

7.2.4.2 Motivational phase

Motivational phase variables, defeat, entrapment, humiliation and hopelessness did not differ significantly between the ideation and enactment groups in Study 1, as predicted by the IMV. Conversely, the predicted differences between the control group and the two self-harm groups, were inconsistent; defeat only differed between controls and those in the ideation group, whilst entrapment differed only between the control and the enactment group. The overall sample size for Study 1 was small, and may have suffered from low statistical power, resulting in the lack of significant differences observed between the

control and self-harm groups for motivational phase variables. This does raise a challenge in interpreting the results for the IMV variables. When non-significant results are expected for some comparisons, but not for others, it is critical not to be selective when using statistical under-powering as a potential explanation for null results; the possibility that the lack of significant differences between the ideation and enactment groups may also be the result of low statistical power, must also be considered.

7.2.4.3 Volitional phase

7.2.4.3.1 Impulsivity and exposure to social modelling of self-harm

Impulsivity and exposure to social modelling were two volitional phase variables explored within Study 1. For both univariate and multivariate analyses, these emerged as being significantly different between the ideation and enactment groups, supporting the predictions of the IMV (O'Connor, 2011) and recent studies investigating IMV variables in larger-scale studies (Dhingra et al., 2015; O'Connor et al., 2012). A central tenet of the IMV is that there are variables that differentiate between individuals who will ideate about, and who will go on to enact, self-harm behaviour. The findings of Study 1 support this and signify that variables within the volitional phase of the model, may bear the most fruit for intervention and treatment development efforts; especially among those who are already suicidal. Volitional phase variables are also expected to differ between control and self-harm ideation groups, and between control and self-harm enactment groups. In this case, it was only exposure to social modelling of self-harm behaviour that differed between individuals in the control and enactment groups; there were no significant differences in exposure to social modelling between the control and ideation groups. For impulsivity, there were no significant differences between the control and two self-harm groups. The disparity in group sizes in Study 1 between control, self-harm ideation and self-harm enactment groups was marked, n= 94, 43 and 50, respectively, again raising questions regarding the statistical power of the study. The size of the ideation and enactment groups was relatively well-matched and this may, therefore, give more weight to the veracity of the significant differences between the ideation and enactment groups on volitional phase variables. For further discussion of statistical power issues arising in this thesis, see section 7.3.1.2 of this chapter.

7.2.4.3.2 Behavioural threshold and tolerance for physical pain

Within the IMV (O'Connor, 2011) and the IPT (Joiner, 2005; Van Orden, 2008; 2010), tolerance for physical pain is considered a component of acquired capability, and this is characterised as a volitional phase variable within the IMV. Previous studies have suggested that individuals who have engaged in self-harm have a higher threshold and tolerance for physical pain than those who have never engaged in self-harm (e.g. Franklin et al., 2011; Hooley et al., 2010). For an extensive systematic review of the literature in this area, see Chapter 2. Neither of the studies within this thesis, that investigated behavioural pain threshold and tolerance, found evidence to support the results of previous work in this area. For the first time, Studies 1 and 3 examined behavioural pain threshold and tolerance in individuals who had ideated about, but not engaged in self-harm, directly comparing them with individuals who had engaged in self-harm behaviour. Studies 1 and 3 found no significant between-group differences for behavioural physical pain. It has been proposed in a seminal study by Gratz et al. (2011) that elevated tolerance for physical pain in self-harm may be a function of distress, such that significant differences in pain tolerance are potentiated by acute stress. No significant effect of stress upon pain was found in the current studies. From the results of this thesis, we cannot conclude that pain threshold or tolerance are different in those who self-harm, relative to individuals who have never self-harmed, or to those who have experienced thoughts of self-harm without engaging in the behaviour. Thus, based upon the findings of the current thesis, we cannot endorse the inclusion of physical pain tolerance as a volitional phase variable within the IMV.

7.3 Key issues raised in this thesis

The implications of the studies' results have been discussed extensively above, however, the 'findings' of this thesis also extend beyond the outcomes, to the methodological and practical challenges of conducting studies of emotional and physical pain in individuals who ideate about or engage in self-harm.

7.3.1 Methodology and study design

7.3.1.1 Recruitment

Studies 1 and 3 within this thesis are the first to ever explore pain threshold and tolerance in self-harm ideation, by directly comparing individuals who have thought about, but never

engaged in self-harm, with those who have enacted the behaviour. One previous study reported that they had attempted to investigate this also, but despite extensive efforts, were only able to recruit 9 individuals fitting the criteria for inclusion in the self-harm ideation group and thus rendering statistical analysis of this group unviable (Hooley et al., 2010). We managed to recruit 25 individuals with self-harm ideation in Study 1 and 20 in Study 3. When participants completed questionnaire measures in the laboratory regarding their self-harm thoughts and behaviours, however, these answers often diverged from the responses given to the researcher in the initial phone screen interview. For example, based on in-lab questionnaire answers, 19 individuals were included within the ideation group for Study 1 and 18 in Study 3. The 'movement' of participants from one group to another between the phone screen interview and their lab visit is often inconsistent, with some participants initially in the ideation group moving to the control group based upon their lab questionnaire answers, whereas others move to the enactment group. Some of the example behaviours given in the self-harm measures employed may jog people's memories, so that they remember an instance of self-harm that perhaps they forgot to report in the telephone interview (for some participants, their most recent episode of self-harm was several years ago). It may also be the case that when completing questions in private on the computer, they feel more able to disclose self-harm behaviour that they did not feel at ease discussing with the researcher over the phone.

There was also movement of participants from the enactment to the ideation groups, between the screening interview and lab questionnaire completion. One reason for this may be the prescriptive nature of some of the questionnaire items. The SITBI (Nock et al., 2008) for example, describes types of self-harm behaviours that a person may have engaged in, e.g. cutting the skin or hitting oneself. Potentially, even with the inclusion of an 'other, please specify option', if participants' methods of injuring themselves do not appear on the list or they are perhaps less severe than the examples given, they may feel that their experiences do not count and fall outside of the category of self-harm.

The shifting of participants from one group to another can be problematic in terms of maintaining relative evenness in group sizes for statistical analysis, but the actual recruitment of individuals endorsing self-harm thoughts but no history of engaging in the behaviour, proved a more significant challenge during the course of this thesis research. Far more individuals have thoughts of self-harm than go on to engage in the behaviour (e.g. O'Connor et al., 2009; O'Connor et al. 2012), and based on this there should be a much larger 'pool' of individuals from which to recruit participants to the ideation group,

relative to the enactment group. Whilst only based on anecdotal evidence, a number of participants within the ideation groups of both Studies 1 and 3 mentioned that the researcher was the first person to whom they had ever disclosed their thoughts of self-harm, saying that they had felt too ashamed to reveal to others that they had thought of hurting or killing themselves. Some previous studies of identity and self-harm behaviour have found that many individuals who have engaged in self-harm feel that it becomes a part of their identity and a group membership, i.e. 'I am a self-harmer' or 'I am a suicide attempt survivor', with some individuals finding this reduces feelings of shame because they do not feel alone (Adams, Rodham & Gavin, 2005; Baker & Fortune, 2008). Whether or not individuals who ideate about, but have never engaged in self-harm, feel a similar sense of group membership is, to our knowledge, unknown. Potentially this may be considered a liminal state, particularly if they have not previously disclosed their thoughts of self-harm; the person who has thought about, but not engaged in self-harm occupies the boundary ground between a 'healthy' individual and a 'self-harmer'. Because of this, those with thoughts of self-harm may be less willing to come forward to take part in research in case their non-group-defined status is compromised.

7.3.1.2 Statistical power

Recruitment issues, particularly for the ideation groups (as described in the section above), undoubtedly have impacted upon statistical power for the current studies, and may mean that some of the results reported within this thesis are subject to Type I ('false positive', finding a significant effect where none exists) or Type II ('false negative' failing to find a significant effect where one does exist) error. The window for participant recruitment within the scope of a PhD project is limited, and with more time, it is possible that a larger sample size may have been achieved. The vast majority of studies that have investigated physical pain tolerance in self-harm, have been conducted with small sample sizes (see Chapter 2 for a full discussion), and many of these have employed similar sample sizes to those of the current study (e.g. Franklin et al., 2013; Hooley et al., 2010). Furthermore, many of these studies have found significant differences in physical pain tolerance between controls and individuals with a history of self-harm. Irrespective of the presence or absence of significant between-group differences, over-reliance upon small sample sizes may mean that such results are possibly spurious and unreliable. Inconsistencies in the landscape of evidence around altered physical pain threshold and tolerance in self-harm, are legion, and may be the result of insufficient statistical power impacting upon results. It is therefore critically important that future studies in this area begin to recognise this, and take steps to

recruit larger samples. This is not without significant challenges, as discussed in section 7.3.1.1 of this chapter, but the potential scientific benefits of conducting high quality, sufficiently powered studies, far outweigh the associated costs of longer study time-frames. One way of accomplishing this may be to conduct more multi-centre collaborative studies. When investigating variables within the IMV model of suicidal behaviour (O'Connor, 2011), it is expected that there will be significant differences in pre-motivational and motivational phase variables between the control and ideation groups, and also between the control and enactment groups. These variables should not, however, differ significantly between the ideation and enactment groups. For volitional phase variables, we would anticipate significant differences between all of the groups, include ideation and enactment groups. When sample sizes are small and statistical power is reduced, the interpretation of IMV variables results can be challenging; the lack of significant differences between ideation and enactment groups on pre-motivational and motivational phase variables is expected within the model, but these could also be null results, with small group sizes masking significant differences. Equally, expected significant differences between the ideation and enactment groups on volitional phase variables could also be a function of group size disparity. Future studies exploring IMV variables should be mindful of statistical power considerations, to ensure that the results are a function of genuine between-group differences and not insufficient statistical power. We would recommend that such studies report observes statistical power within their results to aid interpretation of the findings.

7.3.1.3 Measurement of physical and emotional pain

7.3.1.3.1 Behavioural measurement methods for physical pain

There is no 'gold standard' for the measurement of behavioural physical pain threshold and tolerance within this population, and previous studies have used a wide variety of methods, including the pressure algometer (Glenn et al., 2014), cold pressor (Franklin et al., 2010) and thermode (Schmahl et al., 2006). For further information about the methods used in previous studies, see Chapter 2. In the current behavioural studies, we elected to use the pressure algometer, as it was thought that this would better approximate the type of pain experienced during self-harm, i.e. focal and acute in onset. It is also the method most favoured in recent studies in this area (Glenn et al., 2014; Hooley & St Germain, 2013). The use of the pressure algometer, however, is not without its drawbacks. As the pain induced is dependent upon the pressure that participants can exert, strength was potentially a limiting factor. Indeed, several participants commented that they wanted to press down

harder but did not feel they were physically strong enough to do so. Additionally, there was great variation in the way in which participants applied the algometer to their fingers. Some pressed down very hard, very quickly, delivering a short but intense burst of pain, whereas others pressed down slowly, for a much longer period of time, resulting in a slow building pain. Without the researcher administering the algometer to participants, it is difficult to ensure consistency in stimulus application, but in doing so, the pain elicited may be even less of an adequate proxy for that experienced during self-harm; tolerance for self-applied pain is higher than that for other-applied pain (Braid & Cahusac, 2005). The inconsistencies within previous studies may also be a function of pain measurement method, and there is a need for basic scientific research to explore the methodological nuances of measuring pain within populations of individuals who self-harm. This is a critically important, but thoroughly neglected point within the extant literature on pain and self-harm; indeed, none of the previous studies in this area make any mention of the need for clarity regarding 'gold standard' methodology for assessing pain threshold and tolerance within this population.

7.3.1.3.2 Controlling for potential confounds of physical pain threshold and tolerance

The two studies reported here attempted to control for as many possible confounds as possible; participants were screened for existing medical conditions that may impact upon their ability to sense painful stimuli, e.g. Raynaud's disease, neuropathy, and were also asked to refrain from taking any form of analgesic medication (including cold and flu medications), for at least 8 hours before their lab visit. This is in contrast to numerous previous studies that have neglected to control for even basic potential confounds, such as participants' ingestion of painkilling medication (see Chapter 2 sections 2.3.1.4 and 2.3.4.4).

7.3.1.3.3 Behavioural methods for measuring emotional pain sensitivity

Methods for assessing behavioural sensitivity to emotional pain are highly varied, with some employing difficult or impossible cognitive tasks for participants to solve, socially evaluated speech tasks, or asking participants to recall troubling interpersonal circumstances. In Study 3 of this thesis, we employed the Distress Tolerance Task (DTT; Nock & Mendes, 2008). This is a frequently employed measure of ability to tolerate emotional distress and has been used in many studies of self-harm and other forms of psychological distress, such as disordered eating (Anestis et al., 2012; Nock & Mendes,

2008). Not only did the expected between-group differences between self-harm and control groups not emerge, there was, in fact, barely a discernible between-group difference in scores at all, with almost all participants continuing until the very end of the task. Furthermore, most participants guessed that there was no solution to the task from early on in the study. Studies using this task have mostly been conducted with adolescent populations, so it is possible that the validity of the DTT may be age specific. Participants often reported quite arbitrary reasons for continuing or discontinuing the task; some had a number of cards in mind to attempt to match, and once they reached this, they would stop. When asked why they persevered with the task despite the fact that they strongly suspected there was no solution, participants gave comments such as: "I thought it would be rude not to [continue until the end]!", "I didn't want to let you [the researcher] down" and "I'm not a quitter!" Participants reasons for continuing with the task, and therefore for their distress tolerance score, appeared to have little to do with their level of emotional pain sensitivity.

Other measures of behavioural emotional pain sensitivity may have resulted in different findings, but the majority of existing laboratory distress tolerance measures have received extensive criticism for their lack of realism in comparison to the everyday distress experienced by participants (e.g. Ameral et al., 2014; Meyer et al., 2013). Heightened sensitivity to emotional pain, as well as poorer emotion regulation abilities, have been associated with many forms of psychological distress (Anestis et al., 2012; Gratz et al., 2004). There is a need for better and more reliable measures of emotional pain sensitivity for use in research, and for a thorough evaluation of the validity of existing measures.

7.3.1.3.4 Convergence and divergence between behavioural and self-report measures

Our findings of a lack of agreement between self-report and behavioural measures of both emotional and physical pain sensitivity are consistent with the observations of some other studies (Anestis et al., 2012; McHugh et al., 2011). It is possible that this is the result of a genuine divergence between self-perceived and behavioural sensitivity to emotional and physical pain. More plausible though, is that this inconsistency is the result of a lack of shared variance between these two measurement modalities. McHugh et al (2011) found measures of affective and somatic distress to correlate poorly, and contend that distress tolerance measures may be highly domain specific. Caution should be exercised when selecting methods of evaluating self-reported and behavioural sensitivity to emotional and physical pain, to ensure that measures are assessing the same latent constructs.

7.3.1.4 Use of stress manipulations in individuals who ideate about, and engage in, self-harm

No effect of stress manipulation upon physical pain threshold or tolerance was observed within Study 1. This is the first time that the MAST (Smeets et al., 2012) has been used in this population, and ratings of stress during the stressful and neutral conditions of the task exhibited little difference. Other studies of pain and self-harm have used self-generated scripts, whereby participants are asked to recall a stressful negative interpersonal event (Gratz et al., 2011), or have used stressful speech tasks Franklin et al., 2012). As discussed in section 7.3.1.4 of this chapter, the degree to which laboratory stress manipulations are an adequate proxy for real-life stress experienced by individuals in psychological distress, is highly questionable. It is, however, a fine line to tread, between sufficiently manipulating participants' levels of stress to elicit measurable changes in outcome variables, and conducting ethical research that maintains the safety of participants at potential risk of suicide.

7.4 Limitations of the studies presented in this thesis

The results of this thesis must be interpreted within the context of the studies' limitations. Small sample sizes and the resultant low statistical power is a key limitation of the two laboratory studies reported here. In particular, this is an issue for the self-harm ideation groups, which included very small numbers across both studies. Potentially this may have masked any significant differences between the ideation and enactment groups on measures of physical pain threshold and tolerance. The stress manipulation used in Study 1, the MAST (Smeets et al., 2012), appeared to have little effect on participants. This may have been a result of the 'active' nature of the neutral control condition to which it was compared, or may speak to the questionable representativeness of laboratory stressors relative to real-life stress experienced by participants. The Distress Tolerance Task (Nock & Mendes, 2008) was highly compromised by participants guessing from an early stage that it was an impossible task. Indeed, participants' reasons for continuing or discontinuing the task were largely arbitrary and had little relation to their level of distress or emotional pain sensitivity.

7.5 Unique contribution of this thesis to the literature

Despite some limitations, these studies make numerous important and unique contributions to the literature in this area. In more than two decades of research into altered physical pain

sensitivity and self-harm, these are the first studies to have measured pain threshold and tolerance in individuals who have ideated about, but never engaged in, self-harm. These studies also address the paucity of research investigating the relationship between physical pain threshold and tolerance and other psychological variables associated with self-harm. The two laboratory studies within this thesis controlled for many potential confounds overlooked by previous studies, such as participants' pre-existing medical conditions, ingestion of analgesics prior to study participation etc. Much recent research into pain and self-harm has only explored this in relation to NSSI. The current studies expand knowledge in this area by including a mixed sample (NSSI and suicidal self-harm), that is more reflecteive of the nuanced nature of self-harm motivation. They are the first studies to investigate the relationship between both self-report and behavioural sensitivity to emotional and physical pain in self-harm, finding that self-perceived emotional pain sensitivity is similarly elevated in both self-harm ideation and enactment and that this is higher in those who have self-harmed more recently. The findings of this thesis signify that emotional pain sensitivity is likely to be a pre-motivational variable for inclusion within the IMV model of suicidal behaviour (O'Connor, 2011). Furthermore, this thesis supports the validity of exposure to social modelling of self-harm and impulsivity as volitional phase variables, differentiating those who think about self-harm from those who have engaged in the behaviour, and thus providing an important target for intervention and treatment development. The two laboratory studies presented within this thesis are the first studies outside of the USA to explore the relationship between pain and self-harm in a community sample. Additionally, Study 1 is the first study to employ a repeated-measures experimental design when investigating the effect of stress upon pain threshold and tolerance in self-harm. As discussed in Chapter 2, the overwhelming majority of studies in this area have focussed on NSSI, however, often in the absence of any actual assessment of suicidal thoughts or behaviours. All three of the studies within this thesis assessed both suicidal and non-suicidal self-harm thoughts and behaviours, and thus represent the first studies on 'self-harm' *per se*, as opposed to NSSI *or* suicidal behaviour. In sum, this thesis has made a timely and novel contribution to the field of self-harm research and provided fertile ground for the development of further studies in this area.

7.6 Key directions for future research

This thesis has highlighted a number of key directions in which future research should proceed. There is a significant gap in our understanding of methodological best practices for measuring pain threshold and tolerance in individuals who self-harm. As discussed

extensively in Chapter 2, previous studies in this area have utilised a wide array of different measures, and it is uncertain whether or not results may differ as a function of how pain threshold and tolerance are assessed. It would be a good investment of future research energy to conduct more basic scientific research studies to investigate this, ensuring that further work in this area is focussed upon areas of genuine divergence, as opposed to 'tilting at windmills' that are a function of methodological variation.

Study 1 found no significant effect of stress upon pain threshold or tolerance, contradicting previous research that found stress increased pain tolerance (Gratz et al., 2011). As the stress manipulations used in these two studies were very different, future research should employ a variety of stress manipulations in order to ascertain whether increased pain tolerance is only potentiated by certain types of distress.

Both exposure to social modelling of self-harm and impulsivity were differentially associated with self-harm ideation and enactment, such that those in the enactment group were more likely to know someone who has self-harmed and were more impulsive than those in the ideation group. 'Exposure to social modelling', however, is a broad category in need of unpacking. Potentially, it is not exposure to self-harm *per se* that increases the likelihood of an associated individual engaging in self-harm behaviour, but instead is that both individuals have been exposed to a common set of variables that place them both at increased risk of self-harm, e.g. deprivation, bullying, etc. Future research should explore the nuances of exposure to social modelling of self-harm, in order to isolate key elements that could be modified by treatments or interventions.

The IMV (O'Connor, 2011) is an important recent contribution to the theoretical landscape of suicide research. At present, the model only includes a subset of variables associated with self-harm ideation and self-harm enactment, and more research must be conducted to add to the pool of variables within the model. Furthermore, variables that have traditionally been associated with 'self-harm' as a homogenous concept, should be examined within the context of the IMV to determine whether they are differentially associated with ideation or enactment. The volitional phase of the model that contains factors differentiating between those who will have thoughts (only) of self-harm and those who will go on to engage in the behaviour, is also the sparsest phase of the model. Given the critical importance of improving our ability to detect who will act upon their thoughts of self-harm, there is an urgent need for more research into possible volitional phase variables.

7.7 Conclusions

In sum, this thesis has contributed three empirical studies to the literature around emotional and physical pain in self-harm ideation and enactment. All three of these studies extend existing knowledge in this area and are the first to investigate emotional and physical pain in self-harm ideation. The findings of this thesis provide support for the IMV (O'Connor, 2011), demonstrating that it is volitional phase, and not pre-motivational or motivational phase variables, that differentiate between those who ideate about self-harm and those that have engaged in the behaviour. To this end, impulsivity and exposure to social modelling of self-harm behaviour were identified as key variables differing between self-harm ideation and enactment, and could represent an important target for the development of treatments and interventions. Exposure to social modelling of self-harm, however, must be investigated in a more nuanced manner to determine the key components which make this such a pernicious correlate of self-harm behaviour. No support was found for the idea that physical pain threshold and tolerance are elevated in those who ideate about or engage in self-harm, but these null results may be a consequence of small sample sizes and low statistical power. Self-perceived emotional pain sensitivity is highest in those who have engaged in self-harm, followed by those who have ideated about self-harm and is lowest in controls. Given the pattern of elevated emotional pain sensitivity across both the ideation and enactment groups, emotional pain sensitivity is suggested as a variable within the pre-motivational phase of the IMV.

Appendices

Appendix A
- Quality assessment tool
- Cross-sectional study quality assessments
- Case-control study quality assessments

Appendix B
- Suicide risk assessment protocol

Appendix C
- IMV pre-motivational, motivational and volitional phase variable measures

Appendix D
- Outcome variable measures

Appendix E
- Publications arising from this thesis

Appendix A Table 1
Quality assessment framework for assessing studies included within systematic review of pain and self-harm (Chapter 2)

Criteria	0	1	2
Design	Cross-sectional	Case-control	Prospective
Power	No mention of a power calculation	Power calculation reported, but sufficient power not achieved	Power achieved
Self-Injurious Behaviour Assessment	Non-validated scale; self-report; single question	Hospital admission; items from validated diagnostic/ mood rating scale	Clinical interview; validated scale (e.g. ISAS, SITBI, DSHI)
Suicidal Ideation/behaviour	Not reported/ not assessed	Mixed group of suicidal and non-suicidal self-harming participants	Homogenous groups of either suicidal OR non-suicidal self-harm
Pain Assessment	No assessment at all	Self-report only	Behavioural assessment, e.g. maximum time/ temperature/ pressure/ voltage that could be tolerated.
Appropriate choice of comparison group	No case group free from self-harm *E.g. includes self-harm ideators, those who have previously self-harmed or no comparison group.*	One case group with no personal history of self-harm thoughts or behaviours.	-
Confounding variables *Will require some judgement on behalf of the rater as studies will have done this to differing degrees.*	No attempt to control for confounding factors in recruitment or analyses.	Accounts for basic confounding variables either during recruitment or analysis. E.g. age, gender.	Accounts for basic and additional confounding variables either during recruitment or analysis e.g. medication use/substance abuse, comorbid psychiatric conditions

Appendix A Table 2

Results of quality assessment for cross-sectional studies, displayed from lowest to highest quality

Study	Design	Power	Self-harm assessment	Suicidal ideation/behaviour	Pain assessment	Appropriate choice of comparison group	Confounding variables	Total score
Kemperman et al. (1997)	0	0	0	0	1	1	1	3
Russ et al. (1992)	0	0	0	0	1	1	1	3
Russ et al. (1994)	0	0	0	0	1	0	2	3
Bresin & Gordon (2013)	0	0	2	0	1	1	0	4
Schmahl et al. (2004)	0	0	0	0	1	1	2	4
Niedtfeld et al. (2010)	0	0	0	0	2	1	2	5
Russ, Campbell, Kakuma, Harrison & Zanine (1999)	0	0	0	1	1	1	2	5
Franklin, Aaron, Arthur, Shorkey & Prinstein (2012)	0	0	2	0	2	1	1	6
Franklin, Hessel & Prinstein (2011)	0	0	2	0	2	1	1	6
Weinberg & Klonsky (2012)	0	0	2	0	2	1	1	6
Hooley, Ho, Slater & Lockshin (2010)	0	0	0	2	2	1	2	7
Hooley & St Germain (2014)	0	0	0	2	2	1	2	7
Ludäscher et al. (2009)	0	2	0	0	2	1	2	7
Gratz et al. (2011)	0	2	2	0	2	1	2	9
St Germain & Hooley (2013)	0	0	2	2	2	1	2	9

Appendix A Table 3

Results of quality assessment for case-control studies, displayed from lowest to highest quality

Study	Design	Power	Self-harm assessment	Suicidal ideation/behaviour	Pain assessment	Appropriate choice of comparison group	Confounding variables	Total score
Magerl, Burkart, Fernandez, Schmidt & Treade (2012)	1	0	0	0	1	1	2	5
Bohus et al. (2000)	1	0	0	0	2	1	2	6
Schmahl et al. (2006)	1	0	0	0	2	1	2	6
Glenn, Michel, Franklin, Hooley & Nock (2014)	1	0	2	0	2	1	1	7
Hamza, Willoughby & Armiento (2014)	1	0	2	0	2	1	1	7
Franklin, Hessel, Aaron, Arthur, Heilbron & Prinstein (2010)	1	0	2	0	2	1	2	8
Orbach, Palgi, Stein, Har-Even, Lotem-Peleg, Asherov & Elizur (1996a)	1	0	1	2	2	1	1	8
Orbach, Stein, Palgi, Asherov, Har-Even & Elizur (1996b)	1	0	1	2	2	1	1	8
McCoy, Fremouw & McNeil (2010)	1	0	2	1	2	1	2	9
Orbach, Mikulincer, King, Cohen & Stein (1997)	1	0	1	2	2	1	2	9

Appendix B

Suicide Risk Assessment Protocol

Risk factors for suicide *(Interviewer complete known sections on own)*

- ❒ Male gender (females more attempts, males more completions)
- ❒ Ethnicity (white attempt & complete more than others)
- ❒ Age ≥16 years?
- ❒ Current psychiatric disorder?
  - ❒ Current mood disorder (MDD, Bipolar)
  - ❒ Current substance use disorder (alcohol, drugs)
  - ❒ Current psychotic disorder
  - ❒ Current personality disorder (esp. BPD or ASPD)
- ❒ Suicide history
  - ❒ Previous suicide attempt (yes/no)
  - ❒ Family history of suicide attempts/completions (yes/no)?
  - ❒ Current suicidal ideation (0-10 scale)?
  - ❒ Current plan (yes/no)?
    - Access to lethal means (firearm, drugs, etc)?
  - ❒ Current intent (On scale 0 – 10, what is your current intent to kill yourself ? ___)
- ❒ Other risk factors
  - ❒ Recent loss, separation/divorce/break-up?
  - ❒ Impulsiveness?
  - ❒ Hopelessness about the future?
  - ❒ Current distress, irritability, agitation or other "abnormal" mental state
  - ❒ Depressed mood (On scale 0 – 10 [0 = neg, 10 = pos] how would you rate your current mood? ___)

NOTES :

Protective factors & Safety plan:

- ❒ In treatment? If so, is clinician aware of risk? _____
- ❒ Family/roommate/friends aware of risk? _____
- ❒ [IF YES TO ACCESS] Means restriction (firearms, drugs, family/social support/monitoring)? _____
- ❒ Presence of children in the home, spouse/partner, or other positive relationships?
- ❒ Steps taken to increase subject safety (check all that apply):

LOW RISK == No past attempt or current SITB:

- ❒ Validated subject's feelings
- ❒ Encourage S to contact clinician if distressed or in need of help in future
- ❒ Provide referrals as needed

MODERATE RISK == Past attempt, but intent ≤6

- ❒ (check all completed above)
- ❒ S articulated own safety plan (i.e., what to do if thoughts/urges increase)
- ❒ Provided S with emergency contact numbers (999, find # of own clinician, Samaritans, Breathing Space and from list of referrals)

HIGH RISK == Current SI present, and intent 7-8, but no plan or access to lethal means

- ❒ (check all completed above)
- ❒ Encourage S to immediately contact support(s) and clinician(s)/psychiatric emergency services to inform of risk
- ❒ Call Rory O'Connor ***(must do)***

IMMINENT RISK == Current suicidal intent (7-8 with specific plan/access or 9-10 regardless of plan)

- ❒ (check all completed above)
- ❒ Call Rory O'Connor ***(must do)***
- ❒ S tells/calls clinician and/or people in support network to inform them of level of risk and enlist their assistance in getting subject to a clinician ***(preferable)***
- ❒ If in lab: S should not leave alone. They can leave with family member/friend, experimenter should accompany S to Hospital Emergency Department ***(must do)***
- ❒ If on the phone: Subject should not remain at home alone. Experimenter tells/calls clinician and/or people in support network to inform them of level of risk and enlist their assistance in getting the S to a clinician ***(must do)***
- ❒ If an ambulance is being sent, stay on the phone with the S until the ambulance arrives.
- ❒ If S refuses to do the above: call 999 and inform of subject's location and risk level.

Appendix C

IMV pre-motivational phase variables measures

Multidimensional Perfectionism Scale- Social (MPS-Social; Hewitt & Flett, 1991)

Directions: Please read the following statements and decide to what extent you agree or disagree with them. If you strongly agree, circle 7; if you strongly disagree, circle 1; if you feel somewhere in between, circle one of the numbers from 2 to 6; if you feel neutral or undecided, the midpoint is 4.

	Strongly Disagree						**Strongly Agree**
I find it difficult to meet others' expectations of me.	1	2	3	4	5	6	7
Those around me readily accept that I can make mistakes too.	1	2	3	4	5	6	7
The better I do, the better I am expected to do.	1	2	3	4	5	6	7
Anything I do that is less than excellent will be seen as poor work by those around me	1	2	3	4	5	6	7
The people around me expect me to succeed at everything I do.	1	2	3	4	5	6	7
Others will like me even if I don't excel at everything.	1	2	3	4	5	6	7
Success means that I must work even harder to please others.	1	2	3	4	5	6	7
Others think I am okay, even when I do not succeed.	1	2	3	4	5	6	7
I feel that people are too demanding of me.	1	2	3	4	5	6	7
Although they may not show it, other people get very upset with me when I slip up	1	2	3	4	5	6	7
My family expects me to be perfect.	1	2	3	4	5	6	7
My parents rarely expect me to excel in all aspects of my life.	1	2	3	4	5	6	7
People expect nothing less than perfection from me.	1	2	3	4	5	6	7
People expect more from me than I am capable of giving.	1	2	3	4	5	6	7
People around me think I am still competent even if I make a mistake	1	2	3	4	5	6	7

Perfectionistic Cognitions Inventory (PCI; Flett, Hewitt, Blankstein & Gray, 1998)

Listed below are a variety of thoughts about perfectionism that sometimes pop into people's heads. Please read each thought and indicate how frequently, if at all, the thoughts occurred to you **over the last week**. Please read each item carefully and *circle* the appropriate number, using the scale below.

	Not at all 0	**Sometimes 1**	**Moderately Often 2**	**Often 3**	**All of the Time 4**
Why can't I be perfect?	0	1	2	3	4
I need to do better	0	1	2	3	4
I should be perfect	0	1	2	3	4
I should never make the same mistake twice	0	1	2	3	4
I've got to keep working on my goals	0	1	2	3	4
I have to be the best	0	1	2	3	4
I should be doing more	0	1	2	3	4
I can't stand to make mistakes	0	1	2	3	4
I have to work hard all the time	0	1	2	3	4
No matter how much I do, it's never enough	0	1	2	3	4
People expect me to be perfect	0	1	2	3	4
I must be efficient at all times	0	1	2	3	4
My goals are very high	0	1	2	3	4
I can always do better, even if things are almost perfect	0	1	2	3	4
I expect to be perfect	0	1	2	3	4
Why can't things be perfect?	0	1	2	3	4

My work has to be superior	0	1	2	3	4
It would be great if everything in my life was perfect	0	1	2	3	4
My work should be flawless	0	1	2	3	4
Things are seldom ideal	0	1	2	3	4
How well am I doing?	0	1	2	3	4
I can't do this perfectly	0	1	2	3	4
I certainly have high standards	0	1	2	3	4
Maybe I should lower my goals	0	1	2	3	4
I am too much of a perfectionist	0	1	2	3	4

Perfectionistic Self-Presentation Scale (PSPS; Hewitt et al., 2003)

Perfectionistic Self-Promotion

5. I try always to present a picture of perfection
7. If I seem perfect, others will see me more positively
11. It doesn't matter if there is a flaw in my looks
15. I must appear to be in control of my actions at all times
17. It is important to act perfectly in social situations
18. I don't really care about being perfectly groomed
23. I need to be seen as perfectly capable in everything I do
25. It is very important that I always appear to be "on top of things"
26. I must always appear to be perfect
27. I strive to look perfect to others

Nondisplay of Imperfection

2. I judge myself based on the mistakes I make in front of other people
3. I will do almost anything to cover up a mistake
4. Errors are much worse if they are made in public rather than in private
6. It would be awful if I made a fool of myself in front of others
8. I brood over mistakes that I have make in front of others
10. I would like to appear more competent than I really am
12. I do not want people to see me do something unless I am very good at it
20. I hate to make errors in public
22. I do not care about making mistakes in public
24. Failing at something is awful if other people know about it

Nondisclosure of Imperfection

1. It is okay to show others that I am not perfect
9. I never let others know how hard I work on things
13. I should always keep my problems to myself
14. I should solve my own problems rather than admit them to others
16. It is okay to admit mistakes to others
19. Admitting failure to others is the worst possible thing
21. I try to keep my faults to myself

The Self Rating Scale (SRS; Hooley, Ho, Slater & Lockshin, 2010)

Please respond to the following questions with respect to the scale below.

1	2	3	4	5	6	7
Strongly Disagree						Strongly Agree

1. I am socially inept and socially undesirable.

2. If others criticize me, they must be right.

3. Flaws, defects, and mistakes are intolerable.

4. I often feel inferior to others.

5. At times I have been so ashamed I just wanted to hide.

6. Sometimes I feel completely worthless.

7. I am no more special than anyone else.

8. Others are justified in criticizing me.

IMV motivational phase variable measures

Entrapment Scale (E-Scale; Gilbert & Allan, 1998)

For each of the following attitude statements indicate the extent to which you think it represents your own view of yourself. Read each item carefully and circle the number to the right of the statement that best describes the degree to which each statement is Like You. Use the scale below. Please do not omit any item.

SCALE

0 = Not at all like me 1 = A little bit like me 2 = Moderately like me 3 = Quite a bit like me 4 = Extremely like me

1. I am in situation I feel trapped in	0 1 2 3 4
2. I have a strong desire to escape from things in my life	0 1 2 3 4
3. I am in a relationship I can't get out of	0 1 2 3 4
4. I often have the feeling that I would just like to run away	0 1 2 3 4
5. I feel powerless to change things	0 1 2 3 4
6. I feel trapped by my obligations	0 1 2 3 4
7. I can see no way out of my current situation	0 1 2 3 4
8. I would like to get away from other more powerful people in my life	0 1 2 3 4
9. I have a strong desire to get away and stay away from where I am now	0 1 2 3 4
10. I feel trapped by other people	0 1 2 3 4
11. I want to get away from myself	0 1 2 3 4
12. I feel powerless to change myself	0 1 2 3 4
13. I would like to escape from my thoughts and feeling	0 1 2 3 4
14. I feel trapped inside myself	0 1 2 3 4
15. I would like to get away from who I am and start again	0 1 2 3 4
16. I feel I'm in a deep hole I can't get out of	0 1 2 3 4

Defeat Scale (D-Scale; Gilbert & Allan, 1998)

Below is a series of statements, which describe how people can feel about themselves. Read each item carefully and circle the number to the right of the statement that best describes how you have felt in the last 7 days. Use the scale below. Please do not omit any item.

SCALE

0 = NEVER 1 = RARELY 2 = SOMETIMES 3 = MOSTLY (a lot) 4 = ALWAYS

1	I feel that I have not made it in life	0	1	2	3	4
2	I feel that I am a successful person	0	1	2	3	4
3	I feel defeated by life	0	1	2	3	4
4	I feel that I am basically a winner	0	1	2	3	4
5	I feel that I have lost my standing in the world	0	1	2	3	4
6	I feel that life has treated me like a punch bag	0	1	2	3	4
7	I feel powerless	0	1	2	3	4
8	I feel that my confidence has been knocked out of me	0	1	2	3	4
9	I feel able to deal with whatever life throws at me	0	1	2	3	4
10	I feel that I have sunk to the bottom of the ladder	0	1	2	3	4
11	I feel completely knocked out of action	0	1	2	3	4
12	I feel that I am one of life's losers	0	1	2	3	4
13	I feel that I have given up	0	1	2	3	4
14	I feel down and out	0	1	2	3	4
15	I feel that I have lost important battles in life	0	1	2	3	4
16	I feel that there is no fight left in me	0	1	2	3	4

Other as Shamer Scale (OAS; Goss, Gilbert & Allan, 1994)

We are interested in how people think others see them. Below is a list of statements describing feelings or experiences about how you may feel other people see you.

Read each statement carefully and circle the number to the right of the item that indicates the frequency with which you find yourself feeling or experiencing what is described in the statement.
Use the scale below.

0 = NEVER 1 = SELDOM 2 = SOMETIME 3 = FREQUENTLY 4 = ALMOST ALWAYS

1. I feel other people see me as not good enough.	0 1 2 3 4
2. I think that other people look down on me	0 1 2 3 4
3. Other people put me down a lot	0 1 2 3 4
4. I feel insecure about others opinions of me	0 1 2 3 4
5. Other people see me as not measuring up to them	0 1 2 3 4
6. Other people see me as small and insignificant	0 1 2 3 4
7. Other people see me as somehow defective as a person	0 1 2 3 4
8. People see me as unimportant compared to others	0 1 2 3 4
9. Other people look for my faults	0 1 2 3 4
10. People see me as striving for perfection but being unable to reach my own standards	0 1 2 3 4
11. I think others are able to see my defects	0 1 2 3 4
12. Others are critical or punishing when I make a mistake	0 1 2 3 4
13. People distance themselves from me when I make mistakes	0 1 2 3 4
14. Other people always remember my mistakes	0 1 2 3 4
15. Others see me as fragile	0 1 2 3 4
16. Others see me as empty and unfulfilled	0 1 2 3 4
17. Others think there is something missing in me	0 1 2 3 4
18. Other people think I have lost control over my body and feelings	0 1 2 3 4

Beck Hopelessness Scale (BHS; Beck, Weissman, Lester & Trexler, 1974)

I'm going to read out a list of statements; if the statement describes your attitude for the past week including today, answer 'True'. If the statement does not describe your attitude, answer 'False'.

Please be sure to read each statement carefully.

1. I look forward to the future with hope and enthusiasm

   True False

2. I might as well give up because there is nothing I can do about making things better for myself.

   True False

3. When things are going badly, I am helped by knowing that they cannot stay that way forever.

   True False

4. I can't imagine what my life would be like in ten years.

   True False

5. I have enough time to accomplish the things I want to do.

   True False

6. In the future, I expect to succeed in what concerns me most.

   True False

7. My future seems dark to me.

   True False

8. I happen to be particularly lucky, and I get more of the good things in life than the average person.

   True False

9. I just can't get the breaks, and there's no reason I will in the future.

   True False

10. My past experiences have prepared me well for the future.

    True False

11. All I can see ahead of me is unpleasantness rather than pleasantness.

    True False

12. I don't expect to get what I really want.

    True False

13. When I look ahead to the future, I expect that I will be happier than I am now.

    True False

14. Things just won't work out the way I want them to.

1. I have great faith in the future.

   True False

2. I never get what I want, so it's foolish to want anything.

   True False

3. It's very unlikely that I will get any real satisfaction in the future.

   True False

4. The future seems vague and uncertain to me.

   True False

5. I can look forward to more good times than bad times.

   True False

6. There's no use in really trying to get anything I want because I probably won't get it.

   True False

IMV volitional phase variable measures

Exposure to social modelling of self-harm

Has anyone among your close friends every attempted suicide or deliberately harmed themselves?
YES/NO

Has anyone among your family ever attempted suicide or deliberately harmed themselves?
YES/NO

Impulsivity
(Items from Plutchik Impulsivity Scale; Plutchik, van Praag, Picard, Conte, & Korn, 1989)

I do things on the spur of the moment

0 = Never, 1= Sometimes, 2= Often, 3= Very often

I do things impulsively

0 = Never, 1= Sometimes, 2= Often, 3= Very often

Emotional Reactivity (ERS; Nock, Wedig, Hooley & Hokmberg, 2008)

ERS

This questionnaire asks different questions about how you experience emotions **on a regular basis (for example, each day)**. When you are asked about being "emotional," this may refer to being angry, sad, excited, or some other emotion. Please rate the following statements.

0 Not at all like me	**1** A little like me	**2** Somewhat like me	**3** A lot like me	**4** Completely like me

1	When something happens that upsets me, it's all I can think about it for a long time.	**0**	**1**	**2**	**3**	**4**
2	My feelings get hurt easily.	**0**	**1**	**2**	**3**	**4**
3	When I experience emotions, I feel them very strongly/intensely.	**0**	**1**	**2**	**3**	**4**
4	When I'm emotionally upset, my whole body gets physically upset as well.	**0**	**1**	**2**	**3**	**4**
5	I tend to get very emotional very easily.	**0**	**1**	**2**	**3**	**4**
6	I experience emotions very strongly.	**0**	**1**	**2**	**3**	**4**
7	I often feel extremely anxious.	**0**	**1**	**2**	**3**	**4**
8	When I feel emotional, it's hard for me to imagine feeling any other way.	**0**	**1**	**2**	**3**	**4**
9	Even the littlest things make me emotional.	**0**	**1**	**2**	**3**	**4**
10	If I have a disagreement with someone, it takes a long time for me to get over it.	**0**	**1**	**2**	**3**	**4**
11	When I am angry/upset, it takes me much longer than most people to calm down.	**0**	**1**	**2**	**3**	**4**
12	I get angry at people very easily.	**0**	**1**	**2**	**3**	**4**
13	I am often bothered by things that other people don't react to.	**0**	**1**	**2**	**3**	**4**
14	I am easily agitated.	**0**	**1**	**2**	**3**	**4**
15	My emotions go from neutral to extreme in an instant.	**0**	**1**	**2**	**3**	**4**
16	When something bad happens, my mood changes very quickly. People tell me I have a very short fuse.	**0**	**1**	**2**	**3**	**4**
17	People tell me that my emotions are often too intense for the situation.	**0**	**1**	**2**	**3**	**4**
18	I am a very sensitive person.	**0**	**1**	**2**	**3**	**4**
19	My moods are very strong and powerful.	**0**	**1**	**2**	**3**	**4**
20	I often get so upset it's hard for me to think straight.	**0**	**1**	**2**	**3**	**4**
21	Other people tell me I'm overreacting.	**0**	**1**	**2**	**3**	**4**

Pain Distress Inventory (PDI; Osman et al, 2003)

This questionnaire is about how people respond to physical or bodily pain. Please indicate how descriptive each statement is for you. Please read each statement carefully and then circle a number in the space to the right of each statement.

0 = Not at all like me, 1= Rarely like me, 2= Sometimes like me, 3= Often like me, 4= Very much like me

1. When I am in pain, I feel more dizzy or lightheaded than usual	0	1	2	3	4
2. When I am in pain, my stomach hurts or bothers me more than usual	0	1	2	3	4
3. I am terrified about being in pain	0	1	2	3	4
4. I have difficulty thinking straight when I am in pain	0	1	2	3	4
5. My body shakes or trembles more than usual when I am in pain	0	1	2	3	4
6. When I am in pain, I usually feel the urge to scream or yell at other people	0	1	2	3	4
7. I usually have trouble catching my breath when my pain gets worse	0	1	2	3	4
8. When I am in pain, I quietly wish I could get back at people who make my pain get worse	0	1	2	3	4
9. When I am in pain, I am bothered by feelings of nausea more than usual	0	1	2	3	4
10. When I am in pain, I feel more easily angry with people than I am willing to admit	0	1	2	3	4
11. I have always had a terrible fear of being in pain	0	1	2	3	4
12. When I am in pain, I think seriously about saying nasty things to people	0	1	2	3	4
13. I usually do not get a lot done at work, home, or school when pain gets worse	0	1	2	3	4
14. When I am in pain, I hold grudges against people (e.g.,doctors) who think the pain is all in 'my head'	0	1	2	3	4
15. I am afraid of pain sensations	0	1	2	3	4
16. When I am in pain, I tend to blame other people in general although I do not tell them openly	0	1	2	3	4
17. I usually feel miserable, down, or awful when I am in pain	0	1	2	3	4
18. It is hard for me to focus or concentrate as usual when I am in pain	0	1	2	3	4
19. When I am in pain, my mood is usually down, depressed, or lower than usual	0	1	2	3	4
20. I dread thinking about pain	0	1	2	3	4
21. I feel frightened when I sense pain coming on	0	1	2	3	4
22. When I am in pain, I feel down because I have difficulty enjoying most of the things I usually enjoy	0	1	2	3	4
23. When pain gets worse, nothing seems enjoyable	0	1	2	3	4
24. When I am in pain, I have trouble swallowing food or beverages	0	1	2	3	4
25. My heart pounds or races more than usual when my pain gets worse	0	1	2	3	4
26. I can't stand the thought of being in pain	0	1	2	3	4

Pain Visual Analogue Scale (VAS)

Please draw a vertical line on the line below to let us know how you are feeling right at this moment.

At this moment I feel…

Pain

Not at all Extremely

Appendix D

Outcome variable measures

Self-harm thoughts and behaviours
(items from the Adult Psychiatric Morbidity Survey (APMS; McManus, Meltzer, Brugha, Bebbington & Jenkins, 2009)

Have you ever thought of harming yourself, without wanting to die?

Have you ever actually harmed yourself, without wanting to die?

Have you ever thought of taking your life, even though you would not actually do it?

Have you ever made an attempt to take your life, by taking an overdose of tablets or in some other way?

Motivations for engaging in self-harm
(from the Child and Adolescent Self-Harm in Europe questionnaire, CASE; O'Connor, Rasmussen, Miles & Hawton, 2009)

Do any of the following reasons help to explain why you took an overdose or harmed yourself in some other way?

I wanted to show how desperate I was feeling
I wanted to die
I wanted to punish myself
I wanted to frighten someone
I wanted to get my own back on someone
I wanted to get relief from a terrible state of mind
I wanted to find out whether someone really loved me
I wanted to get some attention

Beck Scale for Suicide Ideation (SSI; Beck, Steer & Ranieri, 1988)

Now, I am going to read aloud a group of three statements at a time. Please indicate the statement in each group that best describes how you have been feeling for the past week. Be sure to listen to all three of the statements in each group before making a choice.

SSI1) 0. I have a moderate to strong wish to live.
1. I have a weak wish to live.
2. I have no wish to live.

SSI2) 0. I have no wish to die.
1. I have a weak wish to die.
2. I have a moderate to strong wish to die.

SSI3) 0. My reasons for living outweigh my reasons for dying.
1. My reasons for living or dying are about equal.
2. My reasons for dying outweigh my reasons for living.

SSI4) 0. I have no desire to kill myself.
1. I have a weak desire to kill myself.
2. I have a moderate to strong desire to kill myself.

SSI5) 0. I would try to save my life if I found myself in a life-threatening situation.
1. I would take a chance on life or death if I found myself in a life-threatening situation.
2. I would not take the steps necessary to avoid death if I found myself in a life-threatening situation.

If you have circled the zero statements in both Groups 4 and 5 above, then skip down to SSI20. If you have marked a 1 or 2 in either Group 4 or 5, then go to SSI6.

SSI6) 0. I have brief periods of thinking about killing myself which pass quickly.
1. I have periods of thinking about killing myself which last for moderate amounts of time.
2. I have long periods of thinking about killing myself.

SSI7) 0. I rarely or only occasionally think about killing myself.
1. I have frequent thoughts about killing myself.
2. I continuously think about killing myself.

SSI8) 0. I do not accept the idea of killing myself.
1. I neither accept nor reject the idea of killing myself.
2. I accept the idea of killing myself.

SSI9) 0. I can keep myself from committing suicide.
1. I am unsure that I can keep myself from committing suicide.
2. I cannot keep myself from committing suicide.

SSI10) 0. I would not kill myself because of my family, friends, religion, possible injury from an unsuccessful attempt, etc.

1. I am somewhat concerned about killing myself because of my family, friends, religion, possible injury from an unsuccessful attempt, etc.
2. I am not or only a little concerned about killing myself because of my family, friends, religion, possible injury from an unsuccessful attempt, etc.

SSI11) 0. My reasons for wanting to commit suicide are primarily aimed at influencing other people, such as getting even with people, making people happier, making people pay attention to me, etc.
1. My reasons for wanting to commit suicide are not only aimed at influencing other people, but also represent a way of solving my problems.
2. My reasons for wanting to commit suicide are primarily based upon escaping from my problems.

SSI12) 0. I have no specific plan about how to kill myself.
1. I have considered ways of killing myself, but have not worked out the details.
2. I have a specific plan for killing myself.

SSI13) 0. I do not have access to a method or an opportunity to kill myself.
1. The method that I would use for committing suicide takes time, and I really do not have a good opportunity to use this method.
2. I have access or anticipate having access to the method that I would choose for killing myself and also have or shall have the opportunity to use it.

SSI14) 0. I do not have the courage or the ability to commit suicide.
1. I am unsure that I have the courage or the ability to commit suicide.
2. I have the courage and the ability to commit suicide.

SSI15) 0. I do not expect to make a suicide attempt.
1. I am unsure that I shall make a suicide attempt.
2. I am sure that I shall make a suicide attempt.

SSI16) 0. I have made no preparations for committing suicide.
1. I have made some preparations for committing suicide.
2. I have almost finished or completed my preparations for committing suicide.

SSI17) 0. I have not written a suicide note.
1. I have thought about writing a suicide note or have started to write one, but have not completed it.
2. I have completed a suicide note.

SSI18) 0. I have made no arrangements for what will happen after I have committed suicide.
1. I have thought about making some arrangements for what will happen after I have committed suicide.
2. I have made definite arrangements for what will happen after I have committed suicide.

SSI19) 0. I have not hidden my desire to kill myself from people.
1. I have held back telling people about wanting to kill myself.

2. I have attempted to hide, conceal, or lie about wanting to commit suicide.

SSI20) 0. I have never attempted suicide.
1. I have attempted suicide once.
2. I have attempted suicide two or more times.

If you have circled the zero statements in SSI20 above, then skip the last item, SSI21.

SSI21) 0. My wish to die during the last suicide attempt was low.
1. My wish to die during the last suicide attempt was moderate.
2. My wish to die during the last suicide attempt was high.

Self-Injurious Thoughts and Behaviors Interview (SITBI; Nock, Holmberg, Photos & Michel, 2007)

These questions ask about your thoughts and feelings of suicide and self-injurious behaviors. Please respond as accurately as you can.

Suicidal Ideation

1) Have you ever had thoughts of killing yourself?

1)_____

0) no 1) yes

2) How old were you the first time you had thoughts of killing yourself? (age)

2)_____

3) How old were you the last time? (age)

3)_____

4) During how many separate times in your life have you had thoughts of killing yourself? 4)_____

(Please give your best estimate.)

5) How many separate times in the past year?

5)_____

6) How many separate times in the past month?

6)_____

7) How many separate times in the past week?

7)_____

8) When was the last time?

8)_____

9) On a scale of 0 to 4 (where 0 is low and 4 is severe), at the worst point how intense were your thoughts of killing yourself?

9)_____

10) On average, how intense were these thoughts?

10)_____

11) When you've had a thought, what method did you think of using?

11)_____

1) own prescription drugs 7) hanging 13) drowning
2) illicit drugs (non-prescription) 8) sharp object 14) suffocation

3) over-counter drugs	9) auto exhaust	15) other's prescription drugs
4) poison	10) other gases	16) other ____
5) firearms	11) train/ car	17) multiple methods _____
6) setting fire to self	12) jump from height	88) not applicable
99) unknown		

12) When you have thoughts of killing yourself, how long do they usually last?
12)_____

0) 0 seconds	5) 1-2 days
1) 1-60 seconds	6) more than 2 days
2) 2-15 minutes	7) wide range (spans > 2 responses)
3) 16-60 minutes	88) not applicable
4) less than one day	99) unknown

13) On a scale of 0 to 4, what is the likelihood that you will have thoughts of killing yourself in the future? 13)_____

Suicide Plan

14) Have you ever actually made a plan to kill yourself?
14)_____

0) no 1) yes

15) How old were you the first time you made such a plan? (age)
15)_____

16) How old were you the last time? (age)
16)_____

17) During how many separate times in your life have you made a plan?
17)_____

18) How many separate times in the past year?
18)_____

19) How many separate times in the past month?
19)_____

20) How many separate times in the past week?
20)_____

21) On a scale of 0 to 4, at the worst point, how seriously did you consider acting on the plan? 21)_____

22) On average, how seriously have you considered acting on them?
22)_____

23) When you've had a plan, what method did you think of using?

23)_____

1) own prescription drugs	7) hanging	13) drowning
2) illicit drugs (non-prescription)	8) sharp object	14) suffocation
3) over-counter drugs	9) auto exhaust	15) other's prescription drugs
4) poison	10) other gases	16) other ____
5) firearms	11) train/ car	17) multiple methods _____
6) setting fire to self	12) jump from height	88) not applicable
99) unknown		

24) When you've had a plan, how long have you thought about it before either moving onto something else or acting on the plan?

24)_____

0) 0 seconds	5) 1-2 days
1) 1-60 seconds	6) more than 2 days
2) 2-15 minutes	7) wide range (spans > 2 responses)
3) 16-60 minutes	88) not applicable
4) less than one day	99) unknown

25) On the scale of 0 to 4, what do you think the likelihood is that you will make a plan to kill yourself in the future? 25)_____

Suicide Attempt

36) Have you ever made an actual attempt to kill yourself in which you had at least some intent to die?

36)_____

0) no 1) yes

37) How old were you the first time you made a suicide attempt? (age)

37)_____

38) When was the most recent attempt?

38)___/____/_____

39) How many days was that from today?

39)_____

88) not applicable
99) time unknown

40) How many suicide attempts have you made in your lifetime?

40)_____

41) How many have you made in the past year?

41)_____

42) How many have you made in the past month?

42)_____

43) How many have you made in the past week?

43)_____

44) What method did you use for your most recent attempt?

44)_____

1) own prescription drugs
2) illicit drugs (non-prescription)
3) over-counter drugs
4) poison
5) firearms
6) setting fire to self
7) hanging
8) sharp object
9) auto exhaust
10) other gases
11) train/ car
12) jump from height
13) drowning
14) suffocation
15) other's prescription drugs
16) other ____
17) multiple methods _____
88) not applicable
99) unknown

45) What were the circumstances that contributed most to your most recent attempt? Put in order of importance.

45a)_____
45b)_____
45c)_____

1) job loss/ job stress/ academic failure
2) dispute with family or friends
3) dispute with spouse/lover
4) financial problems
5) eviction
6) health problems
7) death of another person
8) psychiatric symptoms
9) humiliating event
10) other: _____
11) refuses to answer
88) not applicable
99) unknown

46) What kind of injuries did you have as a result of this attempt?

46)_____

Regarding the most lethal attempt:

47) When did it occur?

47)___/____/_____

48) What kind of injuries did you have as a result of this attempt?

48)_____

49) How long have you usually thought about suicide before making an attempt?

0) 0 seconds
1) 1-60 seconds
2) 2-15 minutes
3) 16-60 minutes
4) less than one day
5) 1-2 days
6) more than 2 days
7) wide range (spans > 2 responses)
88) not applicable
99) unknown

49)_____

50) On the scale of 0 to 4, what do you think the likelihood is that you will make a suicide attempt in the future?

50)_____

Thoughts of Non-Suicidal Self-Injury

51) Have you ever had thoughts of purposely hurting yourself without wanting to die? (for example, cutting or burning)

51)_____

0) no 1) yes

52) How old were you the first time you thought about engaging in NSSI?

(age) 52)_____

53) How old were you the last time? (age)

53)_____

54) During how many separate times in your life have you thought about engaging in NSSI? 54)_____

55) How many separate times in the past year?

55)_____

56) How many separate times in the past month?

56)_____

57) How many separate times in the past week?

57)_____

58) On the scale of 0 to 4, at the worst point, how intense were your thoughts about engaging in NSSI?

58)_____

59) On average, how intense were these thoughts?

59)_____

60) When you have had these thoughts, how long have they usually lasted?

60)_____

0) 0 seconds
1) 1-60 seconds
2) 2-15 minutes
3) 16-60 minutes
4) less than one day
5) 1-2 days
6) more than 2 days
7) wide range (spans > 2 responses)
88) not applicable
99) unknown

61) On the scale of 0 to 4, what do you think the likelihood is that you will have thoughts about engaging in NSSI in the future? 61)_____

Non-Suicidal Self-Injury

62) Have you ever actually engaged in NSSI?

62)_____

0) no 1) yes

63) How old were you the first time?

(age)

63)_____

64) How old were you the last time? (age)

64)_____

65) How many times in your life have you engaged in NSSI?

65)_____

66) How many times in the past year?

66)_____

67) How many times in the past month?

67)_____

68) How many times in the past week?

68)_____

69) Below is a list of things that people have done to harm themselves. Please indicate which of these you've done:

69a)_____ 69b)_____ 69c)_____ 69d)_____ 69e)_____

1) cut or carved skin
2) hit yourself on purpose
3) pulled your hair out
4) gave yourself a tattoo
5) picked at a wound
6) burned your skin (i.e., with a cigarette, match or other hot object)
7) inserted objects under your nails or skin
8) bit yourself (e.g., your mouth or lip)
9) picked areas of your body to the point of drawing blood
10) scraped your skin
11) "erased" your skin to the point of drawing blood
12) other (specify):_____
88) not applicable
99) unknown

70) Have you ever received medical treatment for harm caused by NSSI?

70)_____

0) no 88) not applicable
1) yes 99) unknown

71) On average, for how long have you thought about NSSI before engaging in it?
71)_____

0) 0 seconds
1) 1-60 seconds
2) 2-15 minutes
3) 16-60 minutes
4) less than one day
5) 1-2 days
6) more than 2 days
7) wide range (spans > 2 responses)
88) not applicable
99) unknown

72) On a scale of 0 to 4, what do you think the likelihood is that you will engage in NSSI in the future? 72)_____

Positive and Negative Affect Schedule (PANAS: Watson, Clark & Tellegen, 1988)

This scale consists of a number of words that describe different feelings and emotions.

Read each item and then mark the appropriate answer in the space next to that word. Indicate to what extent you feel this way **right now, that is, at the present moment**. Use the following scale to record your answers.

1 = very slightly or not at all
2= a little
3= moderately
4= quite a bit
5= extremely

Interested

Distressed

Excited

Upset

Strong

Guilty

Scared

Hostile

Noticed

Ignored

Irritable

Alert

Ashamed

Inspired

Included

Excluded

Jittery

Active

Afraid

Enthusiastic

Proud

Nervous

Determined

Attentive

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