Accounting for hypnotic phenomena via motivation and experimenter demands

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Abstract

When completing time judgement (intentional binding) and word-based attention tasks (Stroop) following specific hypnotic suggestions, individuals of higher hypnotic suggestibility have been found to perform in a manner not achievable without suggestions. Cold Control Theory (CCT) in contrast asserts that behaviour carried out following hypnotic suggestion is driven by the same mechanisms utilized in voluntary action such that one can achieve with voluntary action whatever is achieved under suggestion but that under suggestion the individual is affected by a reduced awareness of intention. To investigate this tenet of CCT, two experiments were carried out to explore the potential role of performance expectation (Experiment 1) and in-group demand characteristics (Experiment 2) in suggestion fulfilment among individuals of higher suggestibility. Self-reported beliefs of performance expectations in an intentional binding experiment involving a suggestion for modified performance were gathered from 19 medium suggestibility and 10 high suggestibility participants. The experiment revealed no evidence for specific strategic responding under suggestion, upholding CCT's prediction of modified awareness of intention. The effect of in-group demand characteristics was then tested using 13 participants of unknown suggestibility, 6 higher suggestibility participants and a further 9 participants in a control condition. The manipulation among the latter group was found to affect Stroop task performance in a manner alike that previously attributed to a suggestion for altered performance. Bayesian evidence for this finding was weak yet compelling. It is argued here that the findings of Stroop interference effects, such as within Palfi et al. (2021), may be the product of in-group demand characteristics. The current study proposes that in-group demand characteristics may more broadly drive suggestion fulfilment while still abiding a process of Cold Control.

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Declaration

I declare this Thesis to be the product of my own work. With the acknowledged support, I designed and conducted both experiments. I collected, managed, and analysed all data for both experiments. Additionally, I recruited and screened participants for the described database of participants held at Bournemouth University.

Chapter 1 - **Literature Review**

The phenomena of hypnosis

Within the dimensions of human psychology there are few well-known phenomena more controversial and conceptually elusive than *hypnosis*. In response to a lack of consistency in conceptualising hypnosis across research and literature, Elkins et al. (2015, p. 382) defined hypnosis as, "A state of consciousness involving focused attention and reduced peripheral awareness characterised by an enhanced capacity for response to suggestion". Although this definition seems to broadly represent the phenomena of hypnosis, it is not free from critical review (see Lynn, Green, et al., 2015), and so further context is required to ground an understanding of hypnosis for this study. The 'state' of hypnotic consciousness has been subject to much contention as is evident across the state/non-state and socio-cognitive perspectives. These respectively present the views that hypnosis either involves a distinctly unique conscious state; is a commonplace state not exclusive to hypnosis; or is a measured product of commonly occurring social phenomena such as goals, expectations, held beliefs, procedure and interpersonal factors (Hasegawa & Jamieson, 2002; Lynn & Green, 2011; Lynn, Laurence, & Kirsch, 2015). In alignment with convincing arguments for the redundancy of such debate (Jensen et al., 2017; Kirsch & Lynn, 1995), the present study only requires a simple framing of the hypnotic 'state'. This being, that it is a subjectively reported experiential change expressed by individuals within a hypnosis context. Key to the present endeavour however are the behavioural outcomes elicited by the hypnotic context.

Suggestion fulfilment

To explore dimensions of the hypnosis phenomena it has proven insightful to use tailored suggestion scenarios and measurements of experiential outcomes, with emphasis upon a small percentage of individuals that are highly responsive to suggestions within a hypnotic context (Heap et al., 2004). *Hypnotic suggestions* are cues communicated to influence some form of typically non-volitional experiential response (Kirsch, 1999). In attempts to elicit the effects of hypnosis and measure responsiveness within the laboratory setting, varied *induction*s and assessment procedures have emerged in correspondence with advancements in the knowledgebase (Council, 2002). Researchers currently use standardised scripts for verbal guidance which have been frequently tested and continuously modified. The Waterloo-Stanford Group C Scale (WSGC; Bowers, 1993; 1998) and the since derived Sussex-Waterloo Scale of Hypnotisability (SWASH; Lush et al., 2018) stand as strong current examples of such procedures. Both serve to test and categorise individuals according to their individual

receptivity to hypnotic suggestions. The SWASH contains currently used induction and suggestion scripts to guide the experimenter in delivering 10 suggestions of varying experiential scenarios and a self-report response booklet for participants to record their experiences.

Interestingly, researchers looking toward clarifying attributes of hypnosis have found that the efficacy of induction within hypnotic suggestion procedures over that of hypnotic suggestion absent of inducton has been moderately evidenced at best (for a review, see Terhune & Cardeña, 2016). Moreover, the concept of hypnotic suggestibility is situated within a wider domain of non-hypnotic suggestion effects and differentiation between concepts has been notably difficult (Halligan, & Oakley, 2014; Kirsch, 1997). Non-hypnotic suggestion can be seen as the elicitation of behaviour from or experiential change within an individual that is comparable to a hypnotic suggestion, yet in absence of any hypnotic contexual priming. Non-hypnotic suggestions are administered using context such as explicit experimenter expectations or encouraged imagination (See Braffman & Kirsch, 1999; Lush et al., 2020; Palfi et al., 2021; Parris & Dienes, 2013; Raz et al., 2006). It has been shown that behaviour elicited using hypnotic suggestion can be approximately replicated aside from a hypnotic context, by means of voluntary task fulfilment and non-hypnotic suggestion (Braffman & Kirsch, 1999; Meyer & Lynn, 2011). Such evidence against the necessity of hypnosis and induction procedures in elicitation of specific behaviours, allows for the possibility that effects of both (along with that of non-hypnotic suggestions) are driven more by motivational factors than prevailing theories suggest. Cases of comparing post-hypnotic and non-hypnotic behaviour elicitation have been crucial to informing theories of control in recent years and so will be discussed.

This study will focus on key examples wherein researchers have used designs comparing performance under post-hypnotic suggestion and non-hypnotic suggestion conditions to further theories of control. Because of such differences in interpretation and theoretical stance, labelling of responsiveness to hypnotic suggestion differs across the literature and has changed over time. With an aim of contributing toward mechanistic understandings of suggestion effects and the conceptual framing of hypnosis, this study will maintain the terminology of relevant key studies. Highly responsive individuals will be referred to as highly suggestible individuals or highs, and the trait proclivity for responding to suggestions in any context is henceforth termed *suggestibility*.

Hypnosis and the sense of agency

Layperson conceptions of hypnosis are commonly associated with verbal reports of significantly altered cognitions and experiences such as *sense of agency* (SA; Bowers, 1982; Weitzenhoffer,

1980). Sense of agency may be defined as the awareness of being the originator of an action or cognition and having exercised intent in producing the specific act or cognition. The context of hypnosis and hypnotic suggestion is often reported to affect the sense of agency in the direction of experienced involuntariness and reduced sense of intention associated with behaviours. This has been termed *the classic suggestion effect* (Bowers, 1982; Weitzenhoffer, 1980). Evidence for consistent and definable properties of the classic suggestion effect is given in Polito et al. (2013), who produced a Likert scale self-report tool for scoring subjective experiences of agency (The Sense of Agency Rating Scale). Notably, in a review paper by Moore (2016), agentic experience is comprised of two dissociable elements, judgements of agency and feelings of agency. Judgements of agency are measured through reflective explicit self-reporting of experienced factors of agency such as perceived ownership or degree of control over actions and outcomes. Such measured experiences are influenced through higher order thought processes and socio-cognitive factors such as beliefs and perceptions (Moore & Obhi, 2012). Due to this, explicit measures may be criticised to be postdictive reflections of experienced agency which are open to demand characteristic confounds. Feelings of agency are the product of sensory information processing mechanisms that may be altered in the absence of concurrent higher order thought. This experience has been best explored through means of arguably pre-reflective indirect measurement of apparently dependent experiences such as perceptions of time or sensory intensity. As behaviour following hypnotic suggestion is reported to be experienced with reduced awareness of intention, researchers concerned with the nature of hypnosis and sense of agency have looked to implicit tests in order to explore the degree to which hypnosis genuinely alters experienced agency and by what potential cognitive mechanisms such changes occur. Examples of such research will be explored in detail throughout this study.

The merits of combining hypnosis and agency research are exemplified in studies finding comparably altered sense of agency between highs and individuals with a schizophrenia diagnosis (Polito et al., 2015) suggesting a real and fundamental change of experience under hypnosis. Findings like this are not too surprising considering that there is great similarity between the classic suggestion effect and diagnostic literature for the schizophrenia spectrum, which describes symptoms to the effect of altered agency and cognition of agency (*delusions of control*; American Psychiatric Association, 2013). The use of externally validated methodologies to observe phenomena like that of altered sense of agency among highs and schizophrenia diagnosed groups may aid in advancing understandings of universal and trait group cognitive mechanisms. Any such advancements also stand to contribute toward broader understandings of human consciousness. Hallucinatory experiences and delusions are further

examples of captivating experiential changes associated with both hypnosis and individuals diagnosed under the schizophrenia spectrum. The percentage of individuals that report hallucinatory experiences as a result of suggestion appears to be negatively related to the intensity of the hallucination demands and modality (Lush et al., 2018). Hallucinations, as well as delusions of agency over action and outcomes, are a characterising feature of highs and so are crucial test items in suggestibility scales. Hallucinations are also present across an array of disorders, diseases and impairments, with the frequency and nature of the experiences varying significantly (Schutte et al., 2020). The availability of a population that can experience a range of hallucination modalities and delusions of agency under experimentally controlled conditions, offers a valuable source of information from which a mechanistic understanding of these clinical conditions can be gained. This then allows for the improvement of care and treatment of affected individuals. The current study aims to explore how, if at all, the characteristic responses indicating alterations in experience following hypnotic suggestion translate to genuine experiential change among recruited suggestibility groups.

Theories of cognitive control

Arguably there is a limited consensus about hypnosis and associated underlying mechanisms (Jensen et al., 2017; Landry et al., 2017; Parris, 2017). To elucidate this point, since Sarbin proposed Role Theory (Sarbin, 1950) and Hilgard put forth a neo-dissociative perspective (Hilgard, 1977) there have been numerous descendant additions to the theoretical landscape. Notable examples include the Response Expectancy Theory (Kirsch, 1985; Kirsch & Lynn 1997); Dissociative Control Theory (DCT; Jamieson & Woody, 2007; Woody & Bowers, 1994) and Cold Control Theory (CCT; Dienes & Perner, 2007).

Sarbin's Role Theory proposed hypnotism to be role playing and hypnotic ability as a product of an individuals ability and consistency in the use of acting, imagination, comprehension of the role and self-perception. The theory therefore portrays individuals as having an effortful role in hypnosis without any necessary change in experience. Contrarily, Kirsch (1985) proposed that individuals primarily function through automatic control processes driven by reinforced expectations. Response Set Theory (RST; Kirsch & Lynn, 1997; 1998) proposed that in reflex to stimuli, schema sets for behavioural response are selected according to expectations and shaped by socio-cognitive influence. This perspective offers that the classic suggestion effect is the result of expectancies for involuntary experiences (Lynn & Green, 2011) and established automatic mechanisms.

CCT and DCT have emerged from concepts of neo-dissociation; supervisory attention and contention scheduling (Norman & Shallice, 1986); and higher order thought (Rosenthal, 1986; 2003). DCT proposes that sense of agency is implicated within executive and sub-executive cognitive mechanisms that inform behaviour using stimuli in a cumulative and evaluative manner. The DCT account asserts that hypnosis disrupts this process, allowing sensory information (such as experimenter suggestion) to more directly engage automatic response mechanisms among some individuals. This mechanistic circumvention then ultimately affecting sense of agency in the direction of experienced involuntariness. The Predictive Coding Model (Martin & Pacherie, 2019), which theorises a Bayesian integration of primarily internal cues, similarly proposes that alterations in experiences are the result of attention being shifted toward sources such as experimenter suggestions or memory.

The CCT explains that typical volitional behaviour is subject to contention scheduling using a supervisory attentional system wherein schemas are synthesised through conscious attention, motivation and higher order thought. The fundamental assertion being that some individuals are more able than others to suppress or hold erroneous higher order thought while behaving according to a guided intention. Behaviour elicited from highs within the context of hypnosis is argued to be self-driven yet experienced as less effortful and less voluntary. This being due to prior beliefs of hypnosis diminishing the accuracy or presence of higher order thought. *Phenomenological control* is a concept defined as, “the ability to control subjective experience so that a constructed counterfactual state of affairs appears real” (Dienes, Lush, et al., 2020, p.3). It proposes that experiential changes are influenced in a predominantly implicit manner, operating by a mechanism that may be sufficiently explained under this fundamental CCT assertion. Like hypnotic suggestion, it is proposed that experiential changes may emerge in accordance with a combination of motivators such as instruction, perceived experiment expectancies and self-driven goals. Dienes, Lush, et al. (2020) offer that a simple account of individual differences in a stable ability or proclivity for phenomenological control may explain a range of trait suggestibility group differences including response to suggested experiential change.

In summary, there are numerous theories of control with ranging perspectives and proposed mechanisms. While some of these theories share conceptual frameworks or underlying principles, they differ in mechanistic detail, which subsequently limits the explanatory power for associated phenomena across the theoretical lanscape of control. Such discord coupled with the aforementioned conceptual quandary of hypnosis, has limited the opportunity for consensus and understanding of experiential alterations under hypnosis. With that being said, technological

and methodological ingenuity is allowing novel lines of hypothesis exploration, which appears to be advancing the theoretical lanscape in the direction of Cold Control. Advances in computer technology has enabled experimental designs such as the recent *intentional binding* (IB; Haggard et al., 2002) paradigm. Adoption of this has allowed researchers to provide data regarding sense of agency relating to hypnosis and thus mechanisms of cognitive control. Similarly, modernisation of the classic Stroop task (Raz et al., 2002; Stroop, 1935) and application of technology like that of eye tracking has allowed further hypotheses testing with regards to hypnosis, attention, effort and strategising within suggestion fulfilment. This study intends to offer a critical look at emerging research impacting theories of hypnosis and cognitive control and in particular consider the influence of demand characteristics in producing two key effects in the hypnosis literature. Demand characteristics can be understood as non-intentional contextual factors within experiments that cue participants to perform in a manner desired, or perceived to be desired, by the experimenter. A participants awareness of, and response to demand characteristics is likely to be dependent upon a number of individual and experimental design factors. The potential presence of demand characteristics can and should be effectively controlled within many experimental paradigms, however this is far from a simple matter within hypnosis research. Key concepts and experiment examples under the Stroop and intentional binding paradigms will now be described.

Chapter 2 - **Sense of agency and intentional binding**

Experiment 1

Introduction

Intentional binding is the phenomenon wherein the passage of time between an action and an apparently dependent outcome (e.g., a tone) is subjectively experienced to be shorter in accordance with experienced agency in causing the action (see figure 1 below). The involved temporal judgement errors are dependent upon variables relevant to an essential combination of intention and causality (Haggard, 2017; Moore & Obhi, 2012). Unlike self-report tools such as the sense of agency rating scale, this experienced temporal change is indirectly measured and does not depend upon conscious reflection of agency. The indirect nature of this phenomenon has proven to be valuable in broadening methodological innovations and advancing the sense of agency knowledgebase (Moore & Obhi, 2012). Intentional binding is a construct of action binding (AB) and outcome binding (OB) measures. AB is the shift in temporal judgement of an action towards the outcome time and OB is the reverse shift in the temporal judgement of an outcome towards the time of action (as demonstrated figure 1).

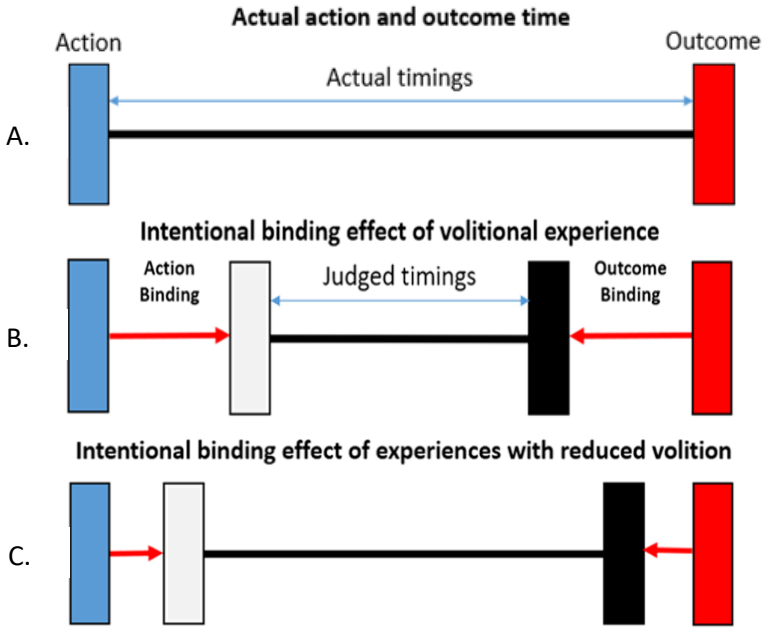

Figure 1 – Three-part illustration of intentional binding. Part A showing objective timescale for action and outcome; part B showing temporal judgement contraction resulting from voluntary experience, achieved through action and outcome binding; and part C showing minimal binding resulting from reduced volition experience. Note: Equal action and outcome binding is not typical but has been idealised for this illustration.

Mechanisms underlying human perception in areas such agency and temporal judgement are still being explored with researchers currently considering cue integration and combination models (Moore & Fletcher, 2012). The cue integration framework proposes that perceptions are informed by and dependent upon a weighting of cues from available predictive and post-dictive (Synofzik et al., 2013), internal and external sources (Moore et al., 2009). Consequently, action and outcome binding are separable with independent analytical value yet are frequently analysed for potential interactions. To measure binding, researchers gather temporal estimates using verbal reports or the arguably more validated and widely used Libet clock method (Libet et al., 1983). The Libet method uses a clock face representation with a clockwise travelling dot as a visual framework for individuals to observe and report the passing of time regarding cues. Libet et al. (1983) originally used the tool to quantify the point of conscious awareness so that they could explore whether conscious awareness of initiating action aligned with evidence of cerebral activity preceding the actual physical action. Findings of the study indicate that conscious awareness precedes action and cerebral activity precedes conscious awareness.

A seminal study of sense of agency measurement was carried out by Haggard et al. (2002). In their study, a series of Libet clock trials were utilised to gather temporal judgements of actions (muscle twitch and key press) and outcomes (tone), comparing voluntary action (spontaneous key press) and involuntary action (muscle twitch induced by transcranial magnetic stimulation) conditions. Results evidenced that voluntary actions were judged by participants as occuring later than they were objectively measured to have occured, while the outcomes were judged as occuring earlier than objective measurement. Involuntary action conditions reflected the opposite in judgement effects**.** The findings were interpreted to demonstrate a link between motor processes of agency and causality.

Trait suggestibility and sense of agency modification

Much like using the binding framework for sense of agency research, its related application with hypnosis serves to enhance methodological diversity and subsequent opportunity for further discovery (Terhune et al., 2017). To best knowledge, at time of this research only three studies have utilised this intentional binding methodology to explore the potential modification of experienced agency within a hypnotic suggestion context.

Following on from the Haggard et al. (2002) involuntariness study, Haggard et al. (2004) conducted the earliest investigation of agency alterations under hypnosis using a combined methodology of temporal judgement measurement and subjective volition self report. Given the classic suggestion effect, Haggard et al. (2004) predicted that experienced volition of actions would be comparably low for passive and hypnotic suggestion (ideomotor) conditions, yet significantly higher in the case of voluntary action. Experienced voluntariness measures were compared across the voluntary, passive (both in and out of the hypnotic state) and suggestion (for involuntary, ideomotor action) conditions. Interestingly, results show no changes in experience under hypnosis alone which opposes the classic suggestion effect. Recent research has supported this finding with data indicating the primary importance of suggestion variables over that of induction procedures (Polito et al., 2014). As predicted, participants did report a higher rate of voluntariness for the voluntary action over the passive action. The suggested ideomotor actions scored as significantly less voluntary than voluntary actions but moreso than passive action. When the same comparisons were made using the temporal judgement data they found all conditions to precede actual action with the suggested ideomotor and passive conditions being comparable and significantly delayed in contrast to the voluntary condition. These findings supported the hypothesis and were interpreted as evidencing anticipatory mechanisms of control present in the passive condition, which suggests a proclivity for anticipatory weighted judgement. The comparability of temporal judgement data in the

ideomotor and passive conditions was interpreted to be evidence that ideomotor suggestions altered mechanisms of conscious awareness relating to action while allowing control mechanisms to function in a manner typical of conscious action. These findings offer moderate support for theories aligned with internally driven control and genuine alterations in experienced agency.

In another key piece of research, Lush et al. (2017) explored the relationship between temporal binding measures and experienced involuntariness in an attempt to reveal the potential impact that beliefs of agency have upon action intention mechanisms. They proposed that if reports of experienced involuntariness among highs equates to actual changes in experienced agency, then this would be reflected in findings of reduced binding. To produce and test the involuntariness experience a *post-hypnotic suggestion* condition was constructed, wherein a pre-conditioned cue activated suggestion of involuntary action was administered. It was predicted that binding differences between voluntary to suggestion, and passive to suggestion conditions, would be greater among highs than among a medium suggestibility group (mediums). OB measures served to confirm the former however there was no sensitive evidence found for the latter, and no OB differences between voluntary and passive conditions. Consistent with predictions, the explicit sense of involuntariness among highs increased in magnitude from the voluntary, to suggestion, to passive conditions. Explicit involuntariness among mediums was comparable between the voluntary and suggestion conditions, with both being significantly lower than the passive condition. Regression analysis of both suggestibility groups in voluntary and suggestion conditions revealed an inverse relationship between reported involuntariness and OB.

A notable finding of the study is support for causal binding (For more on causal binding see Buehner & Humphreys, 2009). The essential finding that binding effects were reduced among highs following suggestion for involuntary actions, supports the argument made for actual changes in experienced agency resulting from hypnosis. The researchers used theory of predictive and post-dictive mechanisms responsible for experiences of agency to explain findings of OB reduction in the suggestion condition. They suggested that hypnotic suggestion may inhibit a pre-representation mechanism which results in experienced involuntariness. Additionally, using the standard deviation (*SD*) of temporal judgements, Lush et al. (2017) showed that highs were overall less precise in the suggestion condition compared to the voluntary condition. This finding is consistent with Cold Control and can be seen as a supportive precursor to the Lush et al. (2019) precision findings.

Lush et al. (2019) explored suggestibility trait differences in awareness of metacognitive motorprocesses alongside testing a cue combination theory of binding. Specifically they tested the CCT assertion that highs have less access to metacognition of intent. Hypnotic suggestion was not used as part of the experimental design for this experiment. They proposed that access to intent information should positively effect an individual's precision regarding action or outcome timing judgements and that this would negatively correlate with binding effects. Results of this study largely supported the predictions under the CCT and cue combination accounts, with highs displaying decreased precision (observed as a SD of temporal estimates) and greater AB in baseline conditions compared to low suggestible participants (*lows*). Notably, OB measures were largely insensitive. This study demonstrates a potential value in analysing the inherent precision data within this methodological approach.

In summary of these three experiments, Haggard et al. (2004) gathered self-reports and temporal judgements of actions from highs in voluntary, passive and suggestion conditions. This data indicated dissociable mechanisms for action generation and agency as well as experiential change following suggestion. Lush et al. (2017) used self-report and temporal judgements under similar conditions with the addition of the full binding paradigm and both highs and mediums. The main finding of their study showed reduced OB among highs (with self-report concordance), which indicates experiential change following suggestion. Lush et al. (2019) used evidence of trait suggestibility group differences in action judgement precision aside from any hypnosis context to conclude that highs have reduced metacognitive access to motor intentions. The study also provided moderate support for a Bayesian cue combination theory of binding. These studies present the CCT as a testable and somewhat validated framework. Furthermore, it appears that there is growing evidence for use of the binding paradigm in measuring sense of agency if analysed with attention to the dissociable but potentially Bayesian nature of the effect.

General limitations of the described intentional binding experiments

These studies have contributed valuable findings to discussion within the theoretical landscape however there are limitations to address, replicability to be tested and alternative accounts still to be considered. The question of whether hypnotic suggestion genuinely modifies cognitive control and the sense of agency, is arguably still unanswered. The intentional binding studies, although related, each have fundamental differences in methodologies which restricts the direct comparability of data. Haggard et al. (2004) did not include an outcome condition and so no binding mechanism was observed. Consequently, applicability of the data within the since established binding paradigm is limited and assumptions drawn from this study hold little value

within the context of any Bayesian theory. While the two most recent studies used the intentional binding paradigm to observe differences between trait suggestibility groups, Lush et al. (2019) did so aside from volition manipulation. The explanatory power of these studies is hindered by partially insensitive results in opposing binding measures. These points emphasise the need for replication and expansion of the hypnosis and binding experiment design. More crucially, the methodologies used in these experiments are open to demand characteristic confounds. It is possible that prior findings are the product of an explicit *demand characteristics* element influencing suggestion response mechanisms. To assert and refine understandings of cognitive control it is pertinent to check such a possibility. The main criticisms of Lush et al. (2017) will now be presented.

Limitations of Lush et al. (2017) considering demand characteristics

For some time, researchers have had evidence for a significant role of factors such as expectancy and motivation upon suggestion effects (Braffman & Kirsch, 1999). In a recent review of the hypnosis and suggestion effects knowledgebase, researchers emphasise an ongoing need to explore the role of expectancy within hypnosis related behaviour (Lynn et al., 2020). The possibility of a phenomenological control mechanism presents a significant threat to the validity of experimental designs wherein measures could be confounded by demand characteristics driven experiential change (Dienes, Palfi, & Lush, 2020). If participants are unaware that they are acting in compliance with cues for demand characteristics, experimenters would not be made aware of this without also measuring indicative factors such as expectancies (for exemplification see Lush, 2020; Lush et al., 2020). The temporal binding process is often viewed as providing implicit measurement for sense of agency and so it has been assumed that the intentional binding studies have sufficiently ruled out such potentially confounding demand characteristics. The current study set out to question the validity of this assumption by observing the role that expectancy plays in how individuals perform under the intentional binding methodology.

There are a number of ways in which the experimental design may have influenced and cued beliefs of participants in a manner that affected performance. Firstly, participants were recruited according to their prior performance in suggestibility screenings. The screening tools used for recruitment of participants focused upon responsiveness to suggestions and unavoidably allowed participants an awareness of how they respond to suggestions. Participants that demonstrated a high level of suggestion fulfilment in the screening procedure may have reinforced perceptions of their own responsiveness to suggestions or tendency to be able to meet perceived performance expectancies. A mixed response to items in the screening process (lower

suggestibility score) may have resulted in individuals identifying less with maximal performance in suggestion related tasks. It is possible that actual performance within the hypnosis screening process did little to alter beliefs but rather was the product of these beliefs. Still, this process allowed participants an ahead of time association between any future hypnosis related experiments and their screening performance. It would also allow participants to associate the screening experimenter with a hypnosis context, which may be an issue if they were consistent and identifiable within the actual experiment. Adding to this, the recruitment materials within this experiment allowed participants prior knowledge of the experimental design to the detail of a hypnotic context and three volition manipulations. Beyond recruitment, the current study asserts that there are potential points of confounding demand characteristics present throughout the experiment procedure.

In Lush et al. (2017), participants were asked to rate their experienced involuntariness several times with an increased frequency during the suggestion condition. The explicit nature of this task may have resulted in participants responding in line with perceived performance expectancies. More specifically, an increased frequency of questioning may have encouraged participants to form beliefs of expectancies for comparable performance between involuntary and suggestion conditions. Under a within-subjects design, the post-hypnotic suggestion cue setting procedure was administered prior to participants completing any experimental conditions. The core conclusions drawn from this study rely on comparing performance under non-hypnotic conditions (voluntary, involuntary) with hypnotic suggestion and an assumption that the former conditions are neither fundamentally hypnotic in nature nor influenced by any hypnotic context. The point made here is that participants were presented with a hypnotic context for the overall experiment, with ample time to form beliefs and respond according to perceived expectancies.

A demand characteristics account for intentional binding effects

The general demand characteristics account proposed is that cues primed participants to assume behaviours consistent with how they believed they were expected to perform, and that these beliefs differed between suggestibility groups. Expectancy differences between groups then being explained by differences in beliefs of hypnosis such as general hypnotic responding, awareness of the classic suggestion effect and prior performance.

The specific demand characteristics account offered in explanation of intentional binding findings is that highs felt motivated to be more accurate in their judgements, especially in the suggestion condition, which due to the difficulty of the task caused them to complete the

button press action in a slower manner. This reduction in speed may have had a counter effect of causing more variable temporal judgements thus decreasing mean precision. Increased but comparable attention to the two event stimuli may have then minimised binding according to a Bayesian cue combination mechanism**.** Driven by differing prior beliefs, mediums inferred expectancies of comparable performance in the post-hypnotic suggestion and voluntary conditions, resulting in consistently quick, yet less attentive performance. Quick responses resulted in reduced judgement variation (higher precision) compared to highs, while decreased attention to action and outcome events increased overall binding. Therefore, the Lush et al. (2017) findings of reduced outcome binding in the suggestion condition and the lower trait precision among highs found by Lush et al. (2019) could be accounted for without reference to Cold Control but rather explained by explicit demand characteristics.

This first experiment was carried out to test whether high and medium suggestibility individuals perceive particular performance expectations for voluntary and post-hypnotic suggestion conditions of the intentional binding design and if so, whether this differs between conditions in the manner that accounts for prior findings. To achieve this, participant groups were given a detailed description of the design and asked to report three possible dimensions of performance expectancies. The experimental design is consistent with recommendations of Orne (1962) in testing for demand characteristics and a recent application of this recommendation as carried out by Lush (2020).

Predictions

H0 would be supported in the case of sensitive evidence for beliefs of no performance expectancy differences between voluntary and post-hypnotic suggestion conditions among highs. This would suggest that prior findings in the Lush et al. (2017) study are not the product of the explicit demand characteristics mechanism hypothesised. Giving caution for the possibility that the data may not elucidate mechanisms present in the original design, the original methodology would be further validated, and the Cold Control Theory would maintain precedence.

H1 predicts that highs will report significant beliefs for performance expectancy differences in the post-hypnotic suggestion condition relative to the voluntary condition. Specifically, differences will be in the direction of slower finger press actions, increased attention to the location of the dot at the time of finger press, and increased attention to the location of the dot at the time of the tone sound. The three question items represent the most apparent potential performance mechanisms underlying a demand characteristics account and

are not necessarily interdependent. Therefore, evidence in favour of H1 for any one item will be interpreted as evidence for demand characteristics.

In the original experiment, unlike highs, mediums performed comparably in both the post-hypnotic and voluntary conditions. In accordance with this, H1 predicts that beliefs of performance expectancy differences reported by mediums should be significantly reduced compared to reports among highs. If both groups were to give significant and comparable reports in the direction predicted for highs according to H1, this would suggest a presence of demand characteristics within the original experimental design. A comparable awareness of such demand characteristics between groups would mean that the prior findings of group differences in the post-hypnotic suggestion condition must be the result of suggestibility group differences beyond that which has been considered in this account.

Method

Participants

Participants were recruited from two databases of individuals that had completed the SWASH screening process. These databases were held at both the University of Sussex and Bournemouth University. The University of Sussex database and a portion of the Bournemouth University database used in person screening methodologies. Most of the participants in the Bournemouth University database were screened using an online adaptation of the SWASH screening procedure (online delivery materials available at https://osf.io/29r6t). In a recent study, the efficacy of online SWASH screening was investigated. The researchers concluded that while online screening may result in lower suggestibility scores, this negative effect is negligible, especially when considered against the potential variability of other affecting factors (Palfi, Moga, et al., 2020). Although the Bournemouth University online screening was not an exact replication of this, the analysis is considered as supportive validation for the general procedure. The aim was to recruit 25 participants of medium suggestibility (scores of 2 to 4.99) and 25 of high suggestibility (scores of 5 or higher). The original study used data for mediums with a mean score of 3.19 (SD = 0.88) and highs with a mean score of 7.48 (SD = 1.24) and so we aimed toward this within the limitations of the held databases. SWASH scoring was calculated in line with guidance given by Lush et al. (2018), (available at https://osf.io/syfqt). All participants were offered a £5 Amazon voucher for completion of the study. Informed consent was gathered using Qualtrics online platform. Ethical approval was granted by the Bournemouth University Ethics committee. As laid out in the pre-registration, two participants (one high and one medium) were excluded due to insufficient time spent completing the questionnaire. Data collection was ended prior to the recruitment target as participant

responding ceased. Data from 19 medium suggestibility participants (one male, mean age = 23.32, *SD* = 8.08) and 10 high suggestibility participants (three males, mean age = 19.80, *SD* = 0.92) was analysed. Mean SWASH scores were 3.35 (*SD* = 0.67) for mediums, and 6.12 (*SD* = 0.88) for highs.

Materials

Participants used their own laptop or PC to complete the experiment online. Qualtrics served as the basis of guidance for participants and for data collection. Informed consent (see appendix A and B) and demographic data were first obtained. Three initial open questions were presented to screen for any prior knowledge of, or participation in, any experiments similar to that of Lush et al. (2017). These also served to encourage consideration of performance expectations. Alongside figures and written descriptions of the intentional binding design, participants were provided with links to two unlisted (by URL invite only) videos, hosted on YouTube. The first video contained a short summary of the experimental design. The second video was a more detailed description and walk through of a participant's role within the intentional binding experiment. A seven-point Likert scale format (ranging from -3 to +3) was used for responding to three core questions. Each of the three sequentially presented questions were accompanied by a written summary of the post-hypnotic suggestion and voluntary action conditions within the described experiment. Instructions were given for participants to respond according to perceived performance expectancy differences for the post-hypnotic suggestion condition relative to the voluntary condition. On the seven-point scale, 0 was indicated to represent comparability between conditions, with -3 and +3 representing beliefs of significantly different performance expectancies in opposing dimensions of performance. To exemplify, one of the question items asked for participants to indicate whether they believed they would be expected to perform a button press action significantly slower (-3), the same speed in both conditions (0), or significantly faster (+3). Participants were able to return to descriptive materials at any stage prior to the debrief, with no time restriction given for any element of the experiment. Forced responses were used for the core questions, meaning that participants were unable to proceed without providing a response. See appendix C for the experiment procedure as presented to participants. The exact Qualtrics presentation can be accessed at https://osf.io/u4y6h/.

Procedure

A Quasi-experiment design was used for this pre-registered experiment. The pre-registration can be seen at https://osf.io/z2tah (Helstrip, 2021). Perceived performance expectancies were measured for the two trait suggestibility groups (highs and mediums). A within-subjects factor of perceived expectancies for performance differences (in a post-hypnotic condition relative to a

voluntary condition) was applied to three dimensions of performance (attention to action, attention to tone sound, and speed of finger press action). The participant's role was to read a detailed description of the Lush et al. (2017) experimental design, to understand the role of a participant within that procedure, and report how they believe they would be expected to perform if participating in the experiment. Invitations to take part in the experiment were sent by means of an email containing a hyperlink to the Qualtrics questionnaire. Guidance was given to read the information sheet, complete a consent form and input demographic data. Upon completion of this, participants were provided with an introductory paragraph describing the Lush et al. (2017) experiment procedure and their role within the experiment. Next, a short summary video of the experimental procedure was provided before the three initial open questions. Once answered, participants proceeded to a detailed description of the Lush et al. (2017) design, which included written description, images, and the second video. Participants then progressed through responding to each of the three core questions. A debrief was presented upon completion of the final question item. As set out in the pre-registration, whole data sets were excluded for any participant completing the experiment in less time than the runtime of both videos (approximately 10 minutes).

Method of analysis

T-tests and Bayes factors were used to measure strength of evidence for differences reported, with conclusions being drawn from Bayesian results. Bayes factors of below 1/3 indicate support for the null (H0), 1/3 to 3 showing data insensitivity, and results over 3 favouring the alternative hypothesis (H1), (Jeffreys, 1961, as cited in Dienes, 2014). In attempts to address the small sample size of this experiment, standard error (SE) figures were adjusted prior to calculating Bayes factors, using the formula of, $SE*(1 + 20/df*df)$, (Dienes, 2014). Original SEs are reported throughout.

In a quasi-experiment, Lush (2020) used a 7-point Likert scale to measure expectancy differences of two conditions (synchronous and asynchronous brush strokes) under a described *rubber hand illusion* paradigm (Botvinick & Cohen, 1998). Seven candidate experiential expectations were tested, and the Likert scale ranged from -3 (certainty of no effect) to +3 (certainty of an effect), with 0 being no certainty either way. They gave directional predictions and calculated Bayes factors using a half-normal distribution based on a prior of 1-scale point difference in expectancies found by Lush et al. (2020). Using a 7-point scale, the current experiment asks participants to report how they believe they would be expected to perform in one condition relative to another. H1 gives directional predictions for reports among highs and so Bayes factors were calculated using a half-normal distribution based on the same 1-scale

point expectancy difference found in Lush et al. (2020). This is denoted as $B_{H(0,1)}$. Robustness regions (RR) were reported as to offer smallest and largest SDs respectively that produce the same sensitivity boundary as the established prior (Dienes, 2019).

Within group means were calculated for each question item. Bayes factors and t-tests were used to measure the significance of difference between the post-hypnotic suggestion condition and the voluntary condition as given in the calculated means for each item. T-tests and Bayes factors were then used to measure differences between groups for each item.

Results

Q1 produced the most prominent mean scores with both groups scoring in the negative direction. This being expectations in the direction of less attention to the dot at the time of action in the post-hypnotic suggestion condition, relative to the control condition. Only mediums showed a negative mean score for Q3, meaning expectations for slower button press under suggestion relative to control (see Table 1). This data runs contrary to H1 predictions for highs.

	Q1) attention to dot at time of action	**Q2) attention to dot at time of sound**	**Q3) speed of button press**
Medium	-0.42 (1.31)	-0.11 (1.49)	-0.26 (0.99)
High	-0.50 (1.72)	0.10 (1.66)	0.10 (1.37)

Table 1 - Belief of expectancies for performance difference in the post-hypnotic suggestion condition relative to the voluntary condition. Beliefs were measured using a seven-point Likert scale under which 0 represented comparability between conditions, with -3 and +3 being beliefs of significantly different performance expectancies in opposing dimensions of performance. Standard deviations are reported in brackets.

Hypothesis critical test - Belief of expectancies for performance differences under the post-hypnotic suggestion condition relative to the voluntary condition among highs

Bayes factors were insensitive for all three question items, although nearing sensitivity in favour of the null. Q1 was the closest to sensitivity, arguably offering weak evidence in support of the null, $t(9) = -.921$, $p < 0.381$, (SE = 0.543), 95% CI [-1.73, 0.73], $B_{H(0,1)} = 0.366$, RR = [0, 1.12]. Q2 and Q3 were further from sensitivity but toward the null. Q2, $t(9) = 0.190$, $p < 0.853$, (SE = 0.526), 95% CI [-1.09, 1.29], $B_{H(0,1)} = 0.610$, RR = [0, 2.15], and Q3, $t(9) = 0.231$, $p < 0.823$, (SE = 0.459), 95% CI [-0.88, 1.08], $B_{H(0,1)} = 0.564$, RR = [0, 1.90].

Hypothesis neutral test - Belief of expectancies for performance differences under the post-hypnotic suggestion condition relative to the voluntary condition among mediums

Sensitivity was found in favour of the null for all three items, Q1, $t(18) = -1.407$, $p < 0.176$, (SE = 0.299), 95% CI [-1.05, 0.21], $B_{H(0,1)} = 0.141$, RR = [0.38, >3]; Q2, $t(18) = -.309$, $p < 0.761$, (SE = 0.341), 95% CI [-0.82, 0.61], $B_{H(0,1)} = 0.279$, RR = [0.81, >3]; and Q3, $t(18) = -1.157$, $p < 0.262$, (SE = 0.227), 95% CI [-0.74, 0.21], $B_{H(0,1)} = 0.121$, RR = [0.32, >3]. The Bayes factors here demonstrate moderate to strong sensitivity.

Hypothesis neutral test - Differences between groups in belief of expectancies

Analysis was somewhat toward the null but insensitive for all three items, Q1 $t(27) = 0.139$, $p < 0.891$ (SE = 0.568), 95% CI [-1.087, 1.245], $B_{H(0,1)} = 0.556$, RR = [0, 1.85], Q2 $t(27) = 0.339$, $p < 0.737$, (SE = 0.605), 95% CI [-1.036, 1.446], $B_{H(0,1)} = 0.670$, RR = [0, 2.36], and Q3, $t(27) = 0.821$, $p < 0.403$, (SE = 0.442), 95% CI [-0.544, 1.270], $B_{H(0,1)} = 0.826$, RR = [0, 2.87].

Discussion

This experiment set out to test whether demand characteristics of an experimental design may be responsible for findings that had been previously attributed to a mechanism of Cold Control. More specifically, whether highs and mediums differed in beliefs regarding experimenter expectations in an intentional binding task and whether any such differences may correlate to an account of belief driven performance. The results show beliefs of performance expectancies for the three most plausible performance mechanisms. Sensitive evidence was found in support of the null for all items among mediums, indicating beliefs for no performance expectancy difference between voluntary and post-hypnotic suggestion conditions. While this finding alone is predicted by the alternative account, it is non-critical and would also be expected in the case that the proposed demand characteristics effect was not present. Bayes factors were insensitive for tests of beliefs among highs and for differences in beliefs between groups. The current experiment, therefore, did not reveal a significant presence of performance expectancy belief differences and in fact the results lean more toward the null than toward the proposed alternative account. Limitations of the experiment design will be acknowledged before interpreting the value of these findings.

Compared to the current experiment, Lush et al. (2017) started with a larger group of recruited highs, from which they removed seven individuals due to being deemed unable to maintain the suggested experience of involuntariness. Mean suggestibility in their excluded group was lower than the remaining group of 10 highs (5.98 to 7.48 respectively). The current

experiment did not include a comparable exclusion process and the group of 10 valid highs had a notably lower mean suggestibility of 6.12. This negatively impacts the validity of applying findings of the current experiment to the cohort of highs used within the original experiment. Furthermore, mediums were somewhat higher scoring in the current experiment. The mean difference between suggestibility groups in the original experiment was 4.29 whereas in the current experiment it was only 2.77. The insensitivity of data for belief differences between groups may be attributable to this lower group score difference.

Three assumptions were made in using an expectancy design. The first being that when provided with a detailed description of an experimental design, individuals infer performance expectancies as they would if they were participating in the described design. The second being the assumption that beliefs of expected performance are explicit and readily available for participants to report on. A final assumption is that the expectancy design does not carry any confounding demand characteristics. To the first point, there are no obvious omissions or disparity between the description and the actual procedure. Yet, it may be the case that the nature of actual participation more strongly triggers beliefs and cues responses in accordance with beliefs and so outcomes of expectancy designs can be assumed to have more moderate findings. Admittedly there is little relevant evidence for efficacy of the expectancy design in this context other than that of Lush, (2020). Regarding the latter assumption, it is possible that demand characteristics are present in the expectancy design. Participants were recruited for this experiment by the same experimenter as for their suggestibility screening, they were advised that they were selected due to prior experiment consent, and the described design involved hypnosis. Participants were arguably exposed to ample cues to form assumptions for experimenter expectancies and have this informed by an awareness of their own suggestibility. The inconclusive nature of the results in this experiment suggests that, if expectancy demand characteristics were present, it is unlikely that they had a large role in driving highs to perform in any one particular manner. Standard deviations for reported beliefs show high variability between participants in both groups with the lowest deviation being 0.99 and the highest being 1.72, (see Table 1). This may be attributed to the small sample size but may also be the product of a flaw in the expectancy methodology. To elucidate, it may be the case participants were uncertain of any actual expectancies for performance in the described design due to not actually completing the original task. If this was the case and participants also assumed expectancies for non-zero responding to the expectancy question items, directional answers may have been no more than guesses. Finally, it is unlikely that requests for participants to consider beliefs for specific performance expectancies would not elicit responses in line with actual beliefs if there were any. It is possible that these beliefs, and the proposed performance dimensions are not the

core mechanisms driving performance. It is unclear what other possible explicit beliefs regarding specific performance dimensions could explain prior findings. It may be that the argued demand characteristics of the intentional binding design influenced beliefs and subsequent performance in a more general manner than for specific dimensions of task demands. If this is the case, not only would the performance dimensions proposed in this experiment not capture such an effect but the beliefs themselves may be less open to explicit identification. Parris et al. (2021) point out that demand characteristic driven effortful performance does not necessarily mean explicit awareness of strategic intention and in fact, altered awareness of intentions may be a consequence of demand characteristics. It is possible then, that reduced intentional binding following a suggestion for involuntariness accurately reflects a reduced sense of agency, driven by some form of demand characteristics.

This experiment offers weak evidence against prior findings being the result of specific performance beliefs. The results and interpretation of Lush et al. (2017) remain unaffected by these findings. A second experiment was conducted using the Stroop experimental paradigm to further explore a possible confounding role of a more general, and implicit demand characteristics mechanism.

Chapter 3 - **The effect of motivation upon Stroop task performance (unregistered)**

Experiment 2

Introduction

Research combining the Stroop task and suggestibility methodologies is proving useful in advancing mechanistic insight and theoretical explanations for automaticity and cognitive control. Experiments under this paradigm share design commonalities with the binding experiments and so are open to some of the same methodological limitations. The domain of relevant Stroop research will now be detailed.

As used in modern research, the Stroop task is commonly understood as an activity in which individuals are presented with stimuli words and are required to identify the colour of the word font. There are three conditions of stimuli words that are frequently used. Incongruent words (e.g., the word 'ORANGE' displayed in a 'blue' colour), neutral words (e.g., 'KNOT' displayed in 'blue'), and congruent words (e.g., the word 'BLUE' displayed in a 'blue' colour). *The Stroop interference effect* is the increased time taken (reaction time) to identify incongruent stimuli compared to the reaction time taken for neutral words. Researchers have evidenced the

presence of a stable and characterising Stroop effect under an expanse of design variations and individual differences, making the Stroop paradigm one of the most robustly validated and widely utilised tools within psychology (For reviews of the Stroop paradigm see MacLeod, 1991; 2005).

Automaticity of word reading (LaBerge & Samuels, 1974) is the prevailing mechanistic explanation for the interference effect. A simplified explanation of one automaticity argument is that the semantic processing of words is more automatic relative to the processing of colours and so word processing interferes with the task of colour naming. This explanation sits within a complex and contentious sphere of automaticity and cognitive conflict theorisation (for a review see Moors & De Houwer, 2006). To exemplify, recent research suggests that there may be multistage competition that modulates separable task, semantic and response conflicts and that this differs between Stroop task type (Augustinova et al., 2018; 2019; Parris, 2014). Aside from such uncertainties in mechanistic detail, Augustinova et al. (2018) make the simple and valuable point that while it may be only one conflict (response) that is sensitive to cognitive control, the magnitude of overall Stroop interference in the classic Stroop task is a negative indicator of cognitive control. Given this, researchers are using a standardised Stroop task methodology (Raz et al., 2002) in conjunction with suggestion manipulations to further test the nature of hypnotic experiences and in so doing, advancing theories of control. Application of hypnosis procedures are having an impact upon the theoretical assumptions drawn from the interference effect. This will now be further explored.

The word blindness suggestion and the Stroop effect

There is moderate evidence for significant differences in Stroop task performance between highs and lows under baseline conditions, aside from any hypnotic or suggestion context (discussed by Raz & Campbell, 2011). The presence of such an effect indicates a fundamental difference in mechanisms of cognitive control between highs and lows. There is a more substantive base of evidence for differences in Stroop task performance between groups when there is some form of suggestion context, which may suggest cognitive control differences that are enhanced or activated by context. Using a mixed factorial design, Raz et al. (2002) tested the effect that a post-hypnotic suggestion to perceive words as meaningless (termed the *word blindness suggestion*; Parris et al., 2012) had upon Stroop task performance under the three Stroop task conditions (neutral, incongruent, congruent) among highs and lows. The presence or absence of suggestion, as well as the three conditions, were within-subjects elements and the order of presentation and suggestibility group was between-subjects. The main finding from this experiment was that suggestion to perceive words as meaningless significantly reduced

interference among highs but not lows. Following from the seminal Raz et al. (2002) experiment, it has been repeatedly shown that when given a suggestion (hypnotic or imaginative) to the effect of not being able to read stimuli words, the Stroop interference effect can be significantly reduced and even eliminated among individuals of higher suggestibility (Parris et al., 2012; 2013; 2021; Raz & Campbell 2011; Raz et al., 2005; 2006). This suggestion-driven minimisation in interference will be referred to as the *word blindness Stroop effect* (WBSE).

Supported by measurements of participant explicit experiences, the WBSE appears at first glance to indicate an actual experiential change wherein words are not understood. As a result, this effect has previously been given as evidence against the classic notion of automaticity for word processing. However, the presence of semantic interference following the word blindness suggestion demonstrates that stimuli words are still being read and processed to a degree sufficient for conflict to arise (Augustinova & Ferrand, 2012). Semantic interference is the increased time taken to respond when font colour does not match a word that carries a semantic colour association (e.g., the word 'SKY' in a 'red' font colour as opposed to 'SKY' in a 'blue' colour). The questions remain as to what mechanisms of word processing are functioning as normal, where the conflict is affected and what strategy or ability enables the mitigation of interference. Cold Control suggests that anything achieved within a hypnosis context can be achieved outside of hypnosis, with only the metacognitive awareness of intent changing among suggestible individuals. From this, it is proposed that individuals fulfil demands of suggested behaviour by unknowingly using some form of strategy. Reductions in the interference effect can be elicited beyond the hypnosis and suggestibility context, such as through perceived social competition (Dumas et al., 2005; Huguet et al., 2004) and visuo-attentional strategy. Crucially, a strategy that sufficiently accounts for the precise manner by which the WBSE as achieved by highs under post-hypnotic suggestion (reduction in RTs for incongruent word trials), is lacking (Palfi, Parris, et al., 2020; Raz et al., 2003). Recent research appears to be ruling out visuo-attentional strategies and unpicking the nature of cognitive processes (Palfi, Parris, et al., 2020; Palfi et al., 2021; Parris et al., 2012; 2021). The current study aims to contribute insight toward the nature of strategic responding that is accountable for the WBSE and whether this falls within the bounds of the CCT. The relevant emerging research will now be described.

Palfi, Parris, et al. (2020) tested four candidate strategies (looking-away, visual blurring, single letter focus, and goal maintenance). They tested trait suggestibility groups (low, medium and high as defined by the SWASH), under a five condition within-subjects design (four

strategies plus a control) with no hypnosis context apparent. They found that while looking away and visual blurring did reduce Stroop interference, this was not achieved by means of the characteristic reduction in RTs for incongruent word trials. A further confirmatory experiment was conducted using unscreened participants and a semantic interference condition to determine semantic as opposed to response conflict mechanisms. Findings were consistent with their first experiment, in that the visual strategies were ruled out as viable explanations for the WBSE. The authors assert through additional analyses that overall response speed changes and combined visuo-attentional strategy use can be ruled out as possible answers to the question of how the WBSE is achieved.

Running contrary to the classic pairing of hypnosis and effortlessness, emerging research using the WBSE design suggests that effort may be vital to sustained hypnotic responding. Parris et al. (2012) evidenced a mechanism of effortful re-activation of suggestion, triggered upon each individual stimuli word in trial sets, rather than upon post-hypnotic suggestion activation. In a more recent WBSE experiment, Parris et al. (2021) provide physiological evidence for the effortful nature of hypnotic responding. In their experiment, highs and high-mediums were recruited for a within participants WBSE Stroop design wherein they completed Stroop tasks under counterbalanced control and post-hypnotic suggestion conditions. Using eye tracking and pupillometry, eye movement and pupil size changes were measured to test for visuo-attentional strategy use and effortfulness. Participants responded using eye movement to colour proxy locations as opposed to verbal or manual input. Results confirmed the presence of the WBSE following the removal of trials containing unnecessary eye movements and that mean pupil size was larger under the suggestion condition compared to no suggestion task completion. While acknowledging the possibility that observed visual gaze may not have been indicative of where participants were attending to, and that pupil size may indicate a vision blurring strategy, this finding was given as evidence against a visuo-attentional strategy and in favour of the effortful responding argument. This conclusion being based on aforementioned evidence discounting visuo-attentional strategy and an established relationship between pupil dilation and cognitive effort.

Palfi et al. (2021) set out to test CCT assertions using the WBSE paradigm. To do so they compared the performance of highs under voluntary and suggestion conditions of Stroop task completion. In the pilot of this study, highs completed the Stroop tasks under control, post-hypnotic suggestion and voluntary within-subjects conditions. Findings showed that the voluntary condition did not result in a comparable reduction in Stroop interference evidencing that metacognitive awareness impacts performance and thus evidence against the CCT.

Expectancies for meaninglessness were the same in both suggestion conditions. The main experiment found the interference effect and the WBSE as expected. Reported control over meaningfulness of words was evidenced to be different between the two suggestion conditions, in that it was mostly experienced as perception in the suggestion condition and as imagination in the voluntary condition, although the data for this was ultimately insensitive. Measured expectancies as well and actual experienced meaninglessness of words were found to be no different between conditions. The critical test of differences between voluntary word blindness and post-hypnotically suggested word blindness conditions revealed significant evidence for no difference in the interference reduction effects. The contrary findings between the pilot and the main experiment were suggested to be the product of a change in experiment guidance given to participants. Specifically, the main experiment encouraged participants believe that they were able to use the same strategy for the voluntary condition as the suggestion condition, whereas in the pilot participants were guided to use imagination, with no specification of a comparable strategy. Evidence in favour of this explanation and the strength of Experiment 2 is that highs achieved the voluntary condition response time (RT) reduction more by means consistent with the WBSE (reduction in incongruent trial RTs relative to neutral trials). The researchers conclude that the latter experiment strengthens evidence for the CCT. This being because it demonstrates individuals as being able to produce the WBSE both within and aside from a hypnotic context with only the metacognitive awareness changing. They extend this to direct future research toward exploring whether suggestibility performance differences between highs and lows are the product not of differences in imaginative strategy but the accompanying process by which highs experience genuine alterations in experience such as involuntariness, rather than lows maintaining an awareness of self-driven imagination.

General limitations of the described WBSE experiments

In key WBSE research, numerous potential limitations in methodology are acknowledged. To exemplify, mechanistic uniformity between modes of responding as well as between the sexes has not been determined. Thus, weighting toward female participants, and the varied use of singular mode responding, incurs limitations of generalisability for any mechanistic assumptions made by these studies. Alone, such criticisms do not gravely undermine the contribution of this study toward understanding theories of control and strategic responding, but again indicate a need for further research and replication. Much like the discussed intentional binding experiments, the WBSE design may be critically undermined by demand characteristic confounds. Specifically, it is proposed here that suggestion response mechanisms could be driven by an element of implicit demand characteristics currently being overlooked. The possibility of this with regards to the Palfi et al. (2021) experiment will now be explored.

Limitations of Palfi et al. (2021) considering demand characteristics

The apparent automaticity of word reading, and thus an assumed unavoidable interference mechanism, appears to have been accepted as sufficient circumvention of demand characteristics concerns in Stroop task experiments. The current study intends to question the validity of this assumption. Palfi et al. (2021) recruited participants following a hypnotisability screening process in a manner like that of Lush et al. (2017), although the content of recruitment materials for the actual experiment is unknown. While this allows for the possibility of pre-participation belief alteration and hypnosis context cueing, the current study again suggests that there are more substantial elements throughout the experiment procedure that may allow for demand characteristic effects.

In the main Palfi et al. (2021) experiment, six self-report question items were used. Two were for expectancies (expected ease of overcoming interference, and of expected word blindness) and four were for actual experiences of meaninglessness. These questions are quite transparent, and it is not clear that participants were unable to infer expectations of responding to them. In Parris et al. (2021), the induction and post-hypnotic suggestion cue setting was administered at the point of the relevant post-hypnotic condition, not as a procedure preceding all conditions. This meaning that participants who completed the suggestion condition second were not exposed to any clear hypnotic context beyond that of recruitment materials. Arguably, this approach offers as pure of a voluntary condition as is apparently achievable under the design. Palfi et al. (2021) however, used a similar within-subjects design and initial post-hypnotic cue setting as has been previously argued to undermine the Lush et al. (2017) design. Adding to this point, the main Palfi et al. (2021) experiment measured experienced hypnotic depth using a 0-5 scale. Results of this revealed that each of the three conditions differed significantly from each other. Interestingly, participant mean reports for the control condition was 0.95 and almost twice as high in the voluntary condition (1.84), with a score of 2.47 within the suggestion condition. If these reports are taken as more than uncertainty among some participants, they can be interpreted to indicate a generalisation of the hypnotic context to the voluntary and even control condition. Alternatively, given that the score of highs under a suggestion condition was approximately half of the maximum, and that the baseline in the control condition was above 0, a statistically significant difference between these means may not rule out the possibility that highs in the post-hypnotic suggestion condition were not satisfactorily affected by the hypnosis context (these possibilities were conceded within the article). Either way, this data can be argued to undermine the conclusion of comparably reduced interference being achieved strictly in and out of hypnosis. Experimenters explained that the

group of participants who completed the volitional condition prior to the suggestion condition would not have been aware of expectations for matched performance and add evidence for no order effects. However, this evidence is insensitive and does not rule out the possibility that highs may be equally driven to perform well in both conditions due to a context of being part of a *special performance group* which can be inferred through the above aforementioned cues.

A demand characteristics account for the word blindness Stroop effect

The WBSE is the minimisation of Stroop task interference achieved via reduced RT for incongruent word trials. This effect occurs among participants of higher suggestibility following a word blindness suggestion. Researchers have not yet identified the strategy by which participants achieve this effect, although there is indication that it involves the recruitment of cognitive resources. The demand characteristics account proposed here is that hypnosis carries an association of being part of a *special performance* group and that this association is a fundamental causal factor in triggering the recruitment of effortful cognitive resources among individuals of higher suggestibility. The effect is not replicated among individuals of low suggestibility due to lacking belief of inclusion within any such group. It may be that such demand characteristics drive first order intentions without higher order thought. This means that the proposed account may be accommodated under the CCT core assertion of altered metacognitive awareness. Experiment 2 therefore set out to test whether the RT effects that occur under the WBSE can be explained by in-group beliefs motivating performance among individuals of higher suggestibility.

To maintain consistency with Palfi et al. (2021), the Stroop task design used within this experiment closely replicated that of Raz et al. (2002). Because the WBSE is characterised specifically by means of RT reduction under incongruent word trials, no congruent word condition was necessary to test for an accountable mechanism. Parris et al. (2021) demonstrated that the WBSE can be elicited among individuals of medium to high suggestibility and so high-scoring mediums were recruited alongside highs. This offered an improved chance of collecting enough data for Bayesian sensitivity. To test the effect of in-group motivation, a group of highs and high-mediums were asked to complete the Stroop task before and after a motivation manipulation. This allowed the experimenter to observe RT differences caused by the manipulation. To address the potential confound of practice effects a second screened group completed the Stroop task twice, absent of the motivation element. The use of pre-screened, higher suggestibility participants, presented the possibility for motivated performance due to familiarity with the experimenter and an experimenter associated context of hypnosis. To offer a control for this, a group of unscreened participants were included and given a similar motivation

manipulation as the non-control screened group. Screened participants were recruited from a Bournemouth University SWASH screening database. Within their screening process they had completed a number of further elements including a cognitive reasoning test (CRT) and so implementation of a potentially convincing in-group motivator for Experiment 2 was chosen according to this. To clarify, the assumption was made that participants would be more convinced that they were genuinely selected due to a special performance ability (aside from that of hyponotic responsiveness) if, when prompted, they recalled an accountable prior performance. The Toplak et al. (2014) CRT was selected due to its simplicity and similarity with the original CRT.

Predictions

This experiment set out to test an account of whether highs and high-mediums can replicate a WBSE comparable Stroop interference reduction following a contexual motivator of being part of a special performance group. Evidence for this would mean that prior WBSE findings can be argued to be the product of such an effect (H1). Significant evidence for no interference reduction among motivated high and high-mediums (H0) would indicate that the WBSE is achieved by a mechanism beyond that of in-group motivation. Conclusions of prior studies would therefore be upheld. The main prediciton for H1 is that highs and high-mediums will demonstrate a significant reduction in incongruent trial RTs following an in-group motivation manipulation, compared to baseline performance.

The Cold Control Theory asserts that only metacognitive awareness of intention differs between suggestibility groups and so lows may be able to achieve the same outcomes generally by the same means as highs. This then predicts that there should be reduced interference among the motivated unscreened group.

It is predicted that significant evidence will be found for a Stroop interference effect in all baseline conditions. Practice effects are expected to improve performance somewhat among all groups however this is not predicted to be of any sensitive or significant magnitude. Therefore, it is predicted that the screened control group will not show a significant reduction in interference upon their second attempt.

Previous experiments have found that rates of erroneous responses are not typically affected by similar such manipulations and do not appear to be crucial to hypotheses. For this reason, no prediction is made regarding error rate data.

Method

Participants

The unscreened group of participants were recruited according to convenience from the general population of Bournemouth University students using an Experiment Participation Scheme. Two further groups of participants were recruited from the SWASH database used within the first experiment. Both of the screened groups consisted of highs (scores of 5 or higher) and high scoring mediums (scores of 3 or higher). From here onward, high scoring mediums will be referred to as high-mediums. Attempts were made to match the latter two groups according to mean SWASH score. All participants were offered £5 or one credit for completion of the study. Of a group of 47 participating individuals, 17 participants did not complete both attempts of the required Stroop task. Two further participants completed all aspects of the experiment but had 100% incorrect responses for one Stroop task attempt. Results are drawn from the remaining 28 participants data sets. There were 13 participants (three males, mean age = 21.31, *SD* = 3.43) in the unscreened group, 9 participants (one male, mean age = 23, *SD* = 7.16, SWASH score = 5.55, *SD* = 1.26) in the control screened group, and six participants in the screened motivation group (zero males, mean age = 24.17, *SD* = (10.03), SWASH score = 5.28, *SD* = 1.14).

Materials/Stimuli

Participants completed the experiment procedure online using their own laptop or PC. The 'Qualtrics' platform was used to guide participants through the experiment (See appendix F for the experiment procedure). Materials as presented via Qualtrics can be accessed at https://osf.io/u4y6h/. This involved obtaining informed consent (see appendix D and E), collection of demographic data, administering the cognitive reflection test, and links to the 'Testable' platform for completion of the Stroop elements. The CRT consisted of seven question items (listed in Appendix F). Participants were presented with 0 to 100 slider scales for responding to the first six question items and a three option, multiple choice format for the final question. Each item was presented sequentially according to a visible 45 second countdown or manual participant submission. The CRT motivation manipulation differed between groups. One screened group were guided to complete the CRT questions without any prior performance expectation or any performance feedback. Lacking any in-group context for the CRT, this group was the control. The other two groups were subject to the in-group motivation manipulations. Before completing the CRT, participants in the other screened group were presented with the statement, "In a previous experiment you have completed a similar task and performed extremely well. As a result, it is now expected that you will perform much better than another group of participants". The unscreened group were similarly presented with a statement before CRT performance. The statement for this group was, "It is expected that you will perform much

better than another group of participants". Upon completion of the CRT, these two groups were presented with a pseudo-results page containing the statement, "Congratulations! Consistent with the experimenter predictions, you have performed very well. Your score is categorised as excellent in comparison to that of participants in another group". The Stroop procedure ran on the "Testable" platform. Stimuli presentation was optimised for participant devices using a standardised measure procedure (indicating the size of a credit/debit card on their screen) and by advising participants to sit at arms-length (60cm) from the screen. All stimuli were written in upper-case font and presented against a white background. The vertical visual angle of the stimuli is 0.5º, while the horizontal visual angle of the stimuli was between 1.3 º and 1.9 º depending on the length of the word. A black cross appeared first to indicate the centre of the screen, after 1500ms this was then replaced with a Stroop stimulus which remained until the participant responded or a maximum of 2000ms. The Stroop stimulus was replaced with a feedback word displayed in black font colour ('correct' or 'incorrect'), which flashed on the screen for 500ms. The interstimulus interval was 4000ms. Feedback output was consistent with correct or incorrect participant input. The experiment only made use of incongruent and neutral stimuli words. The incongruent condition used four colour words (BLUE, RED, YELLOW and GREEN) always presented in a conflicting font colour. The neutral condition used four colour neutral nouns (SHIP, LOT, FLOWER, and KNIFE). Each neutral noun matched a colour word in character length and was presented with equal frequency across trial blocks. Neutral nouns were randomly presented in any of four font colours. All stimuli words were presented sequentially in a single block of 192 trials and were counterbalanced for word type and font colour frequency. Participants responded to the four font colours (BLUE, RED, YELLOW and GREEN) using the index and point fingers on their left and right hands to press "C", "V", "B" and "N" keys, respectively. 48 practice trials were given, using "$$$$$" in place of stimuli words to allow simple key to colour association. Participants were shown set up instructions before beginning practice and actual Stroop task blocks. The participant's role was to quickly and accurately identify the font colour of words and press an associated keyboard key. A final instruction was given before trial blocks began asking participants to aim for accuracy and speed in responding.

Procedure

A mixed design was used, with one between-subjects factor (group motivation) and two within-subjects factors (word type and trial attempt). The three groups were, a SWASH screened group subject to an in-group motivation condition, a SWASH screened group not subject to any motivator and an unscreened group that were subject to an unfounded in-group motivation. The within-subjects factor of word type had two conditions (neutral words and incongruent words).

The final factor of trial attempt had two conditions (baseline attempt and attempt following CRT task). Once participants had completed an informed consent and demographic data collection process, they were presented with a link directing them to complete a block of practice trials. Participants were free to repeat practice trials as needed, until they were confident that they understood the task format. Participants then proceeded to complete the baseline Stroop task. This was followed by the CRT task and manipulation. Following the post CRT statement, (or re-direct page for the control group), participants were presented with links to complete a further practice (if needed) and the final Stroop trial block. Finally, participants were directed to a debrief page to explain the procedure and rationale for administering false CRT expectations and results. Progression through non time sensitive elements of the experiment were set at the participants own pace with encouragement to take 30 second breaks before and after completion of the CRT if desired. Participants were advised that the session should take between 30 and 60 minutes and should be completed in one session. The run time for each Stroop attempt was approximately 10 minutes, practice trials taking 5 minutes per attempt and the CRT taking approximately 6 minutes.

Method of analysis

In line with norms of related research, Stroop task erroneous responses and RT outliers were removed prior to further analysis. For outliers, the SD of RTs for each group for each condition were calculated and all individual timings then filtered through their corresponding SD using an exclusionary boundary of 3SDs. Stroop interference for each group under each condition was calculated by subtracting mean neutral RTs from the respective mean incongruent RTs. The effect of motivation in each group was then calculated by subtracting baseline condition mean interference from motivation condition mean interference. T-tests and Bayes factors were used for within group trial type comparisons (interference) as well as for within group, mean interference comparison, between baseline and motivation conditions. T-tests are reported, however conclusions were drawn using Bayes factors.

Bayesian results of below 1/3 indicate support for the null (H0), 1/3 to 3 showing data insensitivity, and results over 3 favouring the alternative hypothesis (H1). Sample sizes were lower than 30 and so Bayes factors were calculated following the same standard error adjustment procedure as used in Experiment 1. Bayesian analyses were modelled consistent with Palfi et al. (2021) and Parris et al. (2013) in that a maximum interference effect of 62ms is expected in baseline conditions for all groups and with a 30ms interference reduction expected for a strategy accounting for observed WBSE. Therefore, to test the hypothesis neutral prediction for the presence of a Stroop interference effect under baseline condition among all

groups, a half-normal distribution was used with the mode of 0 and SD of 62ms. This is denoted as $B_{H(0,62)}$. For the crucial test of interference reduction, H1 will be modelled following the same studies in that a half-normal will be used with a mode of 0 and SD of 30ms. This is denoted as $B_{H(0,30)}$.

Data transformation

A total of 1066 erroneous key press responses were removed, accounting for 9.75% of the original RT data (see Table 2). Error rate data is provided below to maintain consistency with common practice of similar pieces of research. No analysis was conducted on this data as no predictions were made regarding error rates. Means and SD of RTs for each condition in each group were calculated and then data points that sat beyond 3SDs were removed. In total, 156 RT data points were removed, accounting for 1.43% of all data.

		Incongruent	Neutral
Unscreened	Baseline	197 (15.79)	143 (11.46)
	Motivated	121 (10.31)	126 (10.1)
Screened Control	Baseline	98 (11.34)	77 (8.91)
	Motivation absent	84 (9.93)	68 (8.01)
Screened	Baseline	51 (8.85)	25 (4.34)
	Motivated	47 (8.16)	29 (5.03)

Table 2 – Stroop task errors. The rate of errors as a percentage of total number of trials in each individual condition are reported in brackets.

Hypothesis neutral test for the Stroop interference effect under baseline performance

Under baseline Stroop task performance, the interference effect was found in all three groups, with significance met and substantial sensitivity in favour of H1 for all cases. The unscreened group had the smallest mean difference between trial type (63.73ms, *SD* = 51.301), yet the most substantial Bayes factor, $t(12) = 4.479$, $p < .001$, SE = 14.228, 95% CI[32.732, 94.734], $B_{H(0,62)} = 706.022$, RR[4.67, 21090]). The screened control group had a relatively similar mean difference (73.47ms, *SD* = 54.527) with a much lower but still strong Bayes factor, $t(8) = 4.042$, $p < .004$, SE = 18.176, 95% CI[31.562, 115.388], $B_{H(0,62)} = 44.71$, RR[10.06, 18494]). In the other screened group, the mean difference was almost double that of the control group (139.85ms, *SD* = 71.432) although with the smallest Bayes factor, $t(5) = 4.796$, $p < .005$, SE =

29.162, 95% CI[64.888, 214.815], $B_{H(0,62)}$ = 10.023, RR[24.66, 1205]). Notably, interference was much less pronounced in this group following the motivation condition and was anecdotally comparable to interference observed in the other two groups (see Table 3).

		Incongruent	Neutral	Interference
Unscreened	Baseline	810 (85)	747 (66)	64 (51)
	Motivated	769 (93)	692 (61)	77 (56)
Screened Control	Baseline	804 (138)	731 (100)	74 (55)
	Motivation absent	745 (124)	688 (106)	58 (35)
Screened	Baseline	816 (158)	677 (110)	140 (71)
	Motivated	678 (80)	614 (63)	64 (25)

Table 3 - Stroop task response time performance. Response times are rounded up in milliseconds with standard deviation in brackets

Hypothesis critical test for the within group effect of motivation upon performance

Interference was reduced somewhat under motivation absent repetition among the control screened group, (M_{diff} = 15.845, SE = 21.066). The Bayes factor for this was insensitive, *t*(8) = 0.752, *p* = 0.473, 95% CI[-32.732, 64.423], $B_{H(0,30)}$ = 0.982, RR[0, 134.96]). Interference among the unscreened group increased following the motivation manipulation (M_{diff} = -13.527, SE = 16.851). The Bayes factor in this case showed weak evidence favouring the null, *t*(12) = -0.803, *p* = 0.438, 95% CI[-50.241, 23.188], $B_{H(0,30)}$ = 0.356, RR[0, 32.2]). The final group of screened participants had a large reduction in interference following motivation, almost 60ms beyond that of the effect among the control screened group (M_{diff} = 75.725, SE = 21.778). The Bayes factor shows insensitivity slightly weighted toward H1, *t*(5) = 3.477, *p* = 0.018, 95% CI[19.744, 131.706], $B_{H(0,30)}$ = 2.781, RR[0, 33.46]). See figure 2 for all interference effects.

Hypothesis neutral test of between group differences in interference reduction

Analysis for the difference between the screened control and the unscreened group was insensitive, *t*(17) = 1.1, *p* = 0.286, M_{diff} = 29.37, SE = 26.77, $B_{H(0,30)}$ = 1.420, RR[0, 242]). Insensitivity in the direction of H1 was found when comparing the screened motivation group to the screened control group, *t*(13) = 1.91, *p* = 0.079, M_{diff} = 59.88, SE = 31.41, $B_{H(0,30)}$ =

2.428, RR[0,855]). Sensitive evidence for H1 was found for the difference between the screened motivation group and the unscreened group, $t(17) = 3.08$, $p = 0.007$, $M_{diff} = 89.25$, SE = 28.96, $B_{H(0,30)} = 10.495$, RR[<0.01, 1310]).

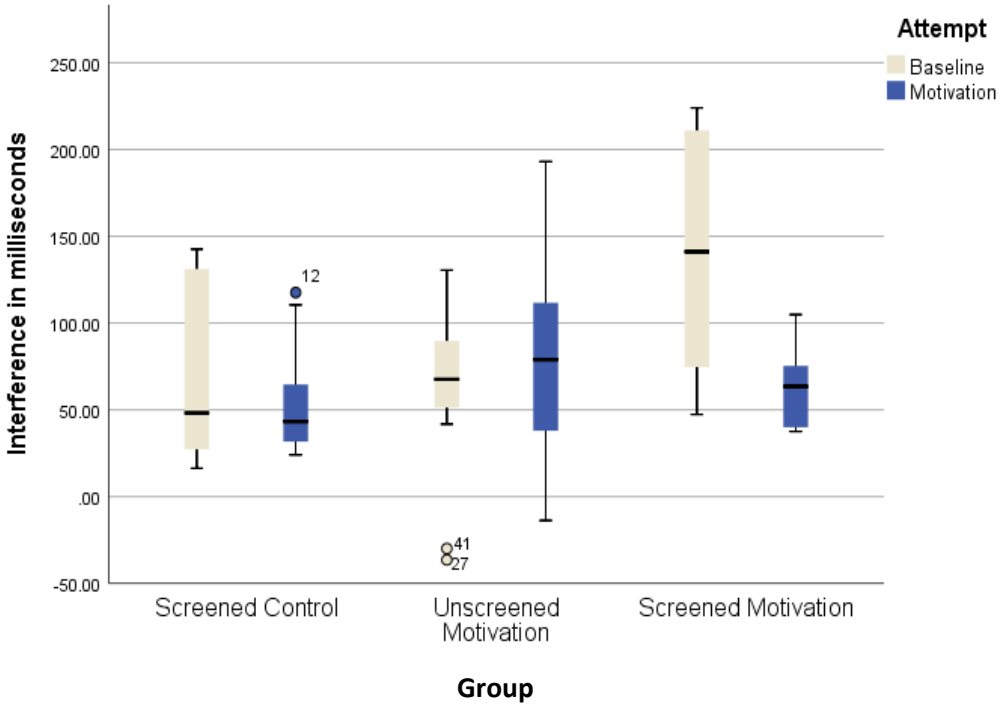

Figure 2 - Box plot displaying Stroop interference effects for each group under each condition.

Discussion

In this experiment, sensitive evidence was found for the Stroop interference effect among all groups under baseline performance. All groups performed faster for both trial types upon second attempts and as expected. This is assumed to be the result of practice effects. The control group showed an insensitive reduction in interference upon their second attempt. The second Stroop task attempt resulted in an insensitive increase in interference among the unscreened group. Bayesian analysis gives weak support for the null in this case. Interference reduction can be seen in the non-control screened group, with RTs for incongruent trials having sped up by over twice as much as neutral trials in the second Stroop task. The Bayes factor for this effect was 2.781, offering weak evidence in favour for H1. While interference was not eliminated, this is not a required characteristic of the WBSE as can be seen in Palfi et al. (2021). From this, it appears that when prompted with demand characteristics of in-group motivated performance, individuals of higher suggestibility appear able to achieve a WBSE like interference reduction. The strength of this argument must now be considered with respect to several limitations.

Crucially, interference reduction was almost five times greater than practice effects of the control group, showing slight H1 support with a Bayes factor of 2.428. The Bayes factor for difference between the unscreened and the screened motivated group was 10.495, showing strong H1 support. There is a rule of thumb that 10-15% of any randomly selected group of individuals are highs (Lush et al., 2018). If this is assumed for the unscreened group, the results may be accounted for by a positive correlation between in-group demand characteristics sensitivity and suggestibility. This would suggest that an in-group interference reduction effect is limited to individuals of higher suggestibility when given a hypnosis context. Alternatively, the in-group manipulation among the unscreened group may have failed due to its unfounded nature and so participants may not have been as motivationally affected. To elucidate, the unscreened participants were told that they were expected to perform better at the CRT task than another group of participants despite there being no supporting rationale as to why and no contact with any other participant group. The screened and motivated group on the other hand were told that they were expected to perform better than another group due to their performance in a prior experiment. Therefore, this latter group may have been sufficiently convinced of their in-group status while unscreened group were not convinced. Unfortunately, the unscreened group were not retrospectively screened nor were they asked to report how convinced they were of the in-group manipulation. It is therefore unclear whether the WBSE like in-group interference reduction can be achieved by any individual when presented with suitable in-group demand characteristics. Research into cognitive control may benefit from further studies using convincing manipulations of belief regarding special performance and in-group status both within and aside from hypnotic suggestibility considerations.

The interesting baseline performance differences between groups must be acknowledged. Participants in the non-control screened group performed anecdotally comparable to the other two groups in the baseline incongruent trials but dramatically faster in the neutral trials (see Table 3). The magnitude of interference among this group was almost double that of the other 2 groups. At the point of baseline performance, participants had not been subject to any manipulations and only the screened groups could have associated the experiment with hypnosis. Also, participants were given no forewarning of a second Stroop task. It is possible that the key finding of interference reduction among the non-control screened group was the result of deliberate performance on the first Stroop trial in anticipation of a second attempt. This anticipation could be explained by an account of participants being familiar with within group designs commencing with baseline tasks. However, if this disparity between neutral and incongruent RTs under baseline performance was the result of cued

expectancies, the two screened groups should have performed comparably. Given that the RTs were far from comparable, it is assumed here that baseline differences indicate a potential variation in ability among participants of each group. The questions remain open as to why, on average, participants in this group had such an ability for accurate and timely neutral word task performance which did not translate to incongruent task performance and why the effect of word incongruence upon response times was so substantially mitigated by positive performance expectation. It may be that there is a subgroup of highs who process words with high automaticity resulting in fast and accurate neutral word processing yet are particularly affected by the nature of interference, unless they are provided with context for positive performance expectation. To explore this proposition and to observe whether these findings are more than just the product of sampling error, replication of this experiment should be conducted on a larger scale to identify any similarly affected individuals. Then, further tests relevant to the areas of cognitive control, automaticity and suggestibility should be carried out to substantiate the existence of a stable sub-group.

Some further points to note when considering the strength of findings for Experiment 2 are that mean difference standard error rates were high, Bayes factors were not particularly strong and participant numbers were below the recommended lower threshold of 20. While this raises concern for the reliability of resulting data, a slight compensation for this is that Stroop tasks for the experiment contained more trials per word type than in the key experiments described. Preliminary data treatment showed that 9.75% of data sets were erroneous and only 1.43% of responses were beyond the 3SD cut off points. These figures are approximate to the norm within the discussed Stroop experiments and demonstrate typical Stroop task performance in a broad sense. With such a small proportion of outlier responses, the suggestion not to trim, as presented in Parris et al. (2013), was disregarded.

Chapter 4 - **General discussion and conclusion**

General discussion

Key hypnosis research using the intentional binding and Stroop task paradigms argues that individuals of higher suggestibility fulfil behaviours according to Cold Control when they believe that the behaviour is a hypnotic suggestion. Cold Control asserts that suggestions are fulfilled by means of self-driven strategies, while metacognitive awareness of intent is absent or reduced. The result then being genuine alterations in experiential states. The current study intended to explore the potential role that demand characteristics may play in suggestion fulfilment. The first experiment aimed to test whether demand characteristics may confound genuine hypnotic responding through explicitly driving specific strategic responding. Results of

this experiment did not reveal the presence of a specific demand characteristic driven strategy for performance of intentional binding tasks. A second experiment was then conducted to test a general account of demand characteristics under the WBSE paradigm. The general account is that demand characteristics implicitly drive motivated performance by influencing individuals to believe that they belong to a special performance in-group. Benefits of this general account over the specific strategy proposition are that it is in line with the discussed evidence of effortful performance in hypnotic responding, and that it does not appear to conflict with the prevailing Cold Control Theory. With caution for methodological and statistical limitations, Experiment 2 offers weak support for the proposal that the WBSE may be accounted for by in-group belief driven motivated performance among individuals of higher suggestibility, and thus offers weak support for the general account. Before discussing implications of Experiment 2 with regard to cognitive control theories, some general limitations need to be noted.

The manual responding mode (as opposed to visual or vocal) was chosen to maximise comparability to Palfi et al. (2021), however, it is unclear whether the mechanistic nature of responding is the same between modes (for discussion of this see Macleod, 1991; Augustinova et al., 2019). Consequently, it may be that the assumptions drawn from these findings are only applicable to manual responding. Equally, this could mean that while results of Parris et al. (2021) influenced the proposed in-group account, their findings are restricted to the visual mode of responding. Experiment 2 only matched participants according to approximate age and SWASH score while leaving individual characteristics such as gender and language ability not controlled. The impact of these factors upon Stroop task response speed and interference effects appears under contention (for discussion and exemplification see Baroun & Alansari, 2006; Bosworth et al., 2021), and there is no known data at the time of the current study to indicate that these variables impact the ability for Stroop interference reduction. This methodological oversight will therefore not be considered a critical flaw, although it may be a possible source of baseline performance differences between groups. Future research exploring the impact of such variables on interference reduction effects should be conducted to clarify these uncertainties.

Conclusions drawn from WBSE findings, specifically that of Palfi et al. (2021), rely on evidence for comparable performance of highs in non-baseline conditions and depends upon assumed fundamental differences between manipulated conditions. Evidence for in-group motivation undermines this. It is plausible that in-group motivation extends to the broader sphere of hypnosis paradigms such as intentional binding. However, dissimilarities between the mechanistic nature of responding under differing paradigms means that generalisability is limited and so paradigm specific replication studies may be worthwhile. The main finding of

Experiment 2 undermines the nature by which the Cold Control Theory has been asserted in some cases and may offer a simpler demand characteristics account of prior findings. Although, considering the wealth of evidence for genuine experiential change under hypnosis, it is more likely that an assumed in-group motivation mechanism contributes to performance alterations while abiding the Cold Control Theory. It may be the case that any individual, if presented with a belief consistent cue for in-group enhanced performance, can complete tasks with an implicit recruitment of effortful cognitive resources which they experience without metacognitive awareness of effort or strategy.

Some studies including Palfi, Parris, et al. (2020) have proposed that strategic responding under Cold Control may be fundamentally imagination-based. If this is the case, it may be that an in-group motivation explanation may fit within an imagination-based account for suggestion effects, in that the recruitment of effortful resources may simply facilitate the imaginative process. However, as discussed in a recent review of this topic by Terhune and Oakley (2020), evidence for a fundamental causal role of imagination is limited with available supporting studies being open to similar potential demand characteristic effects as raised within the current study. They also make the point that suggestion fulfilment of extreme highs and lows may be related to imaginative ability, but this does not dictate a causal role of imagination and may instead indicate subsets of individuals. Furthermore, hypnosis comparable behaviour elicitation using voluntary imagination is volatile, with experiments such as the Palfi et al. (2021) pilot demonstrating opposing findings. In that example, the experimenters suggested strategic responding was affected by particular wording of instructions provided. The in-group effortful performance account may allow for alterations toward involuntariness without the need for a causal imaginative mechanism. Despite the recruitment of effortful cognitive resources, enhanced performance of tasks may feel less effortful due to a reduction in conflict and may feel less agentic due to the implicit nature of the motivation. Participants may, as a result, naturally seek to explain this experience. Within a hypnosis context, highs may attribute this to the nature of hypnosis. Without any hypnosis context, or among lows, a more imagination-based explanation may be the natural tendency to turn to. Any such responding mechanism may then be proportionate to the individuals prior held understanding, belief and expectancies regarding the concerned concepts of hypnosis, suggestibility and imagination.

Conclusion

In conclusion, the Cold Control theory asserts that under hypnosis, highs fulfil behaviours by means of strategic responding, yet genuinely experience altered states such as involuntariness due to reduced metacognitive awareness of intent. Prominent hypnosis experiments using the

intentional binding and Stroop task paradigms have produced evidence in support of Cold Control. The current study identified that these experiments had not sufficiently ruled out the possibility that participant behaviour was driven by demand characteristics such as perceptions of experimenter expectancies or of in-group status. Given a lack of evidence for the proposed specific strategic element of responding, coupled with established evidence for socio-cognitive factors contributing to hypnotic responding, the current study asserted that demand characteristics needed to be explored. A quasi-experiment to test an account of explicit expectancy driven performance was conducted. Findings showed weak support against this account. A second experiment was then carried out to test whether prior findings of hypnotic responding within the Stroop task may be due to perceptions of in-group status implicitly influenced the recruitment of more effortful cognitive resources. Findings showed weak support in favour of this account. These outcomes were interpreted to indicate that while perceived experimenter expectancies are an unlikely candidate for significantly influencing hypnotic responding, a mechanism of in-group driven effortful performance needs to be seriously considered for future experimental designs. For now, the in-group account neither supports not refutes the Cold Control theory as it is possible that such a mechanism simply precedes activation of strategic responding. While a purely in-group demand characteristic driven effortful performance may be a simple explanation for hypnotic responding, the evidence presented here is weak in comparison to evidence in favour of Cold Control, and accountable strategic responding has not yet been ruled out. Future research should continue to explore the group differences in potential strategies of responding, the impact and role of imagination in mechanisms of control and the possibility of demand characteristics driven motivated performance.

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Appendices

Appendix A - **Experiment 1 participant information sheet**

The title of the research project

The intentional binding effect in hypnosis

Invitation to take part

You are being invited to take part in a research project. Before you decide whether or not you wish to take part it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information.

Who is organising/funding the research?

The research is being organised by Jason Helstrip and Dr Ben Parris. Funding for this project has been sourced from the Faculty of Science and Technology at Bournemouth University

What is the purpose of the project?

This experiment sits within a larger research project and has a focus upon topics of hypnosis and the sense of agency. Sense of agency is the awareness of apparent control over actions and events. An example to illustrate the sense of agency is the feeling of causing a light to come on because you chose to press a button that would typically turn the light on. The aim of this study is to consider the validity of prior research findings while exploring alternative theoretical accounts. The research that you have been invited to participate in aims to present you with a description of another experiment design and then, using a questionnaire format, collect your feedback regarding how you believe you would be expected to perform if you were to participate in the experiment.

What would taking part involve?

This experiment is in the format of an online questionnaire hosted by Qualtrics. Participation in this study will require you to sit at a desk for less than 1 hour. You will be asked to read through detailed descriptions of an experimental design, view figures to aid in understanding and to watch 2 short instructional videos. The videos will be on the YouTube platform. You will be

asked to answer a total of 6 questions. For 3 of the questions you will be asked for responses in the form of short sentences and the remaining 3 will be for responses on a scale.

Why have I been chosen?

You have been chosen for this experiment as a result of participating in a prior study delivered by the University of Sussex. In this prior study you indicated a willingness to be contacted for further participation opportunities. You have been identified as a suitable participant as a result of your prior performance. We will be aiming to recruit 50 participants for this experiment.

Do I have to take part?

You are in no way obligated to participate in this piece of research and it is up to you to decide whether or not to take part. If you do decide to take part, you are welcome to ask for a copy of this information sheet to retain. You will be asked to indicate your willingness to participate through completion of a digital Participant Agreement Form. We want you to understand what participation involves, before you make this decision.

Your decision to or not to participate will in no way impact your academic relationships or performance. Any relationships between yourself or a family member with Bournemouth University, the University of Sussex, or the research team, e.g. as a member of staff, as student or other service user, should not influence your decision on whether to take part (or continue to take part).

You do not need to give any explanation or response in the case that you do not wish to participate.

Can I change my mind about taking part?

Yes, you can stop participating in study activities at any time and without giving a reason.

If I change my mind, what happens to my information?

After you decide to withdraw from the study, we will not collect any further information from or about you. With regards to information we have already collected before this point, your rights to access, change or move that information are limited. This is because we need to manage your information in specific ways in order for the research to be reliable and accurate. Further explanation about this is in the Personal Information section below.

What are the advantages and possible disadvantages or risks of taking part?

Whilst there are no immediate benefits for those people participating in the project, it is hoped that this work will contribute to knowledge and understanding in areas of research such as consciousness, agency and related clinical conditions.

We do not anticipate any risks to you from taking part in this study.

What type of information will be sought from me and why is the collection of this information relevant for achieving the research project's objectives?

We will collect your email address, full name and the date on which you participated. This is required to evidence your willingness to participate, to provide you with a £5 Amazon voucher and for us to verify participants. By verifying participants, we mean the process of counting valid completions and checking against an original list of potential participants.
Your responses to the questions will be anonymised and retained as is fundamental to the research.

Will I be recorded, and how will the recorded media be used?

There will be no audio or video recording as part of this study.

How will my information be managed?

Bournemouth University (BU) is the organisation with overall responsibility for this study and the Data Controller of your personal information, which means that we are responsible for looking after your information and using it appropriately. Research is a task that we perform in the public interest, as part of our core function as a university.

Undertaking this research study involves collecting and/or generating information about you as outlined above. We manage research data strictly in accordance with:

- Ethical requirements
- Current data protection laws - These control use of information about identifiable individuals, but do not apply to anonymous research data: "anonymous" means that we have either removed or not collected any pieces of data or links to other data which identify a specific person as the subject or source of a research result.

BU's Research Participant Privacy Notice (see attached or follow hyperlink) sets out more information about how we fulfil our responsibilities as a data controller and about your rights as an individual under the data protection legislation. We ask you to read this notice so that you can fully understand the basis on which we will process your personal information.

Research data will be used only for the purposes of the study or related uses identified in the Privacy Notice or this Information Sheet. To safeguard your rights in relation to your personal information, we will use the minimum personally-identifiable information possible and control access to that data as described below.

Publication

You will not be able to be identified in any external reports or publications about the research. Your information will only be included in these materials in an anonymous form, i.e. you will not be identifiable.

Research results may be used first-hand in various external reports or publications. There may be further use of these research results as part of subsequent projects. Such use is not pre-determined and so at this stage cannot be specified.

Security and access controls

All information collected by us, as a result of your participation, will be digital. All digital information will be stored in a secure location and on a password protected and secure network.

Personal information which has not been anonymised will be accessed and used only by appropriate, authorised individuals and only when this is necessary for the purposes of the research or another purpose identified in the Privacy Notice. This may include giving access to Bournemouth University staff or others responsible for monitoring and/or audit of the study, who need to ensure that the research is complying with applicable regulations.

Data of experiment performance will not be directly relatable back to you, nor will any analysis or findings. Individual identifiers will be encoded merely for the purpose of matching data sets and will not be traceable to email accounts or participant agreement form details. Email addresses will be retained for the purpose of updating you of the study completion and findings if you have indicated interest in this.

Sharing your personal information with third parties

Your limited personal information will not be shared with any other 3rd party.

Further use of your information

The information collected about you may be used in an anonymous form to support other research projects in the future and access to it in this form will not be restricted. It will not be possible for you to be identified from this data. To enable this use, anonymised data will be

added to an open access service: The Open Science Framework - this is an online location where data is stored, which is accessible to the public.

Keeping your information if you withdraw from the study

If you withdraw from active participation in the study we will keep information which we have already collected from or about you, if this has on-going relevance or value to the study. As explained above, your legal rights to access, change, delete or move this information are limited as we need to manage your information in specific ways in order for the research to be reliable and accurate. However, if you have concerns about how this will affect you personally, you can raise these with the research team when you withdraw from the study.

You can find out more about your rights in relation to your data and how to raise queries or complaints in our Privacy Notice

Retention of research data

Project governance documentation, including evidence of **participant agreements**:
we keep this documentation for a long period after completion of the research, so that we have records of how we conducted the research and who took part. The only personal information in this documentation will be that which was stated above, and we will not be able to link this to any anonymised research results.

Research results:

As described above, during the course of the study we will anonymise the information we have collected about you as an individual. This means that we will not hold your personal information in identifiable form after we have completed the research activities. You can find more specific information about retention periods for personal information in our Privacy Notice. We keep anonymised research data indefinitely, so that it can be used for other research as described above.

Contact for further information

If you have any questions or would like further information, please contact Jason Helstrip - jhelstrip@bournemouth.ac.uk.

In case of complaints

Any concerns about the study should be directed to Jason Helstrip - jhelstrip@bournemouth.ac.uk. If you concerns have not been answered by Jason Helstrip, you should contact Bournemouth University - researchgovernance@bournemouth.ac.uk or the

Health and Social Sciences Deputy Dean for Research and Professional Practice: Professor Tiantian Zhang - tzhang@bournemouth.ac.uk

Finally

If you decide to take part, please note that you are welcome to request a copy of this information sheet.

Thank you for considering taking part in this research project.

Appendix B - **Experiment 1 participant agreement form**

Full title of project: **The intentional binding effect in hypnosis**

Name, position and contact details of researcher: Jason Helstrip – jhelstrip@bournemouth.ac.uk.
Name, position and contact details of supervisor: Dr Ben Parris – bparris@bournemouth.ac.uk.

Agreement to participate in the study

You should only agree to participate in the study if you agree with all of the statements in this table and accept that participating will involve the listed activities.

I have read and understood the Participant Information Sheet **(The intentional binding effect in hypnosis)** and have been given access to the BU Research Participant Privacy Notice which sets out how we collect and use personal information (https://www1.bournemouth.ac.uk/about/governance/access-information/data-protection-privacy).
I have had an opportunity to ask questions.
I understand that my participation is voluntary. I can stop participating in research activities at any time without giving a reason and I am free to decline to answer any particular question(s).
I understand that taking part in the research will include the following activity/activities as part of the research: • Completing an online questionnaire using the Qualtrics service • Watching brief descriptive videos using the YouTube platform
I agree that BU researchers may obtain and process my information as described in the Participant Information Sheet
I understand that, if I withdraw from the study, I will also be able to withdraw my data from further use in the study **except** where my data has been anonymised (as I cannot be identified) or it will be harmful to the project to have my data removed.
I understand that my data may be used in an anonymised form by the research team to support other research projects in the future, including future publications, reports or presentations.

I confirm my agreement to take part in the project on the basis set out above.

Appendix C - **Experiment 1 procedure**

In this questionnaire you will be asked to read through descriptions of an experimental design. You will then be asked to answer a number of questions about the experimental design. To start with, please read the below summary and watch the summary video. Once you have done this, you will be presented with a few initial questions.

Summary of experimental design

In this experimental procedure, participants observe a clock face with a moving dot. The core tasks asked of the participants are to complete simple key press actions and to make timing estimates. The timing estimates are of either actions or tone sounds. To make the timing estimates, participants are required to move the dot to the location they believed it to be at the time of the action or tone.

This experimental procedure has three action conditions. This meaning that the key press action is completed in three different ways.

The three action conditions are

Voluntary action, passive action and post-hypnotically suggested involuntary action.
Please now watch a short video further summarising this experimental design.

Please now watch the video

(To do so, copy and paste the below URL into a new tab. This should take you to YouTube. Keep this questionnaire open)

https://www.youtube.com/watch?v=Te3NnabkytM&feature=youtu.be

[NEXT PAGE]

You have now been given a summary of an experimental design. Please take your time to consider and respond to the questions below. Please keep responses to a brief sentence or two. Once you have completed the questions, click 'next' for the main part of the experiment.

1. Have you previously participated in an experiment using elements of the described procedure? If so, please give a brief description.
2. What do you think is the purpose of the three action conditions?
3. What do you think the experiment aims to test by gathering timing estimations?

[NEXT PAGE]

Participants taking part in the summarised experiment would typically be given the below guidance. Please briefly consider this before proceeding to a more detailed description of the experimental procedure.

Invitation

You are being asked to take part in a research study on the timing of the conscious experience of performing a simple voluntary motor action and the perception of an auditory stimulus.

What will happen

You will be asked to watch a computer generated clock face and to report the position of the clock hand when you either press a key on a computer keyboard or hear a beep. You should wait for one full revolution of the clock before pressing the key. After each trial has ended, you will be able to use a mouse to report the position of the clock hand. You will have five unrecorded trials to familiarise yourself with the procedure. There will be four blocks, two in which you will be asked to report the position of the clock when you heard a beep and two in which you will be asked to report the time at which you pressed a key. Each block will consist of forty trials, separated by a short break. There will be three conditions. In one you will perform the trials as described above. In another your finger will be pulled onto the button by the experimenter pulling down on a string attached to a fabric loop. In a third condition you will undergo a hypnotic induction and given the hypnotic suggestion that will perform the button press without having the experience of intending to do so. Hypnotic induction will be performed by the principle investigator, who has received training in an internationally recognised hypnosis lab.

[NEXT PAGE]

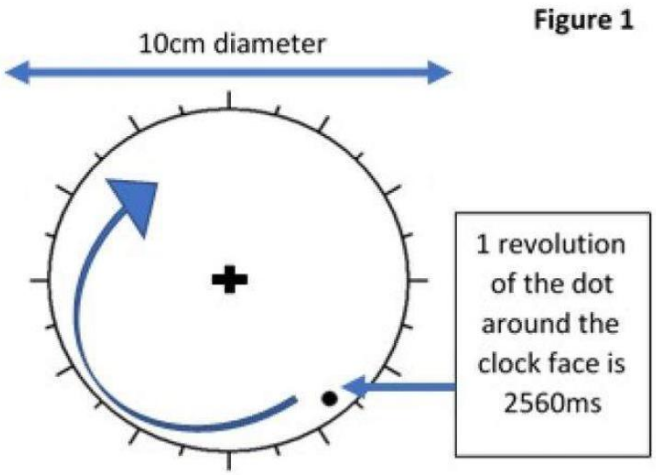
Shortly you will be presented with some more questions about the experimental design that we have summarised so far. You will be asked to answer the questions as though you were a participant in the design. To be able to do this, it is important that you fully understand the

experimental design. Please take your time to carefully read the detailed description, examine the figures and watch the short video below before proceeding to the questions. When answering the questions you will be given some reminder information and be able to return to the description if needed.

Experiment description

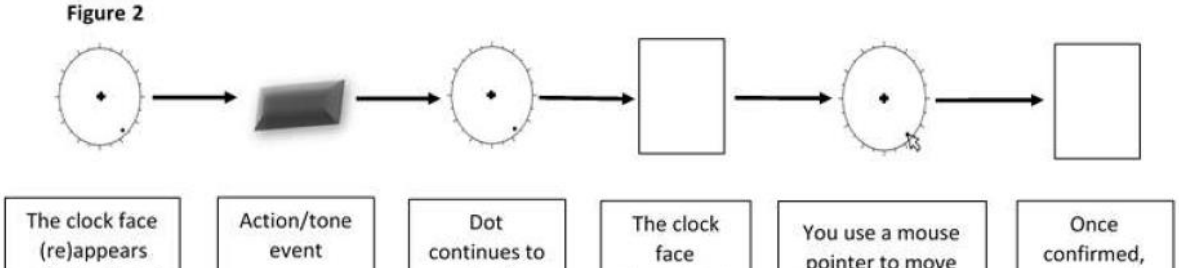
Throughout the experiment participants are seated at a computer with a keyboard in front of them. Participants are guided to maintain focus upon the middle of the screen and are presented with a clock face similar to that in **figure 1.** Participants complete a series of time judgements while observing a dot rotating around the clock face.

Figure 1



Judgements are of either an action (participant pressing 'space bar') or a tone sound. The complete process of observing and then making a judgement is referred to as a ‘trial’ and is illustrated in **figure 2**.

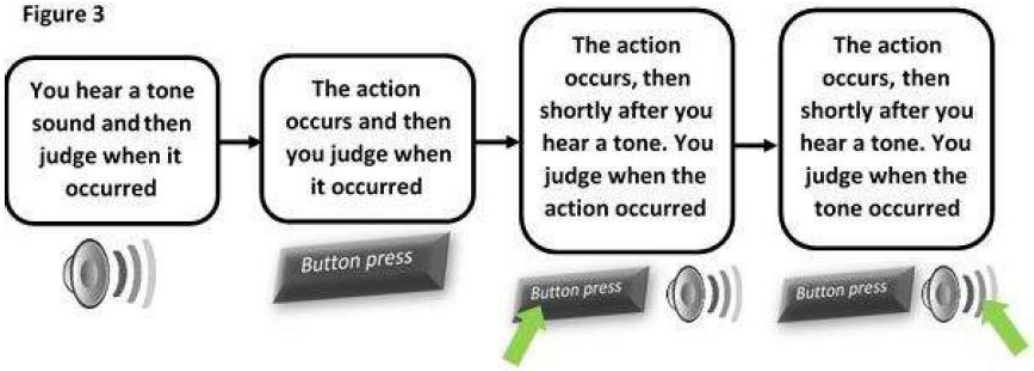
Figure 2



Participants make four different types of judgements **(see figure 3).** Participants complete a set number of trials for each judgement type before moving on to the next judgement type. As this experiment has three different conditions (variations of how the action is completed), this whole

process is completed three times in no particular order. Reminder: 'action' means the act of pressing the 'space bar'.

Figure 3



Three action conditions

Voluntary: Participants press the 'space bar' when they wish to do so.

Passive: The experimenter controls the participants finger to press the 'space bar'. They do this using a piece of material wrapped around the participants finger. They pull the finger to complete the action while out of the participants view.

Suggestion for involuntariness

This involves a hypnosis technique called post-hypnotic suggestion. For this process, the experimenter conducts a hypnotic induction with the participant. In this induction, participants are given the suggestion that when they hear a ‘hand clap’ they will perform the button press without having the experience of intending to do so. Participants are then counted out of hypnosis and prepared for participation in the trials. This process is done at the start of the experiment, after participants have had a short practice of the trial process. To clarify, participants will know which condition they are completing as they will either have a loop of

material around their finger (Passive), hear a hand clap 20 seconds before each block of trials (post-hypnotic suggestion) or neither (voluntary).

Additional notes

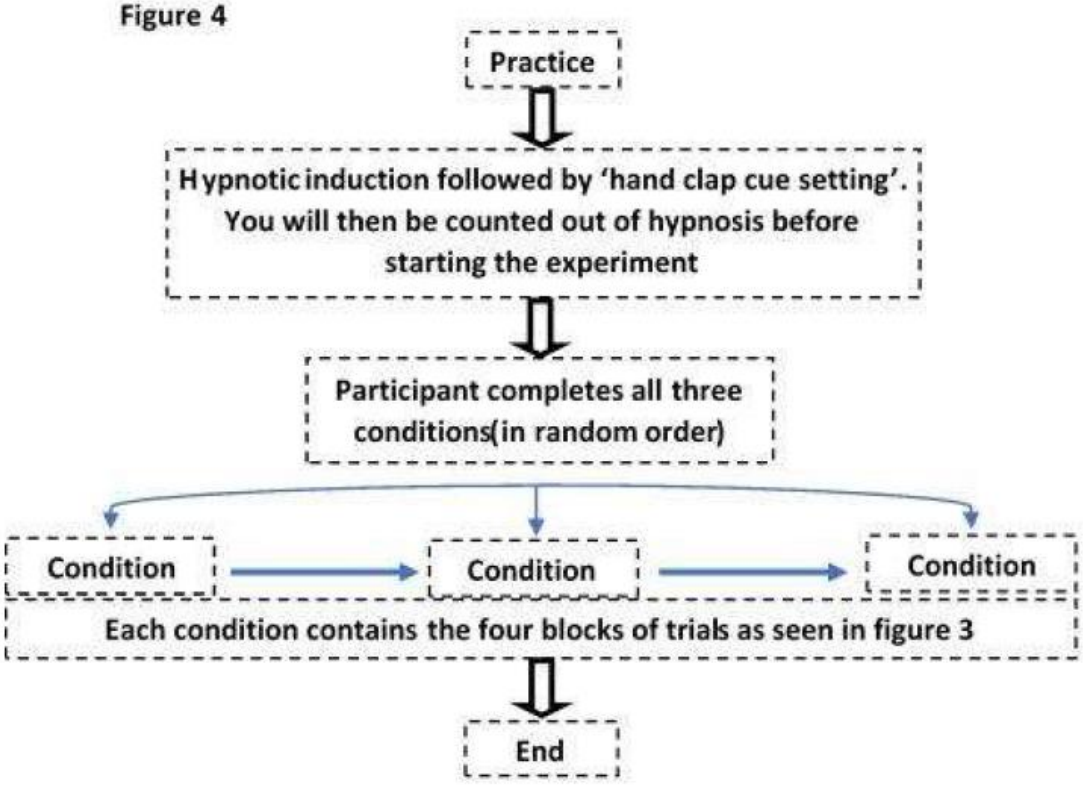
Participants in this experiment are asked multiple times in each condition to verbally rate (on a scale of 0-5) the experienced involuntariness of the action. Participants in this experiment are advised at the start of the experiment not to pre-plan or strategically aim for any location on the clock.

For a further visual summary of the overall process please see figure 4 and use the URL for a detailed video explanation.

(Copy and paste the below URL into a new tab. Keep this questionnaire open)

https://www.youtube.com/watch?v=aZbMCBBKIC0&feature=youtu.be

Figure 4



Thank you for taking the time to consider the experimental design in more detail.

You will now be asked to respond to three questions using a scale ranging from -3 to +3.

You are welcome to return to the description page while answering the questions if needed.

The given statements request you to consider your perceptions of the experimental design as

though you are a participant in that experiment. The statements are specifically for comparisons between the voluntary and post-hypnotic suggestion conditions.

[NEXT PAGE]

Conditions reminder (given alongside each of the below three questions)

Voluntary: You, as a participant, press the 'space bar' voluntarily for all trials in this condition.

Post-hypnotic suggestion: You, as a participant would hear a hand clap before each block of trials in this condition. The hand clap activates the suggestion that your finger will move involuntarily to press the 'space bar' for all trials in a block.

Question one of three

In the post-hypnotic suggestion condition, compared to voluntary condition, are you expected to pay less, the same or more attention to the dot's location when you press the button?

Significantly less attention (-3)	-2	-1	Same attention in both conditions (0)	+1	+2	Significantly more attention (+3)

[NEXT PAGE]

Question two of three

In the post-hypnotic suggestion condition, compared to voluntary condition, are you expected to pay less, the same or more attention to the dot's location when the tone sounds?

Significantly less attention (-3)	-2	-1	Same attention in both conditions (0)	+1	+2	Significantly more attention (+3)

[NEXT PAGE]

Question three of three

In the post-hypnotic suggestion condition, compared to voluntary condition, are you expected to press the button more slowly, the same or more quickly?

Significantly slower (-3)	-2	-1	Same speed in both conditions	+1	+2	Significantly quicker (+3)

(0)

Appendix D - **Experiment 2 participant information sheet**

The title of the research project

Factors affecting cognitive control

Invitation to take part

You are being invited to take part in a research project. Before you decide whether or not you wish to take part it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information.

Who is organising/funding the research?

The research is being organised by Jason Helstrip and Dr Ben Parris. Funding for this project has been sourced from the Faculty of Science and Technology at Bournemouth University

What is the purpose of the project?

This experiment sits within a larger research project and has a focus upon Stroop task performance, reasoning ability and cognitive control (the awareness and apparent control over actions and events). The aim of this study is to consider the validity of prior research findings while exploring alternative theoretical accounts. The main focus of this experiment is to collect data of your responses while completing Stroop task.

What would taking part involve?

This is an online experiment with two key elements. One element being a questionnaire and the second being a Stroop task. The Stroop task involves you being required to press keyboard buttons to indicate the font colour of words that you see on a screen.

The ‘Qualtrics’ questionnaire platform will be used to guide you through the experiment. This will include informed consent, demographic data input (such as your name, age and gender), and a 7-item cognitive reasoning questionnaire. The ‘Testable’ platform will be used for Stroop elements. Participation in this study will require you to sit at a desk for no more than 1 hour.

Do I have to take part?

You are in no way obligated to participate in this piece of research and it is up to you to decide whether or not to take part. If you do decide to take part, you are welcome to ask for a copy of this information sheet to retain. You will be asked to indicate your willingness to participate through completion of a digital Participant Agreement Form. We want you to understand what participation involves, before you make this decision.

Your decision to or not to participate will in no way impact your academic relationships or performance. Any relationships between yourself or a family member with Bournemouth University or the research team, e.g. as a member of staff, as student or other service user, should not influence your decision on whether to take part (or continue to take part).

You do not need to give any explanation or response in the case that you do not wish to participate.

Can I change my mind about taking part?

Yes, you can stop participating in study activities at any time and without giving a reason.

If I change my mind, what happens to my information?

After you decide to withdraw from the study, we will not collect any further information from or about you. With regards to information we have already collected before this point, your rights to access, change or move that information are limited. This is because we need to manage your information in specific ways in order for the research to be reliable and accurate. Further explanation about this is in the Personal Information section below.

What are the advantages and possible disadvantages or risks of taking part?

Whilst there are no immediate benefits for those people participating in the project, it is hoped that this work will contribute to knowledge and understanding in areas of research such as consciousness, agency and related clinical conditions.

We do not anticipate any risks to you from taking part in this study.

What type of information will be sought from me and why is the collection of this information relevant for achieving the research project's objectives?

We will collect your email address, full name, age, gender and the date on which you participated. This is required to evidence your willingness to participate, to provide you with a £5 Amazon voucher (if applicable) and for us to verify participants. By verifying participants, we mean the process of counting valid completions and checking against an original list of

potential participants.
Your responses will be anonymised and retained as is fundamental to the research.

Will I be recorded, and how will the recorded media be used?

There will be no audio or video recording as part of this study.

How will my information be managed?

Bournemouth University (BU) is the organisation with overall responsibility for this study and the Data Controller of your personal information, which means that we are responsible for looking after your information and using it appropriately. Research is a task that we perform in the public interest, as part of our core function as a university.

Undertaking this research study involves collecting and/or generating information about you as outlined above. We manage research data strictly in accordance with:

- Ethical requirements
- Current data protection laws - These control use of information about identifiable individuals, but do not apply to anonymous research data: "anonymous" means that we have either removed or not collected any pieces of data or links to other data which identify a specific person as the subject or source of a research result.

BU's Research Participant Privacy Notice (see attached or follow hyperlink) sets out more information about how we fulfil our responsibilities as a data controller and about your rights as an individual under the data protection legislation. We ask you to read this notice so that you can fully understand the basis on which we will process your personal information.

Research data will be used only for the purposes of the study or related uses identified in the Privacy Notice or this Information Sheet. To safeguard your rights in relation to your personal information, we will use the minimum personally-identifiable information possible and control access to that data as described below.

Publication

You will not be able to be identified in any external reports or publications about the research. Your information will only be included in these materials in an anonymous form, i.e. you will not be identifiable.

Research results may be used firsthand in various external reports or publications. There may be further use of these research results as part of subsequent projects. Such use is not pre-determined and so at this stage cannot be specified.

Security and access controls

All information collected by us, as a result of your participation, will be digital. All digital information will be stored in a secure location and on a password protected and secure network.

Personal information which has not been anonymised will be accessed and used only by appropriate, authorised individuals and only when this is necessary for the purposes of the research or another purpose identified in the Privacy Notice. This may include giving access to Bournemouth University staff or others responsible for monitoring and/or audit of the study, who need to ensure that the research is complying with applicable regulations.

Data of experiment performance will not be directly relatable back to you, nor will any analysis or findings. Individual identifiers will be encoded merely for the purpose of matching data sets and will not be traceable to email accounts or participant agreement form details. Email addresses will be retained for the purpose of updating you of the study completion and findings if you have indicated interest in this.

Sharing your personal information with third parties

Your limited personal information will not be shared with any other 3rd party.

Further use of your information

The information collected about you may be used in an anonymous form to support other research projects in the future and access to it in this form will not be restricted. It will not be possible for you to be identified from this data. To enable this use, anonymised data will be added to an open access service: The Open Science Framework - this is an online location where data is stored, which is accessible to the public.

Keeping your information if you withdraw from the study

If you withdraw from active participation in the study we will keep information which we have already collected from or about you, if this has on-going relevance or value to the study. As explained above, your legal rights to access, change, delete or move this information are limited as we need to manage your information in specific ways in order for the research to be reliable and accurate. However, if you have concerns about how this will affect you personally, you can raise these with the research team when you withdraw from the study.

You can find out more about your rights in relation to your data and how to raise queries or complaints in our Privacy Notice

Retention of research data

Project governance documentation, including evidence of **participant agreements**:
we keep this documentation for a long period after completion of the research, so that we have records of how we conducted the research and who took part. The only personal information in this documentation will be that which was stated above, and we will not be able to link this to any anonymised research results.

Research results:

As described above, during the course of the study we will anonymise the information we have collected about you as an individual. This means that we will not hold your personal information in identifiable form after we have completed the research activities.

You can find more specific information about retention periods for personal information in our Privacy Notice.

We keep anonymised research data indefinitely, so that it can be used for other research as described above.

Contact for further information

If you have any questions or would like further information, please contact Jason Helstrip - jhelstrip@bournemouth.ac.uk.

In case of complaints
Any concerns about the study should be directed to Jason Helstrip - jhelstrip@bournemouth.ac.uk. If you concerns have not been answered by Jason Helstrip, you should contact Bournemouth University - researchgovernance@bournemouth.ac.uk or the Health and Social Sciences Deputy Dean for Research and Professional Practice: Professor Tiantian Zhang - tzhang@bournemouth.ac.uk

Finally

If you decide to take part, please note that you are welcome to request a copy of this information sheet. Thank you for considering taking part in this research project.

Appendix E - **Experiment 2 participant agreement form**

Full title of project: Factors affecting cognitive control

Name, position and contact details of researcher: Jason Helstrip – jhelstrip@bournemouth.ac.uk.
Name, position and contact details of supervisor: Dr Ben Parris – bparris@bournemouth.ac.uk.

To be completed prior to data collection activity

Agreement to participate in the study
You should only agree to participate in the study if you agree with all of the statements in this table and accept that participating will involve the listed activities.

I have read and understood the Participant Information Sheet (Factors affecting cognitive control) and have been given access to the BU Research Participant Privacy Notice which sets out how we collect and use personal information (https://www1.bournemouth.ac.uk/about/governance/access-information/data-protection-privacy).
I have had an opportunity to ask questions.
I understand that my participation is voluntary. I can stop participating in research activities at any time without giving a reason and I am free to decline to answer any particular question(s).
I understand that taking part in the research will include the following activity/activities as part of the research: Completing an online questionnaire using the Qualtrics service Repetitive actions
I agree that BU researchers may obtain and process my information as described in the Participant Information Sheet
I understand that, if I withdraw from the study, I will also be able to withdraw my data from further use in the study except where my data has been anonymised (as I cannot be identified) or it will be harmful to the project to have my data removed.
I understand that my data may be used in an anonymised form by the research team to support other research projects in the future, including future publications, reports or presentations.

I confirm my agreement to take part in the project on the basis set out above.

Confirmation of consent will be indicated by the participant selecting a confirmation button on Qualtrics

Appendix F - **Experiment 2 procedure**

Have you previously participated in an experiment using the Stroop task? If so, please give a brief description

_____

[NEXT PAGE]

The link below will take you to a practice environment of the Stroop task. You are welcome to practice as much as needed
Please note that in the practice environment, words have been replaced with '$$$$$'
The Stroop tasks will request that you provide some demographic data and an ID. For the ID please use your first and last name followed by your year of birth. For example: [AlbertEinstein79]
When you are happy to do so, please CLICK HERE to practice (Do not close the questionnaire tab)
Once you feel confident that you understand your role in the task please proceed to the next page for the actual experiment task

[NEXT PAGE]

Now that you have taken the time to practice you can proceed with the actual Stroop task
The actual task contains more trials and so will take approximately 10 minutes
When you have finished, please return to this questionnaire tab and proceed to the next page
If needed, take a 30 second break
When you are happy to proceed with the task please CLICK HERE
[NEXT PAGE]

Thank you for completing the Stroop task
For the next part of the experiment you will be asked 7 questions
You will have 45 seconds to answer each question
Please use the slider beneath each question to indicate the first answer that comes to mind

The below statement is only present here for the unscreened motivation group
"It is expected that you will perform much better than another group of participants"

The below statement is only present here for the screened motivation group
"In a previous experiment you have completed a similar task and performed extremely well. As

a result, It is now expected that you will perform much better than another group of participants”

If needed, please take a 30 second break before starting this task

CRT questions answered using a 100-point slider scale:

1. A bat and a ball cost £1.10 in total. The bat costs a pound more than the ball. How much does the ball cost?

[NEXT PAGE]

2. If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets?

[NEXT PAGE]

3. In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake?

[NEXT PAGE]

4. If John can drink one barrel of water in 6 days, and Mary can drink one barrel of water in 12 days, how long would it take them to drink one barrel of water together?

[NEXT PAGE]

5. Jerry received both the 15th highest and the 15th lowest mark in the class. How many students are in the class?

[NEXT PAGE]

6. A man buys a pig for £60, sells it for £70, buys it back for £80, and sells it finally for £90. How much has he made?

[NEXT PAGE]

CRT question answered by multiple choice:

Simon decided to invest £8,000 in the stock market one day early in 2008. Six months after he invested, on July 17, the stocks he had purchased were down 50%. Fortunately for Simon, from July 17 to October 17, the stocks he had purchased went up 75%. At this point, Simon has:

- ○ A. Broken even in the stock market
- ○ B. Is ahead of where he began
- ○ C. Has lost money

[NEXT PAGE]

The below CRT results page was omitted for the screened control group

CRT TEST RESULTS

Congratulations!

Consistent with the experimenter predictions, you have performed very well

Your score is categorised as excellent in comparison to that of participants in another group

Thank you for completing this section
Please now proceed to the final part of the experiment

[NEXT PAGE]

For the final part of this experiment you are required to complete the Stroop task again
If you would like a reminder of the procedure please use the link below to return to the practice environment
Remember to use your first and last name followed by your year of birth as ID. For example: [AlbertEinstein79]
CLICK HERE to practice
(Do not close the questionnaire tab)
If needed, take a 30 second break
Once you feel confident that you understand your role, please proceed to complete the Stroop task for a final time

[NEXT PAGE]

Now that you have taken the time to practice you can proceed with the actual Stroop task
The actual task contains more trials and so will take approximately 10 minutes
When you are happy to proceed with the task please CLICK HERE

When you have finished the task, please return to this questionnaire tab and proceed to the next page

[NEXT PAGE]

The below page was presented only to the unscreened group

Please indicate whether you are happy to be contacted by the researcher for further related experiments

- ○ YES
- ○ NO