Hypnosis and imagination

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Abstract
Hypnosis involves the use of verbal suggestion to modulate behaviour and experience. Hypnosis and imagination have long been associated and the view that hypnotic suggestion effects changes in experience through imagination is a persistent one. In this review, we first present a brief overview of hypnosis and then turn to its potential relationship to imagery and imagination. We consider whether individual differences in imagination may relate to hypnotic suggestibility and the extent to which imagery is recruited during response to hypnotic suggestions in psychological and neuroimaging studies. Finally, we briefly consider the roles of imagery and suggestion in clinical applications of hypnosis. We conclude that whilst hypnotic suggestibility may relate to variability in imagination, hypnotic suggestion and voluntary forms of imagery are subserved by dissimilar neurocognitive mechanisms.

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In the late 18th century, the French government commissioned an inquiry into *animal magnetism*, a historical precursor to hypnosis (Gauld, 1992). Animal magnetism consisted of a set of practices that purportedly allowed practitioners to heal individuals through the transmission of a universal magnetic fluid that would pass from a practitioner's body to the individual. The inquiry, directed by Benjamin Franklin, performed some of the first double-blind experiments in the modern era and observed that positive responses to treatment were associated with the *suggestion* that one had received the treatment, rather than whether one had actually received the treatment. It was concluded that the effects of animal magnetism were attributable to *imagination* (Franklin et al., 2002). Although in contemporary parlance the mechanism underlying such effects would be viewed as a confluence of suggestion, response expectancies, and/or demand characteristics (e.g., (Lynn, Kirsch, & Hallquist, 2008), imagination continues to be closely associated with hypnosis and viewed as a germane phenomenon or one that may exert a mechanistic influence in hypnotic phenomena.

In this chapter we aim to synthesize contemporary knowledge of the relations between hypnosis and imagination. Following a brief overview of hypnosis and hypnotic suggestibility, we describe various lines of research pertaining to whether and how hypnosis may relate to imagination, understood as the process of forming images, or the ability to do so. In particular, we consider how imagery abilities may relate to hypnotic suggestibility, how imagery may spontaneously manifest in the context of hypnosis, and to what extent response to hypnotic suggestion recruits imagery-specific mechanisms. We also draw a distinction between voluntary and involuntary processes in imagery. Subsequently, we review research pertaining to whether hypnotic suggestion shares overlapping neurophysiological substrates with imagination and how imagery can be incorporated into clinical applications of hypnosis. We conclude by highlighting outstanding questions and specifying future directions for research in these domains. Our overarching conclusion is that hypnosis and imagination represent distinct phenomena.

Hypnosis and hypnotic suggestibility

Hypnosis is most parsimoniously conceptualized as a set of techniques involving the use of verbal suggestion to produce changes in behaviour and awareness. A session typically begins with an induction; inductions vary considerably but most consist of instructions and suggestions for relaxation and reduced meta-awareness. The utility of an induction, in terms of its effect on suggestibility, differs based on the mode of assessment as well as the individual respondent, with the sources of this variability poorly

understood (Terhune & Cardeña, 2016). However, there is broad agreement that the induction functions as a sociocultural ritual and capitalizes on perceptions of hypnosis as a method for modulating awareness. Following an induction, individuals frequently report spontaneous changes in different experiential dimensions including time perception, body image, and imagery (Pekala & Kumar, 2007). Although poorly understood, these effects seem to be driven by a confluence of beliefs, expectations, contextual factors, and suggestibility (Cardeña & Terhune, in press).

Following the induction, an experimenter or clinician will administer one or more suggestions for alterations in awareness and concomitant changes in behavior (Kirsch & Lynn, 1995). *Suggestions* are communications for involuntary experiences (Kirsch, 1999): they are phrased as something that *happens* to an individual as opposed to something that they willfully *perform*, so as to augment the extra-volitional phenomenology of the suggested response (Spanos & Gorassini, 1984). Suggestions can be used to modulate a range of motor, cognitive, and perceptual functions and broadly fall into two classes: *facilitative* suggestions are those for a motor response or positive cognitive or perceptual state whereas *inhibitory* suggestions are those for the disruption of such responses. Factor analyses of standardized scales indicate that response to suggestions is subserved by both a core latent trait of *hypnotic suggestibility* and ancillary componential traits related to responsiveness to specific suggestions (Woody & Barnier, 2008).

It has long been known that members of the general population exhibit marked variability in hypnotic suggestibility (Laurence, Beaulieu-Prévost, & du Chéné, 2008) and it is widely accepted that individual differences in hypnotic suggestibility represent the principal moderator of responsiveness to hypnotic interventions. Hypnotic suggestibility can be reliably measured using work-sample assessments in which an induction is followed by a set of suggestions and tests of responsiveness (Woody & Barnier, 2008). Approximately 10-15% of the population display low hypnotic suggestibility, another 10-15% display high hypnotic suggestibility and the remaining 60-80% display a modest level of hypnotic suggestibility. Twin studies strongly suggest that hypnotic suggestibility is heritable (Morgan, 1973) although its genetic basis is poorly understood (Rominger et al., 2014). Evidence suggests that hypnotic suggestibility peaks in pre-adolescence, subsequently declines, and plateaus in late adolescence (Rhue, 2004) with high stability in adulthood (Piccione, Hilgard, & Zimbardo, 1989). The sources of developmental changes are unknown but may relate to changes in imagination and fantasizing (e.g., (Rhue, 2004) or the development of the prefrontal cortex and corresponding (meta)cognitive functions (Terhune, Cleeremans, Raz, & Lynn, 2017). Multiple

lines of evidence point to heterogeneity among highly suggestible individuals, which may be accounted for by the presence of two subtypes (Carlson & Putnam, 1989): a *dissociative subtype*, characterized by increased involuntariness during response to suggestion and an *imagery* subtype, characterized by superior imagery (King & Council, 1998; Terhune, Cardeña, & Lindgren, 2011).

The principal phenomenological feature of response to hypnotic suggestion is an attenuation in the *sense of agency*, the cognitive attribution that one is the author of one's actions and experiences (Haggard, 2017). Distorted volition is so prominent during hypnotic responding that it has come to be referred to as the *classic suggestion effect* (Weitzenhoffer, 1974). In turn, the absence of involuntariness during response to suggestion is widely viewed as indicative of *compliance* and is not considered a hypnotic response (P. Bowers, Laurence, & Hart, 1988) - a positive response to a suggestion is only considered as reflective of a genuine response if it is accompanied by a reduction in the sense of agency. This attenuation covaries with hypnotic suggestibility such that highly suggestible individuals experience less agency when responding to suggestions (Polito, Barnier, Woody, & Connors, 2014). Although inherently subjective, these alterations have been corroborated with implicit perceptual measures of the sense of agency, such as *intentional binding*, the perceived temporal contraction of the duration between actions and their consequences (J. W. Moore & Obhi, 2012). In particular, recent research found that highly suggestible individuals exhibited *less* intentional binding during response to suggestion (Lush et al., 2017).

Despite significant advances in recent years, current understanding of the mechanisms underlying response to suggestion remains poor. One promising line of research is the proposal that responses to suggestion are implemented through normal cognitive control mechanisms but in the absence of awareness that control is being implemented (Dienes & Perner, 2007). For example, whilst top-down mechanisms may enable the suppression of pain in response to an analgesia suggestion, the individual remains unaware of this and experiences the concomitant analgesic response as extra-volitional. In support of this account, recent studies have demonstrated that highly suggestible individuals have *delayed* awareness of intentions and *impaired* metacognition pertaining to their sense of agency (Lush, Naish, & Dienes, 2016; Terhune & Hedman, 2017). An outstanding question though is how control is implemented in this account (Terhune, 2012): how are some highly suggestible individuals able to exercise such remarkable feats of top-down regulation such as complete analgesia? One possibility is that response to suggestion is facilitated by superior cognitive control. However, there is no robust evidence for superior control in this population at

baseline (e.g., (Varga, Nemeth, & Szekely, 2011), although some research hints at different brain activation patterns during selective attention in highly suggestible participants relative to controls (Cojan, Piguet, & Vuilleumier, 2015). Whether and to what extent such effects facilitate response to suggestion is unknown.

A perennial question is where hypnosis falls within the broader domain of suggestion and suggestibility, and whether the various phenomena linked under this term can be encapsulated within a broader category such as *direct verbal suggestibility* (Halligan & Oakley, 2014; Oakley & Halligan, 2017). Although it is conceptually appealing to consider hypnosis as a member of a broader class, the evidence that these different phenomena form a single homogeneous category is mixed. Hypnotic suggestibility covaries moderately to highly with non-hypnotic suggestibility when the measures are functionally equivalent and administered in the same context (Braffman & Kirsch, 1999). Other studies have revealed smaller, or non-significant, effects when the measures differ more considerably (Tasso & Perez, 2008). Similarly, there is mixed evidence regarding the relationship between hypnotic suggestibility and placebo responsiveness (e.g., (Raz, 2007), which similarly depends in part on suggestion. These studies suggest a relationship between hypnotic suggestibility and non-hypnotic forms of suggestibility although the magnitude of such covariance is unclear and subject to moderators that have yet to be properly elucidated.

Imagination and hypnotic suggestibility

Response to suggestion involves the generation of representational states that can effect pronounced changes in behaviour and thus it is plausible that imagination is used in the production of these representations. Here we take *imagery* to reflect a percept-like mental state in the absence of a corresponding sensory stimulus and *imagination* as the ability to voluntarily generate or manipulate imagery for task-specific goals. Hypnosis and suggestion-based phenomena are widely referred to as *imaginative* (e.g., (Kihlstrom, 2008) and standardized behavioral measures of non-hypnotic suggestibility, which are otherwise identical to hypnotic suggestibility scales but without an induction, are often referred to as indices of *imaginative suggestibility* (Braffman & Kirsch, 1999). A corollary of the assumption that imagination is involved in hypnosis is that highly suggestible individuals should display superior imagery abilities.

There is broad evidence that highly suggestible individuals score higher on psychometric measures indexing the propensity for *spontaneous* imaginative experiences in one's daily life (for a review, see (Cardeña & Terhune, 2014). For example, they reliably score higher on measures of *absorption*, the

propensity for experiencing all-encompassing states in which one's attention is consumed by some type of activity (e.g., (Roche & McConkey, 1990). They also often report greater vividness of mental imagery (e.g., (Marucci & Meo, 2000), imaginative involvement (Glisky, Tataryn, Tobias, Kihlstrom, & McConkey, 1991), fantasy-proneness (e.g., (Braffman & Kirsch, 1999), and use of an imagic cognitive style (Sheehan & Robertson, 1996), although some studies report mixed or non-significant results (e.g., (Kogon et al., 1998). Similarly, highly suggestible individuals reliably experience greater *spontaneous* imagery in response to an induction (Pekala & Kumar, 2007) and imaginative involvement and absorption during stimulus exposure (e.g., (Maxwell, Lynn, & Condon, 2015). Multiple studies also suggest an association between suggestibility and the capacity to become immersed in a dramatic role (Panero, Goldstein, Rosenberg, Hughes, & Winner, 2016; Sarbin & Lim, 1963).

Despite these consistencies, these effects tend to be modest in size and are subject to interpretational debate. They could be artefactual of context administration effects: correlations between self-report measures are often higher when measured in the same context (Council, Kirsch, & Grant, 1996). Insofar as highly suggestible individuals may be more responsive to contextual cues (e.g., (Marucci & Meo, 2000), this criticism should be considered although there is as yet no consensus on what constitutes a *suitable* context (Barnier & McConkey, 1999). Similarly, these relationships may be inflated by the explicit invocation of imagination on certain suggestions on some suggestibility scales (Woody & Barnier, 2008). A further consideration is whether these effects reflect greater imaginative involvement or a generalized propensity for alterations in awareness (Cardeña & Terhune, 2014). For example, absorption covaries with the tendency to have anomalous perceptual states in a variety of contexts (e.g., (Granqvist et al., 2005); possessing the foregoing constellation of characteristics may render one prone to liminal experiential states that are easily shaped by environmental cues and suggestions. Moreover, aside from a few studies (e.g., (Sarbin & Lim, 1963), extant studies provide little information regarding the extent to which highly suggestible individuals possess the capacity to *control* imaginative episodes, a theoretical requirement for any account proposing a role for imagination in hypnotic responding.

The latter criticism can be addressed by the administration of cognitive tasks requiring the use of visual imagery. Research studies pursuing such an approach suggest a complex relationship between hypnotic suggestibility and imagery. Multiple studies have reported that highly suggestible individuals display superior performance on visual imagery tasks (Sheehan & Robertson, 1996). However, these effects are not

reliably observed (e.g., (Carli, Cavallaro, Rendo, & Santarcangelo, 2007) and may be non-linear. In particular, imagination might not be a strong correlate of hypnotic suggestibility but poor imagery may be a marker of *low* hypnotic suggestibility (Sheehan & Robertson, 1996). Moreover, multiple studies suggest the presence of an imagery subtype among highly suggestible individuals (Wallace, Allen, & Propper, 1996), which appears to be distinct from the dissociative subtype (Terhune et al., 2011).

Research in this domain has traditionally focused on visual imagery but there is good reason to question this somewhat myopic orientation. The suggestions on hypnotic suggestibility measures mostly target motor and somatosensory systems, such as the perceptions that one's arm is paralyzed or incredibly heavy, respectively (Woody & Barnier, 2008), thereby warranting greater consideration of these domains. In recent years, a number of studies have pursued such an approach and indicate that highly suggestible individuals may have superior imagery pertaining to the body. An early study found that hypnotic suggestibility was associated with greater vividness of motor imagery (Glisky, Tataryn, & Kihlstrom, 1995) and multiple laboratory studies suggest that highly suggestible individuals have superior kinesthetic, tactile, and pain imagery than low suggestible controls (for a recent review, see (Srzich, Byblow, Stinear, Cirillo, & Anson, 2016)). However, nearly all of these studies used an *extreme groups design*, in which low suggestible individuals (who are not representative of the general population) acted as controls (Lynn, Kirsch, Knox, Fassler, & Lilienfeld, 2007), and thus these apparent differences should be interpreted cautiously (discussed further below).

Further research on imagery abilities in highly suggestible individuals will benefit from using more rigorous measures of imagery and adhering to double-blind protocols. Many older studies used cognitive tasks for which the interpretation of performance is ambiguous (for a review, see (Sheehan & Robertson, 1996). Many also relied solely on self-report measures that may be more easily influenced by demand characteristics and may also be poor indices of actual imagery ability (Srzich et al., 2016). Moreover, few studies have adhered to double-blind protocols. Although the use of double-blind experiments is nearly universally valuable, it is essential with highly suggestible individuals who may display hypersensitivity to environmental cues that could function as suggestions (Marucci & Meo, 2000). This implies a strong potential for artefactually superior imagery performance among highly suggestible in unmasked experiments – it will be imperative for future research to more stringently control for these effects. A final concern with extant studies is an overreliance on extreme-groups designs contrasting high with low suggestible

individuals (Lynn et al., 2007). This design is problematic because the latter represent an atypical subset (~10-15%) of the population. Any studies showing *superior* imagery among highly suggestible individuals may merely reflect *inferior* imagery among low suggestible individuals. Medium suggestible individuals, are a superior control group, especially if low suggestible individuals have poorer imagery (Sheehan & Robertson, 1996).

A more refined understanding of the relations between hypnotic suggestibility and imagination may be developed by considering this association through the lens of the phenomenology of hypnosis. Insofar as distorted volition represents the primary signature of hypnotic responding (K. S. Bowers, 1981), it is important to distinguish between *voluntary* and *involuntary* imagery, namely the generation and manipulation of imagery (imagination) versus the experience of *intrusive* images. Response to suggestion may share more in common with the latter. Indeed, research has shown that the experience of involuntary goal-directed imagery is associated with response to suggestion whereas voluntary goal-directed imagery may impede responsiveness (Comey & Kirsch, 1999). By contrast, one might argue that elevated absorption among highly suggestible individuals reflects a learned capacity to voluntarily use fantasy for psychological protection during exposure to stressful life events (Wilson & Barber, 1983). However, absorption may reflect an automatic dissociative coping response to stress or a non-pathological form of perseveration (Jamieson & Woody, 2007) rather than a manifestation of the higher-order control of imagery. Preliminary evidence hints that highly suggestible individuals are more likely to experience intrusive thoughts (and potentially imagery) (Bryant & Idey, 2001) (see also (Terhune & Cardeña, 2015). One parsimonious way to integrate these data is that the imagery subtype will display superior voluntary imagery (Terhune et al., 2011; Wallace et al., 1996), whereas the highly suggestible dissociative subtype will display more involuntary imagery, although we suspect that the relations among these variables will probably be far more complex. Nevertheless, future research may benefit from coupling cognitive tasks indexing imagination with recent methods for studying intrusive imagery in the laboratory (Lau-Zhu, Holmes, & Porcheret, 2018).

Imagination and hypnotic responding

Here we consider the question of whether and, if so, how imagination plays a role in response to hypnotic suggestions. Before doing so, it is important to distinguish two mechanistic paths through which imagination might influence hypnotic responding. On the one hand, response to suggestion could be considered to be

fundamentally an imaginative phenomenon in which one explicitly uses imagery to facilitate response to suggestion. On the other hand, imagination may be recruited while responding to suggestion, or in response to specific suggestions as part of a broader mechanistic sequence, but not be a central driving mechanism that enables hypnotic responding. Here we examine whether imagery ability confers any benefits in responsiveness to hypnotic suggestions and whether imagery plays a causal role in hypnotic responding.

Little attention has been devoted to the specific question of whether imaginative ability is specifically linked to superior hypnotic responding and the available evidence is mixed. For example, when comparing imagery and dissociative subtypes of highly suggestible individuals (Terhune et al., 2011), the former were *less* responsive than the latter to hallucination suggestions, even though these suggestions might be expected to involve the recruitment of imagery. Another study showed that participants who were responsive to a false memory suggestion displayed lower scores on a measure of imagic cognitive style than those who were less responsive, even though this style was positively and linearly related to hypnotic suggestibility (Sheehan & Robertson, 1996). By contrast, some studies have reported that imagery ability correlates with responsiveness to specific suggestions (Laurence et al., 2008) and that responsiveness to hypnotic suggestions is associated with greater vividness of suggested imagery (Spanos, Stenstrom, & Johnston, 1988). On the whole, these studies hint at a possible role for imagery in hypnotic responding but this evidence is correlational.

Multiple studies that have examined the utilization of imagery strategies during hypnotic responding present a clearer picture and suggest that imagination doesn't play a causal role in facilitating response to suggestion. Perhaps the most damning evidence against a role for voluntary imagery in hypnotic responding is provided by a study on hypnotic analgesia in highly suggestible participants (Hargadon, Bowers, & Woody, 1995). Hargadon and colleagues contrasted two procedures involving the prescription or proscription of the use of counter-pain imagery during hypnotic analgesia and observed that the two were essentially equally effective in reducing pain relative to baseline. This strongly suggests that the *intentional* use of imagery does not augment hypnotic responding. These results are further corroborated by studies suggesting that goal-directed imagery during hypnotic responding does not facilitate response to suggestion and may even impede responsiveness (e.g., (Comey & Kirsch, 1999). Moreover, mental representations associated with pain reduction in the aforementioned study (Hargadon et al., 1995) were actually associated

with pain reduction to a greater extent when they were experienced as *involuntary* than as *active* strategies, again highlighting how imagination does not provide an added advantage in hypnotic responding.

There are multiple competing ways of reconciling the foregoing results with the research described in the previous section, which seems to point to superior imagery among highly suggestible individuals. First, imagery may be correlated with hypnotic suggestibility but *epiphenomenal* in the context of hypnotic responding. That is, superior imagery may be part of the broader neurocognitive profile of high hypnotic suggestibility but not play a causal role in response to suggestion. Second, imagery may only be beneficial, and play a mechanistic role, in some individuals, which is broadly consistent with evidence for an imagery subtype and variability in strategy use among highly suggestible individuals (e.g., (Terhune et al., 2011). Although Hargadon and colleagues' (1995) study considered variability in imagery during hypnotic responding, they did not investigate whether imagery in hypnotic responding was moderated by subtype. Third, insofar as response to different types of suggestions may represent partially distinct componential abilities (Woody & Barnier, 2008), it is possible that imagery is utilized in only certain types of suggestions. For example, motor imagery and motor suppression imagery may predict responsiveness to facilitative and inhibitory motor suggestions, respectively (Srzich et al., 2016). A final possibility, alluded to above, is that response to suggestion is facilitated by imagery, but its strategic use is implemented outside of awareness. According to this account, voluntary imagery during hypnotic responding is epiphenomenal or even counterproductive in effecting hypnotic responding but involuntary, suggestion-mediated, imagery plays a mechanistic role.

Neuroimaging of imagination and suggestion in hypnosis

Perhaps the most robust assessment of the role of imagery in hypnosis is afforded through neuroimaging studies that address the last of the above possibilities, namely whether voluntary imagery (related to imagination) and involuntary imagery (related to suggestion) have overlapping neurophysiological substrates. In a study of pain, researchers used fMRI (functional Magnetic Resonance Imaging) to explore brain activity in three conditions in highly suggestible participants (all following a hypnotic induction) (Derbyshire, Whalley, Stenger, & Oakley, 2004). In two of the conditions participants were given the suggestion that, following a cue, a painful heat stimulus would be delivered to their right hand. In one, the heat stimulus was administered, creating an actual pain experience, whereas in the second the cue was not

followed by the stimulus and acted as a suggestion to experience pain. In the third condition, the participant was told that there would be no pain stimulus following the cue but that they should "imagine the pain as clearly as possible". Pain ratings taken after each trial demonstrated that the participants experienced pain in the first two conditions (physically- and suggestion- induced pain). In addition, they confirmed that they imagined pain clearly in the third condition. The fMRI data showed activation of pain-related areas in the first two conditions but not in the imagined condition. A similar study using PET (Positron Emission Tomography) compared patterns of brain activation during real, imagined, and suggested (hallucinated) auditory experiences in highly suggestible participants following a hypnotic induction and found activity in auditory cortex in the real and the suggested conditions but not in the imagined condition (Szechtman, Woody, Bowers, & Nahmias, 1998). Other studies have yielded similar results (for a review, see (Oakley & Halligan, 2013).

These studies suggest that imagination and hypnotic suggestion engage different neurophysiological substrates, thereby providing further corroboration for the self-report and behavioural studies described in previous sections. That is, there seems to be a clear difference between simply imagining an experience and having what is essentially an 'as-real' experience in response to a hypnotic suggestion. Indeed, the overlap between activation patterns of real perceptual states and suggested experiences strongly suggests that hypnotic experiences more closely resemble perceptual than imaginative states. Moreover, both studies demonstrate that brain changes corresponding to real, physical events can be generated by psychological processes, such as suggestion, and resulting experiences are not simply products of the individual's voluntary imagination (Oakley & Halligan, 2013). Nevertheless, one line of criticism of these studies is that imagination and suggestion conditions have not always been properly matched for wording, and participants' response expectancies (Braffman & Kirsch, 1999). Moreover, none of these studies have controlled for the possibility that highly suggestible individuals merely "held back" in the imagination conditions due to demand characteristics and the concomitant belief that they should be less responsive in the imagination conditions (Spanos, 1986). Nevertheless, these studies provide the most compelling demonstration yet that suggested responses are implemented through distinct mechanisms from those involved in imagination. These and other studies are also relevant to the long-standing question of whether clinical symptoms of functional neurological disorders (historically referred to as hysteria or conversion disorder) with no obvious clinical cause can be dismissed as *simply* imaginary or indicative of malingering

(Oakley, 2012; Oakley, Ward, Halligan, & Frackowiak, 2003). With the increasing accessibility of neuroimaging techniques to clinical and psychological research it became possible to explore brain changes that might accompany such symptoms.

Early single-case studies of medically unexplained (hysterical) and hypnotically suggested left-sided paralysis found that failure to move the leg when requested to do so was accompanied by brain activity typically associated with the inhibition of voluntary motor responding (Halligan, Athwal, Oakley, & Frackowiak, 2000). The remaining possibility that the failure to move was simulated was addressed in a subsequent PET study (Ward, Oakley, Frackowiak, & Halligan, 2003) involving a groups of participants who received instructions to move their leg following a left-sided paralysis suggestion or while simulating the same paralysis (both following a hypnotic induction). No leg movements were seen in either condition and an independent examination of participants revealed no differences between them. The participants however rated the involuntariness of their failure to move in the suggested paralysis condition as substantially higher than in the simulation condition. The PET data also showed a clear difference in brain activity between the two conditions, consistent with the view that participants *cannot*, rather than *will not*, move their leg. Overall, these results support the view that hypnotically suggested paralysis, in common with conversion disorder paralysis, is experienced as real rather than being imaginary and under voluntary control (see also (Srzich et al., 2016; Vuilleumier, 2014).

More recent research has used fMRI to explore further the neural basis of suggested limb paralysis (Deeley et al., 2013) and other psychiatric and cultural experiences that are reported as occurring involuntarily such as spirit possession and alien control as well as automatic writing and thought insertion (Walsh, Oakley, Halligan, Mehta, & Deeley, 2015). These studies have shown that these phenomena are accompanied by subjective reports and brain activity that are consistent with their status as involuntary experiences rather than voluntarily imagined events. Based on this evidence, hypnotic experiences have been characterised as socially-driven role-plays or strategic enactments, orchestrated outside awareness in response to a direct verbal suggestion and involving the creation of neural activity consistent with the suggested change (Oakley & Halligan, 2009, 2013).

Clinical applications of imagery in hypnosis

Voluntary imagery is commonly used to explore past and future events and situations in psychological therapies. Using hypnotic suggestion to create what we have labelled 'involuntary imagery' in the form of 'as real' experiences, however, raises the possibility of taking that process a step further by facilitating a virtual reality context within which to experience and to resolve psychological problems. Though the empirical evidence is not extensive (M. Moore & Tasso, 2008), an influential meta-analysis of 18 studies that compared the outcome of Cognitive Behavioural Therapy (CBT) with and without hypnosis over a wide range of psychological symptoms concluded that the inclusion of hypnosis procedures enhanced outcomes for over 70% of patients (Kirsch, Montgomery, & Sapirstein, 1995). Similarly, in a review of randomised controlled studies, the adjunctive use of hypnosis was found to produce better outcomes in the treatment of a range of pain conditions than other treatments (Patterson & Jensen, 2003). There is also good evidence from case studies (Walters & Oakley, 2006) and randomised control trials (Gonsalkorale, Miller, Afzal, & Whorwell, 2003; Whorwell, Prior, & Faragher, 1984) for the greater efficacy of behavioural therapy when combined with hypnotically suggested gut-directed imagery in treating irritable bowel syndrome.

As an example, patients can be taught techniques to control their pain using hypnotically suggested imagery which they can then use later for themselves with or without hypnosis. In an fMRI study addressing the efficacy of this procedure, fibromyalgia patients were shown, prior to the experimental session, a diagram of a pain dial that was used to represent their level of pain whilst receiving hypnotic suggestions to increase or decrease dial ratings to modulate their pain (Derbyshire, Whalley, & Oakley, 2009). During the scanning sessions, the patients were asked to bring the dial to mind and use it to increase or decrease their pain both with and without a hypnotic induction (the order of these conditions was counterbalanced across groups). The patients reported significant changes in their pain experience in both conditions though they reported a feeling of being more in control, with greater reduction in their pain in the hypnosis condition. In the two conditions the reported pain changes were reflected in appropriate reductions or increases in brain activity in areas associated with the pain *neuromatrix*. In actual clinical practice, patients are encouraged to rehearse and strengthen the pain dial effect by rehearsing it in self-hypnosis.

A number of effective psychological procedures for the treatment of phobias involve exposure to the feared object or situation whilst practising anxiety reduction procedures. Ideally this is carried out *in vivo*, though this is often impractical - with live spiders, for example, or where the fear is associated with heights. Simply imagining the situation is only partially effective. In our own clnical experience, however, the virtual

reality aspect of hypnotically-suggested scenarios can quickly and flexibly create an *in vivo* experience in the clinic without the need for expensive equipment and individualised programming of real scenarios from a client's past, which is required by computerised alternatives (see below). Imagined spiders are typically perceived by clients to be 'not be real' and in practice real spiders are uncontrollable. In contrast, hypnotically suggested spiders are not only perceived as being real but with appropriate additional suggestions, including client originated self-suggestions, can be rendered "obedient" and can change location, shape, size or physical appearance as well as taking on less threatening 'personal' characteristics.

One of our own case studies combined progressive desensitization and hypnotic suggestion in a participant with an environmental phobia, which had affected all parts of her life at home and in her workplace whenever it was windy (Walters & Oakley, 2003). In particular, she reported that the musical sound of a familiar fountain she had re-experienced in hypnosis evoked calming and reassuring feelings and was subsequently able to use that association to control her fear of the wind. She lived on a houseboat and had a particular anxiety watching the branches of an elder tree with its branches moving dangerously in the wind. Re-experiencing the tree's movement in the context of hypnosis as one of "dancing to the trickling sound" of her fountain (which spontaneously transformed to the more robust sounds of a waterfall) was instrumental in her overcoming her phobia. A clear conclusion drawn from this and similar clinical experiences, underpinned by the neuroimaging evidence describe above, is that in using hypnotic interventions in clinical practice the word *imagine* should be replaced with *experience* – suggestions evoking perceptual states seem to be more effective than instructions for the use of imagination.

Summary and outstanding questions

Despite the widespread view that hypnosis and imagination engage overlapping processes, the present review suggests that they are dissimilar phenomena. Multiple lines of evidence imply that hypnotic suggestibility may be associated with imagery vividness, or perhaps even imagery ability, although these effects may be non-linear (Sheehan & Robertson, 1996). There is only weak evidence that imagery ability translates to superior hypnotic responding but this question has not been systematically investigated (Laurence et al., 2008). Moreover, empirical studies measuring imagery during hypnotic responding suggest that the voluntary use of imagery does not seem to play a causal role in response to suggestion (Hargadon et al., 1995) but this research does not rule out the possibility that responses are facilitated by the recruitment

of imagery outside of awareness (involuntary imagery). The view that mental representations that are produced by voluntary acts of imagination and are different from those resulting from hypnotic suggestion is further corroborated by neuroimaging research, which indicates that suggested and imagined states are associated with differential brain activation patterns (Oakley & Halligan, 2013). A similar picture emerges in clinical application of hypnotic suggestion, which appears to be more effective than the use of imagination alone. Cumulatively, the available evidence suggests that responses to hypnotic suggestions among highly suggestible individuals are independent of imagery and imagination.

Despite our tentative conclusion that imagination and hypnotic suggestion are dissimilar processes, there are numerous outstanding questions with considerable theoretical import. Although hypnotic suggestion does not seem to rely on, or benefit, from suggestion-congruent imagery (Hargadon et al., 1995), whether different subtypes of highly suggestible individuals differentially utilize imagery during hypnotic responding has not yet been explored and will be valuable in coming to grips with heterogeneity in strategy utilization more generally. Similarly, the possibility that imagery may facilitate response to suggestions in modality-specific ways has not been afforded sufficient attention and may help in understanding the componential mechanisms that underlie response to suggestion (Woody & Barnier, 2008). Although research implies that imagination and suggestion have dissimilar neural correlates, these studies have not harnessed state-of-the-art methods for decoding overlapping recruitment of neural assemblies, such as multivariate pattern and representational similarity analyses (Haxby, Connolly, & Guntupalli, 2014). These methods will significantly advance understanding of the extent to which suggestion and imagination activate shared and distinct neural representations. Pursuing these and other avenues of research will help to strengthen our understanding of the similarities and dissimilarities between suggested experiences and imagination.

Acknowledgments

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