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Abstract

In the 19th century it was recognised that neurological symptoms could be caused by 'morbid ideation' as well as organic lesions. The subsequent observation that hysterical (now called 'functional') symptoms could be produced and removed by hypnotic suggestion led Charcot to hypothesise that suggestion mediated the effects of ideas on hysterical symptoms through as yet unknown effects on brain activity. The advent of neuroimaging 100 years later revealed strikingly similar neural correlates in experiments matching functional symptoms with clinical analogues created by suggestion. Integrative models of suggested and functional symptoms regard these alterations in brain function as the end point of a broader set of changes in information processing due to suggestion. These accounts consider that suggestions alter experience by mobilising representations from memory systems, and altering causal attributions, during pre-conscious processing which alters the content of what is provided to our highly edited subjective version of the world. Hypnosis as a model for functional symptoms draws attention to how radical alterations in experience and behaviour can conform to the content of mental representations through effects on cognition and brain function. Experimental study of functional symptoms and their suggested counterparts in hypnosis reveals the distinct and shared processes through which this can occur.

Hypnosis as a Model

Introduction

Apparent similarities between hysteria and hypnosis have been noted from the 19th onwards. In particular, the process of suggestion has been viewed as a potential explanation of hysterical symptoms, operating via effects on brain function (e.g. Charcot and Marie 1892; Oakley 1999). This chapter considers the relationship between hypnosis and hysteria, now described as 'functional neurological symptoms'. Characteristics of hypnosis are outlined before considering ways in which hypnosis might act as a model for functional symptoms. This provides a basis for evaluating past and current attempts to explain functional symptoms by analogy with hypnosis.

Hypnosis and Suggestibility

In a report on hypnosis for the British Psychological Society, hypnosis was defined as:

"an interaction between one person, the 'hypnotist', and another person or other people, the 'subject' or 'subjects'. In this interaction the hypnotist attempts to influence the subjects' perceptions, feelings, thinking and behaviour by asking them to concentrate on ideas and images that may evoke the intended effects. The verbal communications that the hypnotist uses to achieve these effects are termed 'suggestions'" (Heap et al 2001). Auto-suggestions refer to suggestions that are self-administered, while the 'classic suggestion effect' entails that responses elicited by suggestions are experienced as involuntary and effortless" (Weitzenhoffer 1980). Although suggestion is employed in hypnosis, it has a broader definition as "a form or type of communicable belief capable of producing and modifying experiences, thoughts and actions. Suggestions can be (a) intentional/ nonintentional, (b) verbal/nonverbal, or (c) hypnotic/ nonhypnotic" (Halligan and Oakley 2014).

Suggestive processes have formed part of cultural practices since recorded history, but the explicit recognition of suggestion as a psychological process that can be deliberately used to produce specific effects dates from the 19th century (Ellenberger 1994). In the case of hypnosis, verbal suggestions to relax and focus attention, generally administered in a standardised way as a 'formal induction procedure', are used to establish a hypnotic state or 'trance'. In keeping with the content of typical suggestions in the induction procedure, the hypnotic state is characterised by attentional absorption, disattention to extraneous stimuli, and relaxation. Induction of the hypnotic state increases responses to further suggestions (e.g. of limb paralysis) although some individuals respond to the same suggestions without a formal induction procedure (Braffmann and Kirsch 1999).

A variety of scales have been developed to measure individual responsiveness to suggestions, such as the Harvard Group Scale of Hypnotic Susceptibility (Shor and Orne 1962). These scales generally include a hypnotic induction followed by test suggestions and an assessment of the subject's response to each. 'Hypnotisability' or 'hypnotic suggestibility' is typically defined as the number of suggestions that an individual responds to on a standard scale of this type. A resemblance between hypnosis and functional neurological symptoms has been noted at this basic level of how hypnotic responsiveness is determined; as Kirsch put it, "Hypnotized subjects are asked to experience paralysis, amnesia, anaesthesia, involuntary movements and hallucinations. In fact, hypnotisability is measured as the number of conversion and dissociation symptoms that the person is able to display" (Kirsch 1990). This resemblance is central to the claim that hypnosis can act as a model for functional symptoms. Before examining the evidence for this claim in more detail, we will first consider how hypnosis might act as a model for functional symptoms based on recent accounts of models in scientific explanation.

Explanatory models in scientific explanation

An explanatory model allows "the construction of hypotheses about unobservable processes and structures that can be used to explain observable phenomena" (Harre 2002 p. 54). Explanatory models rest on a particular use of analogy, in which (i) patterns of similarity and difference between the source model and subject are identified; (ii) the source model and subject are recognised as subtypes of an overarching category or 'supertype' which defines the characteristics they share in common. The source model of hypnosis allows the construction of an overarching category which also includes functional neurological symptoms – specifically, a category of phenomena characterised by subjectively realistic, involuntary alterations

in experience and behaviour that conform to ideas, beliefs, and expectations. Hypnotic phenomena and functional neurological symptoms 'inherit' this shared characteristic as members of the category (Harre 2002).

In some cases the success of an explanatory model can be demonstrated through experiments in which features of the subject are represented and investigated by controlled manipulation of the source which would be impossible or difficult in the subject itself. Hypnosis has been extensively used to model functional symptoms in this way (Bell et al 2011) – for example, by using suggestion to reproduce and then remove specific functional symptoms in healthy participants whilst measuring brain activity. This allows much more precise comparison of hypnotic phenomena and functional symptoms than would otherwise be the case. If hypnosis is a good explanatory model for functional neurological symptoms then it should display certain characteristics. It should be ontologically plausible (involve the same kind of processes); the processes should clearly relate to general theories of cognition and brain function and apply to both hypnosis and functional symptoms; and the model should allow prediction of features of functional symptoms (such as brain mechanisms), and vice versa. Features of what would count as a successful use of hypnosis as a model for functional neurological symptoms can be tested against successive versions of this model since the 19th century.

The initial construction of hypnosis as a model for hysteria

Many psychiatrists, neurologists and psychologists explored the relationship between hypnosis, suggestion, and hysteria in the 19th and early 20th centuries (Ellenberger 1994). Here we focus on the work of the pioneering neurologist Jean Martin Charcot (1825-1893) and the philosopher, psychiatrist, and experimental psychologist Pierre Janet (1859 – 1947). This is not only because of their central influence in their own time, but also because their proposals continue to inform contemporary research.

Charcot proposed that motor symptoms of hysteria derived from unconscious 'fixed' ideas based on suggestions or autosuggestions "remaining isolated from the rest of the mind and expressing themselves outwardly through corresponding motor phenomena" (Ellenberger 1994). Charcot used the recently discovered technique of hypnosis to produce and remove hysterical symptoms. He proposed that the effects of fixed ideas in both hysteria and hypnosis operated via as yet unexplained 'dynamic or functional lesions' in the cortical motor area opposite the paralysis (Charcot 1889). These dynamic lesions produced a temporary version of the more permanent loss of function due to structural damage caused by conditions such as stroke, which had been well described in the 19th century. In Charcot's words, it was 'one of those lesions which escape our present means of anatomical investigation' (Charcot 1889).

Charcot's proposal that brain function could be re-organised by ideas to produce involuntary symptoms radically differed from the dominant clinico-anatomic method in medicine and neurology that viewed symptoms as solely arising from discrete brain lesions. Charcot's views had been influenced by the English neurologist John Russell Reynolds, who in 1869 had introduced the concept of 'psychic paralysis' (Reynolds 1869). Reynolds wrote, "some of the most serious disorders of the nervous system, such as paralysis, spasm, pain, and otherwise altered sensations, may depend upon a morbid condition of emotion, or idea and emotion, or of idea alone … they sometimes associate themselves with distinct and definite diseases of the nervous centers, so that it becomes very important to know how much a given case is due to an organic lesion,

and how much to morbid ideation" (Reynolds 1869). Reynolds gave an example of a young woman whose father had become paralysed after a reversal of fortune. She had to support the household by giving lessons, which involved long walks around the town. As Binet and Féré summarised the case in their book *Animal Magnetism*, 'influenced by the fatigue caused by so much walking, it occurred to her that she might become paralysed and that their situation then would be terrible. Haunted by this idea, she felt a growing weakness in her limbs, and after a while was quite unable to walk. The pathology of the affection was understood by Reynolds who prescribed moral treatment. He finally convinced the patient that she was able to walk, and in fact she resumed the practice" (Binet and Féré 1891 p. 323f.). As Charcot put it, hysterical paralysis arose when "the idea comes to the patient's mind that he might become paralysed; in one word through autosuggestion, the rudimentary paralysis becomes real" (Charcot & Marie 1892).

The influence of ideas on the symptoms of hysteria and their hypnotic counterparts was also emphasised by Charcot's younger colleague Pierre Janet. Janet, like Charcot, considered both hysteria and hypnosis to operate through the suggestive effects of ideas. Indeed, Janet felt that suggestion based on ideas was so central to both hysterical and hypnotic phenomena that without exposure to relevant ideas, the respective effects would not occur (Ellenberger 1994). Janet originated the modern notion of dissociation as a 'narrowing of the field of consciousness' resulting in an abnormal splitting off or compartmentalisation of mental functions that are normally closely associated (Janet 1907). Janet viewed dissociation as influenced by the suggestive effect of 'fixed ideas' based on unresolved traumatic memories. Suggestibility was defined as the tendency for a simple idea to develop into chains of association which then influence mental function and behaviour (Halligan and Oakley 2014). Janet's masterly case studies showed how the involuntary behaviour of hysterics, performed without awareness of recollection, reproduced and indirectly expressed earlier traumatic experiences (Janet 1907). While Janet's approach was similar to Charcot's in many respects, he did not accept Charcot's thesis that hysterical symptoms were caused by temporary 'dynamic' lesions by analogy with 'structural' lesions causing more permanent deficits. The question of the brain basis of dissociation and suggested effects could not be addressed until the invention of neuroimaging about 100 years after the death of Charcot.

Contemporary versions of hypnosis as a model for functional symptoms

Developments in cognitive neuropsychology and neuroimaging have led to a re-examination of earlier proposals about hypnosis as model for hysteria (see in particular the influential paper of Oakley 1999). Here we consider these recent developments.

Neuroimaging studies

Hypnotic suggestion has been used to create experimental models of a range of functional or dissociative symptoms, in some cases allowing comparison of brain correlates of symptoms and their suggested analogues.

Limb paralysis

In a Positron Emission Tomography (PET) study, Halligan and colleagues used suggestion to produce a left leg paralysis in a single hypnotised participant that

reproduced the functional paralysis of the patient in their prior study (Marshall et al 1997; Halligan et al 2000). Attempted movement of the paralysed limb was associated with increased right anterior cingulate cortex (ACC) and orbitofrontal cortex (OFC), resembling activation changes of the clinical study. It was concluded that similar processes of executive inhibition might underpin hypnotically suggested and functional paralysis. A follow up study with 12 highly hypnotisable participants addressed the criticism that the hypnotised subject might have feigned their paralysis (Ward et al 2003). While independent clinically trained observers were not able to distinguish suggested and feigned paralysis, brain activity to suggested paralysis largely replicated the previous single case study (although ACC activation was not found) and markedly differed from the feigned condition (Ward et al 2003).

Functional magnetic imaging studies of suggested limb paralysis have also been conducted, noting that the fMRI environment does not interfere with response to suggestions (Oakley et al 2007). Cojan and colleagues used hypnotically suggested paralysis to replicate their earlier study that used the GO NOGO task in functional paralysis patients (Cojan et al 2009 a, b). Suggested paralysis was also associated with normal motor cortex activation during the preparation phase, supporting the view that paralysis was not working through suppression of motor intention. They also found that anterior prefrontal and ACC activity was increased in all hypnosis conditions, not just suggested paralysis, which they took as evidence of state related hypnosis changes rather than a mechanism to inhibit movement. As with their study of functional paralysis, they reported increased functional connectivity between the motor cortex and precuneus, proposing that in both cases motor inhibition (paralysis) may be mediated through mental imagery and self-reflective processing rather than executive inhibition. Also, functional paralysis but not suggested paralysis was associated with modulation of ventromedial prefrontal cortex (VMPFC) (Cojan et al 2009b). This was interpreted as evidence of involvement of affectively laden self-representations and memories in modulating motor function in functional but not suggested paralysis.

The question of whether functional and suggested motor inhibition (paralysis) is mediated through executive inhibition, or modulation by emotion, memory, and self-related processing, or some combination of these processes appears unresolved at present. For example, a study of hypnotically induced left-hand paralysis using resting state fMRI showed changes in resting state networks that could be associated with both altered self-related processing and engagement of executive inhibition (Pyka et al 2011), while a recent fMRI study of suggested left upper limb paralysis was consistent with a selective role for ACC in movement inhibition (Deeley, Oakley et al 2013). Inconsistent findings may be partly attributable to differences in experimental design. Nevertheless, similar patterns of brain activity have been found when studies with functional paralysis patients have been closely reproduced with suggested paralysis – except for activation of VMPC in functional paralysis but not suggested paralysis in Cojan and colleagues' studies. This draws attention to the important issue of potential differences in the role of emotion and memory processing between functional and suggested symptoms which we discuss further below.

Functional amnesia

Mendelsohn and colleagues used suggestion in hypnosis to selectively block memory specific aspects of a cue when a post-hypnotic cue was given (Mendelsohn et al 2008). Only the highly hypnotically responsive group showed impaired recall

compared to low responders and a control group instructed to feign high hypnotisability. Reduced recall was associated with reduced activity in left extrastriate occipital lobe and the left temporal pole, as well as increased activity in the left rostrolateral PFC. These effects were reversed when the post-hypnotic amnesia suggested was removed. These findings are consistent with studies of functional amnesia which show increased activity of prefrontal inhibitory regions and decreased activity of medial temporal lobe memory systems during attempted recall (reviewed in Bell et al (2011)).

Loss of agency and awareness

Functional neurological symptoms include loss of the sense of agency or perceived self-initiation and control of movements. For example, involuntary movements present as convulsions in non-epileptic seizures, or complex automatisms in fugues or other dissociative episodes. Reductions of agency in functional disorders can also be accompanied by loss or narrowing of awareness – as occurs, for example, in about half of patients with non-epileptic seizures (Brown et al 2011). Alterations of agency and awareness also form part of other pathological conditions such as schizophrenia, in which loss of agency is illustrated by passivity phenomena such as alien control of movement. In this symptom movements are interpreted and experienced as under the control of an external agent. Disruptions of agency involve not only movements but also the sense of control and ownership of mental contents such as thought, emotion, and personal identity – as in dissociative identity disorder, in which speech and actions occur as if under the control of an alternate indwelling personality; and thought insertion in schizophrenia, in which thoughts are experienced as introduced into the mind by an external agent. Alien control of thought or movement - sometimes associated with loss of awareness - is also described in culturally influenced dissociative phenomena such as spirit possession, mediumship, and shamanism (Osterreich 1974, Rouget 1985). These closely related alterations in experience across pathological conditions and cultural settings raise the question of whether they involve changes in shared cognitive and brain systems involved in the usual sense of agency and awareness. Suggestion has been used to address this question because it allows the creation of experimental analogues of closely related alterations in experience.

(i) Non-epileptic seizures, involuntary movement and loss of awareness

While suggested convulsions cannot be safely or informatively produced in an fMRI scanner, it is possible to model non-epileptic seizures by suggesting involuntary movements with and without loss of awareness. Suggested simple involuntary actions (joystick movement) were associated with altered functional connectivity between motor planning brain regions (supplementary motor area, SMA) and regions involved in movement execution (e.g. premotor areas, M1, S1) (Deeley, Walsh et al 2013). Reduced awareness of hand movement was associated with decreased activity in brain areas involved in bodily awareness (BA 7) and sensation (insula), suggesting a mechanism for the loss or narrowing of awareness reported in about half of patients with non-epileptic seizures (Brown et al 2011) as well as other forms of dissociation.

(ii) Dissociative identity changes

In some forms of dissociative identity disorder and the similar phenomenon of 'lucid possession' (Osterreich 1974), the subject is aware of the mental contents of an

alternate personality or possessing agent but otherwise unable to control their speech or actions (Deeley et al 2014). An experimental model of these experiences and attributions of control by another agent involved a suggestion of an engineer conducting research into limb movement. The engineer had found a way to enter the subject and control movement from within. The subject was aware of the thoughts and motives of this possessing agent but unable to control the hand movements produced by it. Suggested control by the external agent was associated with an increase in functional connectivity between M1 (a key movement implementation region) and BA 10, demonstrating functional coupling with brain regions involved in the representation of agency in experiences of loss of motor control to another agent (Deeley et al 2014).

(iii) Complex automatisms and loss of awareness

Brain mechanisms for complex automatisms have been investigated in experiments employing suggestions for automatic writing, in which control of movement (handwriting) and thought (thinking of a sentence ending) is attributed to an engineer (Walsh et al 2014, 2015). An additional experimental condition involved loss of awareness for automatic writing. At a phenomenological level the suggestions for external control were associated with a sense of reduced ownership as well as control for movement and thought (Walsh et al 2014, 2015). The experiments therefore modeled loss of control, ownership and awareness of complex movement and thought. These experiential changes can occur in pathological and culturally normative dissociative states, as well as alien control of movement and thought insertion occurring in schizophrenia. Loss of perceived control of movement and thought were associated with largely non-overlapping changes in brain activity and connectivity. In the case of movement, involuntary handwriting was associated with increased activity of a left-lateralised cerebellar-parietal network. This is consistent with a 'forward model' account that increased activity in this network during involuntary movement reflects loss of the suppression of sensory processing of self-generated movement that accompanies voluntary actions (Blakemore et al 2003, Frith 2005). Thought insertion, by contrast, was associated with reduced activity in networks supporting language and self-related processing. However, in addition to these modality specific changes in brain activity, both experiences involved a reduction in activity of left SMA and altered functional connectivity between SMA and brain regions involved in movement implementation and language processing respectively. Similar changes did not occur during a simulation condition. Taken together these results suggest that reduced SMA activity may represent a general mechanism for the experience of loss of control and ownership of thought and action, acting with distinct changes in brain function and connectivity that underpin specific features of each phenomenon. On this account the earlier experiment showing reduced connectivity between SMA and M1 during involuntary simple movement of a joystick was powered to detect changes in SMA connectivity but not activity (Deeley, Walsh et al 2013). Reduction of SMA activity during involuntary simple movement can be tested in a follow up study with a larger sample size. A prediction arising from these symptom modelling studies is that loss of perceived control for movement and thought in dissociative psychopathology and schizophrenia involves disruption of SMA activity and connectivity, even if the factors modulating this disruption are specific to each condition (Deeley et al 2013). These findings illustrate the importance of a transdiagnostic approach when attempting to understand basic mechanisms involved in disruptions of agency. Also, loss of awareness for involuntary writing was associated with reduced activity of left-sided posterior

cortical network including BA 7 (superior parietal lobule and precuneus), and posterior cingulate cortex, demonstrating overlapping brain processes in loss of awareness of both simple and complex movement (Deeley, Walsh et al 2013; Walsh et al under review).

Integrative models of functional and suggested phenomena

These brain imaging studies identify the immediate changes in brain activity underpinning specific changes in experience and behaviour, but raise the question of how we should conceptualise the wider processes leading to these changes. In other words, how *do* ideas, or – in the language of cognitive neuroscience - *mental representations* such as concepts, images, memories, beliefs and expectancies, alter brain function to produce functional symptoms or suggested alterations in experience? Mesulam observed how 'our highly edited subjective version of the world' is the product of extensive associative elaboration and modulation of sensory information across the processing hierarchy of the brain (Mesulam 1998). Integrative theories of functional and suggested phenomena identify cognitive and brain processes which affect this 'editing' of information before its presentation to conscious awareness as a late stage of processing (Brown 2006; Brown and Oakley 2004; Oakley 2006b; Oakley 2009a; 2009b; Bell et al 2011; Brown et al 2011). While these theories have undergone extensive development in response to refinement of general accounts of cognitive architecture and brain function, they share features in common. The contents of consciousness are viewed as a working model of the environment produced by the interpretation and organization of sensory data by information in memory (Brown et al 2011, Oakley 1999b). The working model guides behavioural responses to the environment. Routine behavior is controlled by learned cognition and action programmes selected automatically with minimal conscious effort or awareness. Novel actions, by contrast, engage attention and a sense of effort and self-awareness. In both cases there is generally little or no introspective access to the selection of representations from memory that inform consciousness and behaviour. This means that consciousness and behaviour can be 'distorted by disproportionately active material in memory, leaving us prone to both misperceptions and behaviors that conflict with goals in self-awareness' (Brown et al 2011). In this view the content of 'rogue representations' mobilized from memory informs functional symptoms and suggested effects, respectively. In the case of symptoms or suggested effects that involve disruptions of agency (such as paralysis or involuntary movements), the representations may not only establish an expectancy that a type of experience or behaviour will occur, but critically that it is not self-caused – the difference between 'your arm is rising' rather than 'you are raising your arm' (Spanos and Gorassini 1984, Oakley and Brown 2005).

The content of 'rogue' representations can have many sources. In the case of functional illness their content may be based on experiences of illness in oneself or others, cultural learning, or expectancies established by the verbal communications of health care providers. They may also assume different forms – imagery based schemata, verbal representations, episodic memories, or cue driven action programmes based on associative learning. In the case of hypnosis, the representational content of suggestions is typically verbally encoded. However, post-hypnotic suggestion can establish automatic response tendencies to internal or external cues which operate outside awareness. In many cases this may be closer to the cognitive processes generating functional symptoms.

The 'rogue representations' underpinning functional symptoms may be cued by many psychological processes – such as anxious anticipation of symptoms (as in the case of the young woman described by Reynolds (1869); attention to and misinterpretation of bodily sensations; as well as social reinforcement in settings such as work, health and social care, and personal relationships. The emphasis of integrative approaches on the influence of diverse mental representations and causal attributions on functional symptom formation is consistent with a recently proposed hierarchical Bayesian model of functional symptoms derived from computational neuroscience (Edwards et al 2012). This model provides a detailed account of how prior beliefs interact with sensory processing across different levels of neural organisation to generate functional motor and sensory symptoms (Edwards et al 2012).

Emotional arousal or specific types of emotion are not present in hypnotic models of functional symptoms, which employ induction procedures that establish a state of relaxation. This recalls the finding that functional paralysis, but not suggested paralysis, is associated with modulation of VMPFC, interpreted as indicating affectively-laden cognitive processing in functional but not suggested paralysis (Cojan et al 1999b). However, it is only by convention that hypnotic induction procedures establish a state of emotional calm and relaxation. Suggestions reproducing affective and self-representational aspects of functional paralysis would be predicted to enlist VMPC (assuming these cognitive processes explain its engagement). In other words, to paraphrase Reynolds (1869), there is no inherent reason why suggestions should not only produce the ideas but also the ideas coupled with emotions that can elicit functional symptoms. The greatest challenge here may be to elicit verbal descriptions of the subjective experience of symptom onset in patients with functional symptoms that could then be modeled with hypnotic suggestions. This difficulty reflects the tendency of patents with functional disorders not to acknowledge psychological factors in symptom onset, or indeed because the relevant psychological processes may be hard to describe or largely operate outside conscious awareness.

Relationships between functional symptoms, suggestive processes and hypnosis

A prediction arising from hypnosis as a model for functional symptoms is that highly hypnotically responsive individuals should be more likely to develop functional symptoms. Some studies have shown an association between hypnotisability and a tendency to develop sensorimotor functional symptoms ((Bliss 1984, Roelofs, Hoogduin et al 2002, Roelofs, Keijsers et al 2002, Moene et al 2001). Also, a recent study shows that hypnotisability is associated with susceptibility to the rubber hand illusion (Walsh, Guilemette et al 2015). In this illusion the perceived location of a hand being stroked out of sight is mislocalised to the position of a rubber hand being stroked in view. The rubber hand acts as a non-verbal, visually based implicit suggestion. Greater susceptibility to the illusion in more hypnotically responsive individuals may indicate a more general responsiveness to non-verbal, implicit suggestive processes that contribute to functional symptoms – such as a symptom observed in another. Despite this, high hypnotic responsiveness (or indeed susceptibility to the rubber hand illusion) may not be necessary for functional symptoms to arise (Popkirov and Giro 2015; Ricciardi et al 2015). This is not only because most people respond to at least some suggestions, but also because irrespective of hypnotisability individuals may be more responsive to the suggestive effects of a relevant illness representation under conditions of stress, trauma, social conflict, preoccupation, or other factors motivating symptom formation and the

adoption of an illness role.

While the subjective experience of symptom formation in functional patients is difficult to access, there may be scope for eliciting patient descriptions based on psychological treatment where trust with a therapist and self-reflection are established. Case histories of this kind could help determine whether there are 'styles' of functional symptom formation, by analogy with 'styles' of hypnotic responding that are associated with differing degrees of automaticity. Hypnotic subjects with a 'concentrative' response style focus their attention of the content of the suggestion and tend to experience the suggested effects as 'happening by themselves'. By contrast, those with a 'constructive' response style who engage in mental imagery have a greater awareness of actively contributing to the suggested effects – although once established they are nevertheless experienced as involuntary and realistic (Brown and Oakley 2004).

Cultural and historical variation in functional symptoms, as well as hypnosis, draw attention to how radical alterations in experience and behaviour can conform to the content of mental representations (Deeley 2003, Deeley 2013). For example, the widespread category of spirit possession is constituted by dissociative identity change often accompanied by phenomena such as collapse, convulsions, paralysis, and aphonia (Deeley 1999, Rouget 1985). Research on 'harmful' spirit possession following political violence shows cultural influences on dissociative responses to trauma (Igreja et al 2010). Alternatively, some societies enlist powerfully suggestive ritual practices to induce and reverse forms of dissociation such as spirit possession as part of healing or other socially valued experiences (Seligman and Kirmayer 2008). Cross-cultural research is important because it extends understanding of the full range of functional and dissociative phenomena. It also reveals the suggestive effects of explicitly directive speech and actions and implicit social modeling outside hypnotic procedures, as well as the social and psychological values attached to some forms of dissociation (Deeley in press). In terms of the explanatory model we are considering in this chapter, functional neurological symptoms, other cultural forms of dissociation, and hypnosis all belong to an overarching category of 'suggestive-dissociative phenomena'. As such, research into one subtype should provide insights into the others.

One of the more obvious dissimilarities between functional symptoms and suggested effects relate to time scale. Functional symptoms presenting to health services usually (but not always) persist for much longer than hypnotically suggested effects – days to years, rather than minutes to hours. The persistence of functional symptoms may be due to psychologically relevant needs, but may also relate to secondary social, neurocognitive, and bodily adaptation that influence how the symptoms are maintained. Physical changes such as atrophy or contracture of a chronically underused limb are unlikely to be well modelled with suggestion. From a neurocognitive perspective, chronicity of symptoms may be associated with changes in underlying mechanism. For example, in some cases there may be a transition from symptom maintenance based on representations derived from explicit memory (such as mental imagery of symptoms) to engagement of implicit associative learning (such as conditioned inhibition of limb movement countermanding an intention to move). Hypnotic suggestion could potentially be employed to model this kind of neurocognitive adaptation to symptom maintenance over extended time periods. Studies of this kind could help understand not only the range of neurocognitive mechanisms that can mediate functional symptoms, but also their potential temporal

relationships.

Conclusion

In the 19th century it was recognised that neurological symptoms could be caused by 'morbid ideation' as well as organic lesions (Reynolds 1869). The subsequent observation that hysterical symptoms could be produced and removed by hypnotic suggestion led Charcot to hypothesise that suggestion mediated the effects of ideas on functional symptoms through as yet unknown effects on brain activity. The advent of neuroimaging 100 years later revealed strikingly similar neural correlates in experiments matching functional symptoms with clinical analogues created by suggestion. Integrative models of suggested and functional symptoms regard these alterations in brain function as the end point of a broader set of changes in information processing due to suggestion. These accounts consider that suggestions alter experience by mobilising internal representations from memory systems, and altering causal attributions, during pre-conscious processing which alter the content of what is provided to our highly edited subjective version of the world. 'Suggestion' in this sense is a broad term which recognises that representations underlying symptom formation can be embedded in a variety of cognitive processes (explicit or implicit memory, verbal or non-verbal) and be linked to a range of internal or external cues. Future studies with closer symptom matching can test whether all brain correlates of functional symptoms can be reproduced in suggested analogues. This will require a more refined understanding of the phenomenology of functional symptom formation to guide symptom modelling with suggestion. Suggestion and fMRI have also been used to model functional symptoms such as involuntary movements, loss of awareness, identity change and complex automatisms. While these functional symptoms have been little studied with neuroimaging – not least because of the problem of capturing symptoms in the scanner – the hypnotic models identify potential brain mechanisms for their functional counterparts and may inform their experimental study. Perhaps the deeper significance of hypnosis as a model for functional symptoms is that hypnosis, as well as cultural and historical variation in functional symptoms, draw attention to how radical alterations in experience and behaviour can conform to the content of prior mental representations through effects on cognition and brain function. Experimental study of functional symptoms and their suggested counterparts in hypnosis reveals the distinct and shared processes through which this can occur.

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