DOES THE PROCESSING OF HYPNOTIC ANALGESIA REQUIRE ATTENTION-DEMANDING RESOURCES?

A dual-task analysis of hypnotic-susceptibility-mediated differences in executive attentional processing between hypnotic and nonhypnotic analgesia

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DEDICATION

This thesis is dedicated to the memory of Ernest R. Hilgard, Kenneth S. Bowers and Nicolas P. Spanos, who all sadly passed away in recent years. Their research efforts spanning several decades have contributed immensely to our understanding of clinical hypnosis in general and hypnotic analgesia in particular, and have inspired many others, myself including, to pursue further research in these areas.

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PREFACE

For most people, myself included, the first contact with hypnosis is through watching a demonstration of hypnosis either on television or as part of a live audience. Such performances can be quite spectacular and are certainly entertaining. However, to me they remained interesting stage phenomena, much like those performed by a skilled magician, and did not arouse any scientific interest into hypnosis. Being interested in pain management thought, one sooner or later comes across accounts of hypnotic analgesia, that is the use of hypnotic suggestions to achieve relief of pain and distress. Whatever ones opinion about hypnosis, it has been thoroughly proven, both in clinical and experimental settings, that some people do achieve significant and clinically important benefits when using hypnotic suggestions over and above those available to the average person using nonhypnotic coping methods. The interesting question, which has been debated by some researchers for decades, is what are the processes whereby hypnotic analgesia is achieved, and are these fundamentally different from those involved in the execution of nonhypnotic coping strategies.

More recently, pain research has increasingly emphasised the role of attention in pain processing and in particular the ability of pain to have priority access to processing resources and dominate conscious processing at the expense of other activity. This interference with other ongoing activity is one of the major pain-related handicaps experienced by people with chronic pain. The concept of attention, and in particular the distinction between controlled and automatic processing, is crucial to an understanding of both pain processing and hypnosis and provides an important and fascinating approach for studying the two.

This thesis was written as part of a study investigating differences in attentional interference effects between hypnotic and nonhypnotic analgesia. The main hypothesis tested is whether: "Hypnotic analgesia, unlike nonhypnotic pain-coping strategies, can be achieved without reliance on high-order (executive) attentional resources and therefore results in no or only minimal interference with other ongoing and attention-demanding activities.

A proper understanding of this topic and the wider context wherein it occurs requires some knowledge of the following key aspects: (1) pain and pain management; (2) pain coping strategies; (3) attention, and in particular access to, and interference with, attentional resources in multiple task environments; (4) consciousness; and (5) hypnosis. The introduction to this thesis follows this outline.

Chapters one to six form the introduction. Some sections of the introduction provide additional and more in-depth information (particularly on the neurophysiology of pain, attention, and hypnosis) that are useful for a fuller appreciation of these topics and can assist the reader in understanding how these main aspects are linked together. However, strictly seen these are not necessary for a direct understanding of the main research question. For the convenience of the reader, these sections are marked with a red asterisk (⊛) following the section heading. They include sections 1.4, 3.6, 5.2, 5.5, 5.6.2.2., 5.7, and all of chapter 4.

Chapter 1 provides an overview of the main aspects of our current understanding of pain processing and the control mechanisms involved. Particular reference is given to inhibitory control processes descending from cortical and subcortical brain structures. As Chapter 6 will show, there is evidence for hypnosis-related differences in the effectiveness of such inhibitory control mechanisms. The final section briefly covers how the advances in pain research have influenced pain management practices.

Section 1.4 ⊛ provides more in-depth information on the affective-emotional dimension of pain, on the changes that take place when a pain condition becomes chronic, and on the neurophysiology of cortical and subcortical brain structures involved in pain processing and responding. It is in the management of chronic pain where hypnotic analgesia may have its greatest advantage. The specific question of the current study is part of an underlying research effort to enhance our understanding of pain mechanisms and derive at more effective methods for the control of particularly chronic pain. Developments in the area of neurophysiology are leading to a more specific understanding of the theoretical mechanisms of pain, which in turn contributes to the development of more specific and effective pain management practices. It is for this reason that these areas are given substantial coverage in the introduction of this thesis.

Chapter 2 "Psychological methods of pain control" consists of two main parts. The first part introduces behavioural and cognitive pain coping strategies, highlights factors that may influence their utility, and evaluates evidence for the effectiveness of such strategies. It then describes some of the influences of anxiety on pain responding, outlines the cognitive costs of using attention diversion and pain suppression strategies, and contrasts the effectiveness of attention diversion versus sensation monitoring strategies. The second part describes the main characteristics of hypnotic analgesia, looks at both clinical and experimental evidence for its effectiveness, and outlines proposed mechanisms whereby hypnotic analgesia may reduce pain.

Chapter 3 "Attention, multi-task performance, and task interference." This chapter briefly describes the main characteristics of information processing: competition for limited capacity processing resources, and the selection of information for further processing. It continues with a description of how this latter process is influenced by both bottom-up stimulus-driven biases and by top-down control. It then highlights the development of models of attention with particular reference to Shiffren and Schneider's (1977) distinction between controlled and automatic processing, and outlines the main components of Norman and Shallice's (1986) hierarchical model of supervisory attentional control. This is followed by a description of how interference and the demands of concurrent task performance are treated by traditional limited-capacity models of attention, and by models based on multiple resource theory. The next section describes the interruptive quality of pain, its specific (hard-wired) capacity to capture attention, and factors that may moderate the interruption of ongoing activity. This is followed by a brief section on biases in the processing of emotion-arousing information and preliminary findings regarding the efficacy of distraction tasks with an emotional theme.

Section 3.6 ⊛ deals with the neurophysiology of attention. This section reviews the different dimensions of attentional processing and their anatomical correlates, including arousal and targeted readiness which are also important aspects in pain processing, and novelty which is important for attentional capture and effective distraction strategies.

Particular attention is given to the mechanisms involved in the control of attention and findings supporting the existence of anterior and posterior attentional systems. This section provides a summary of the background knowledge that has led to the development of the neuropsychophysiological model of hypnosis described in section 5.7.3.2.

Chapter 4 briefly introduces the topic of consciousness and relates conscious and unconscious processes with respectively controlled and automatic attention. It does so with particular reference to Bernard Baars' Global Workspace theory of consciousness and briefly describes how this conceptualisation can be used to explain such phenomena as hypnosis, absorption, dissociation and involuntariness. Many actions and processes are either well established (learned and familiarised) or may be programmed (hard-wired) as is the case with pain so that they, once activated, can be executed on an automatic and subconscious level. As will be covered in section 5.6, some researchers and theorists argued that hypnosis is one of these processes.

Chaper 5 "Hypnosis" starts with a description of the nature and characteristics of hypnotic phenomena, and the factors that may contribute to the experience of hypnosis. The next three sections deal more in-depth with the three main factors: hypnotic susceptibility, absorption, and dissociation respectively.

Section 5.6 compares and critically evaluates the main models of hypnosis: the dissociated experience and dissociated control models and the social-psychological model of hypnosis, and the predictions they make regarding the involvement of attention. The next part highlights some more recent findings that indicate that the opposing views of social psychological and special process (i.e. dissociation) explanations both appear to apply, but at different ends of the continuum of hypnotic responding.

Section 5.2 ⊛ covers the assessment and measurement of hypnotic susceptibility. Experimental studies of hypnosis phenomena commonly use scores on standard hypnotic susceptibility scales as the criterion for allocating subjects to experimental conditions on the basis of their hypnotic ability. This section explores the argument as to how well such measures capture the important components of hypnotic responding.

This is relevant because there is increasing support for the notion that (1) individual differences in hypnotic responding reflect differences in kind (i.e., underlying mechanisms) rather than in dimension (i.e., position along the continuum of a single trait), and (2) there exist subsamples of highly hypnotisables exhibiting distinct patterns of responding and brain activity that are not differentiated by the standard hypnotic susceptibility tests which treat highly hypnotisables as a homogeneous group.

Section 5.5 "Unconscious influences in hypnosis" indicates how human behaviour in general, and hypnotic responding in particular, can be influenced by information that is perceived and processed outside of normal conscious awareness. It highlights how the social psychological explanation of hypnosis emphasises the importance of Type I unconscious influences such as demand characteristics, expectancies, and social compliance; but, unlike the dissociation model of hypnosis, denies the influence of Type II unconscious influences involving genuine alterations in the way information is processed such as the down-regulation of nonessential functions and a shift towards increased primary process thinking. This section also reviews experimental research into the relative efficacy of direct and indirect hypnotic suggestions, and highlights how a type of control experiment called the real-simulator design can be used to assess the influence of demand characteristics.

Section 5.7 It is the area of neurophysiological research that provides important new insights in the, otherwise largely stagnated, debate about the mechanisms underlying hypnotic responding in general and hypnotic analgesia in particular. This section reviews neurophysiological evidence for fundamental changes in brain activity that: (1) can distinguish the hypnotic from the nonhypnotic state, and (2) can distinguish between individuals with low and high hypnotic susceptibility in each of these states. It concludes with a summary of a neuropsychophysiological model of hypnosis that is based on the result of these studies.

Chapter 6 "The current study" starts with a description of the two studies by Miller and Bowers (1986; 1993) that form the basis for the current experiment.

This is followed by a description of the main aim of the current study and the ways in which the methodology was changed in an effort to increase the sensitivity of the design and allow for greater specificity when analysing the effects of the experimental manipulation. The last section outlines the specific hypotheses of the current study.

Chapters 7 and 8 make up the method section for respectively the hypnotic susceptibility screening stage and the experimental part of the study.

Chapters 9, 10, and 11 comprise the results section. Chapter 9 covers the results of analysis of tracking performance data relating to the main research question. Chapter 10 lists the results of the assessment of pain intensity and pain unpleasantness ratings as well as data on subjects' level of absorption, strategy use, and hypnotic depth. Chapter 11 briefly summarises the results of hypnotic susceptibility measurements during the screening part of the study. The data in Chapters 10 and 11 does not directly relate to the main research question, but does provide additional information used in interpreting the results and supports the arguments made and conclusions reached in the discussion section.

Chapter 12 starts with a discussion of results relating to the main research question (hypotheses 1 and 2) and evaluates possible reasons for the absence of hypothesised differences in interference effects. The effectiveness of the tracking task is examined with reference to the characteristics of attentional capture of visual motion, and recommendations are made for future research and improvements to the current design. This is followed by a discussion of the analyses of pain ratings (hypotheses 3 and 4). Finally, recent research of attentional processing during hypnosis is evaluated with particular emphasis on neuroimaging studies providing direct measures of localised cortical activation during hypnosis and performance of attention-demanding tasks.

ABSTRACT

There is substantial evidence that hypnotic analgesia can be effective in reducing pain and distress in both experimental and clinical settings in at least a sizeable portion of the population. However, the mechanism whereby hypnosis achieves this are not well-understood and various explanations have been proposed. These offer fundamentally different predictions about the attentional involvement of hypnotic analgesia, which are highly relevant to pain research as the disruption of ongoing activity is one of the more debilitating aspects of pain. While cognitive-behavioural coping strategies may attenuate pain of short duration, their effortful deployment further interferes with ongoing activity, and there are strong indications that their effectiveness rather rapidly decreases as pain perseveres. If, as dissociated-control theory proposes, hypnotic analgesia does not require attentional effort for its execution, it would provide significant advantages for individuals who can effectively achieve it (i.e., those who are highly susceptible to hypnotic suggestions). This hypothesis was further tested in an experimental study using a dual-task scenario and repeated-measures design. One hundred and ninety student volunteers were first screened for hypnotic susceptibility using the Hardvard Group Scale of Hypnotic Susceptibility: Form A, and seventy-eight also completed a more demanding follow-up assessment using the Waterloo-Stanford Group C scale. This resulted in fifty individuals who qualified for participation in the experimental part of the study by scoring as either high or low hypnotisable on both these measures. Of these, 12 lows and 14 highs went on to take part in an experimental study that had high and low hypnotisables performed a cognitively demanding tracking task while using either hypnotic analgesia or cognitive-behavioural strategies to cope with iontophoretically administered pain. Interruption of tracking performance during each coping method was used as a measure of central attentional resources needed to execute that coping strategy. Results did not find evidence for the hypothesised absence of interference effects among high hypnotisables using hypnotic analgesia. Possible reasons are examined and exploration of data indicates that the tracking task was not difficult enough to require significant and continuous attention, and lacked sensitivity to distinguish interference effects between treatment conditions.

Findings do not allow a conclusion of support for either explanation of the mechanisms underlying effective hypnotic analgesia. Highly hypnotisable subjects using hypnotic analgesia did achieve significantly greater reductions in both the intensity and unpleasantness of the pain than low hypnotisables using hypnotic analgesia or high and low hypnotisables using cognitive-behavioural coping strategies. Characteristics of the attentional capture of visual motion are discussed and suggestions made for future research and improvements to the design of the current study. Considerable attention is given to findings of a large body of neurophysiological studies of brain activity and a proposed neuropsychophysiological model of hypnosis. When combined, results of these studies indicate that: the mechanisms of attentional control involved in the process of hypnosis are fundamentally different from those involved in the use of standard cognitive-behavioural strategies, but that both processes do require central attentional effort and resources.