



# A laboratory analogue of mirrored-self misidentification delusion: The role of hypnosis, suggestion, and demand characteristics

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## ABSTRACT

Mirrored-self misidentification is the delusional belief that one's own reflection in the mirror is a stranger. In two experiments, we tested the ability of hypnotic suggestion to model this condition. In Experiment 1, we compared two suggestions based on either the delusion's surface features (seeing a stranger in the mirror) or underlying processes (impaired face processing). Fifty-two high hypnotisable participants received one of these suggestions either with hypnosis or without in a wake control. In Experiment 2, we examined the extent to which social cues and role-playing could account for participants' behaviour by comparing the responses of 14 hypnotised participants to the suggestion for impaired face processing (reals) with those of 14 nonhypnotised participants instructed to fake their responses (simulators). Overall, results from both experiments confirm that we can use hypnotic suggestion to produce a compelling analogue of mirrored-self misidentification that cannot simply be attributed to social cues or role-playing.

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## 1. Introduction

Hypnotic suggestions can cause dramatic alterations in participants' subjective experience and behaviour (Kihlstrom, 2007, 2008). These alterations can be used to investigate many aspects of consciousness. One application is in the study of psychopathology. Researchers can use specific suggestions to recreate clinical symptoms in the laboratory, yet do so in a way that has no lasting consequences for participants (Kihlstrom, 1979). According to Oakley and Halligan (2009), this approach creates "virtual patients" (p. 266), temporary analogues of clinical conditions that researchers can study to inform understanding of the conditions themselves. For this reason, hypnosis has been used to model a wide range of clinical disorders (Oakley & Halligan, 2009, 2013; Woody & Szechtman, 2011). In previous research, we applied this approach to study the mirrored-self misidentification delusion, the belief that one's reflection in the mirror is not oneself (Connors, Barnier, Coltheart, Cox, & Langdon, 2012; Connors & Barnier, et al., in press). In the current experiments, we examined how various components of a hypnosis procedure – namely the induction (instructions that define the situation as hypnotic), suggestions (instructions for specific imaginative experiences), and demand characteristics (unintentional cues that invite particular responses) – contribute to the hypnotic analogue.

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### 1.1. Mirrored-self misidentification

Mirrored-self misidentification commonly occurs in advanced global dementia, though it can also occur before other symptoms of dementia are detectable (see Connors & Coltheart, 2011; Connors, Langdon, & Coltheart, *in press*). Epidemiological studies have found that 2–10% of patients suffering from Alzheimer's disease misidentify their own reflection in the mirror (see Connors, Langdon, et al., *in press*). The delusion has also been reported in schizophrenia (Gluckman, 1968) and after right hemispheric stroke (Villarejo et al., 2011). For many patients, the delusion can cause considerable distress. Many patients cover up all mirrors to avoid seeing the stranger and some even throw objects at their reflection (Gluckman, 1968). Other patients remain largely indifferent (Breen, Caine, & Coltheart, 2001) or treat their reflection as a companion (Phillips, Howard, & David, 1996). The delusion can occur despite intact semantic knowledge of mirrors (e.g., being able to define their properties and function; Breen et al., 2001; Villarejo et al., 2011). The delusion can also occur despite an ability to accurately recognise other people's reflections in the mirror (Breen et al., 2001; Spangenberg, Wagner, & Bachman, 1998; Villarejo et al., 2011).

Mirrored-self misidentification is an example of a monothematic delusion, a delusion limited to a single topic. An influential theory of monothematic delusions is the two-factor account proposed by Langdon and Coltheart (2000; see also Coltheart, Langdon, & McKay, 2011). According to this theory, two factors are required for a delusion to form and persist. The first factor (Factor 1) generates the content of the delusion and typically involves a neuropsychological anomaly affecting perceptual, emotional, or autonomic processing. In the case of mirrored-self misidentification delusion, Factor 1 can be either impaired face processing (and hence a difficulty recognising one's own face in the mirror) or mirror agnosia (an inability to use mirror knowledge when interacting with mirrors). Both of these deficits can generate the idea that there is a stranger in the mirror (Coltheart, 2007). Indeed, Breen et al. (2001) reported two patients with mirrored-self misidentification: one with impaired face processing and the other with mirror agnosia. The second factor (Factor 2) explains the maintenance of the delusion and involves a deficit in belief evaluation. The presence of Factor 2 accounts for why some patients with Factor 1 develop a delusion and other patients with Factor 1 do not (for a description of non-delusional patients with Factor 1 deficits, see Connors & Coltheart, 2011; Ellis & Florence, 1990). Thus, patients with both Factor 1 (either impaired face processing or mirror agnosia) and Factor 2 (a deficit in belief evaluation) will develop the delusion.

### 1.2. Creating a hypnotic analogue

Delusions can be difficult to study. Patients with delusions often have co-occurring symptoms and impairments that may interfere with or confound investigation. Mirrored-self misidentification delusion, for example, usually occurs in dementia and is particularly difficult to study because of the associated cognitive and neurological deterioration. Patients with delusions may also be reluctant to participate in research that could view their strongly held beliefs as pathological. Hypnosis provides a means of creating a laboratory model of delusions on demand and avoiding these challenges (Kihlstrom, 1979; Woody & Szechtman, 2011; for further background on hypnosis, see Barnier & Nash, 2008; Kihlstrom, 2007, 2008). As we have discussed elsewhere (e.g., Connors & Barnier et al., 2012), hypnosis is suited to modelling delusions for two reasons. First, delusions and hypnotic phenomena show many similarities. Both, for example, involve distorted beliefs about reality that are maintained despite counterevidence (Kihlstrom & Hoyt, 1988; Sutcliffe, 1961). Second, the two-factor theory of delusions is a general cognitive model (Coltheart, 2007). According to this view, disruptions at a cognitive level cause the delusion whether or not neurological damage is also present. Hypnosis can disrupt cognitive processes in a top-down manner. This allows researchers to produce an analogue of a delusion and simulate the impact of neurological damage in a way that is temporary and completely reversible (Connors, 2012; Cox & Barnier, 2010; Oakley & Halligan, 2009, 2013).

A successful analogue of a clinical condition, in this case mirrored-self misidentification, needs to meet at least two criteria (Kihlstrom, 1979). First, the analogue needs to demonstrate that it can model the surface features of the condition in question. Most critically in the case of mirrored-self misidentification, the analogue needs to model the core belief that one's reflection is a stranger and the delusion's resistance to challenge. Second, the analogue needs to demonstrate commonality with the condition in terms of underlying mechanisms. It must "move beyond mere 'demonstration' experiments and begin to analyse the underlying psychological processes in detail" (Kihlstrom, 1979, p. 464). A hypnotic analogue of mirrored-self misidentification informed by the two-factor theory thus needs to be able to recreate the delusion from analogues of its Factor 1 and Factor 2 components without using suggestions that are so directive as to specify the overall delusion (see Reyher, 1962).

Some preliminary work we conducted began to address these two criteria. In two experiments, we demonstrated that hypnosis could model the surface features of the delusion (Barnier, Cox, Connors, Langdon, & Coltheart, 2011; Barnier & Cox et al., 2008). In Barnier et al. (2011), we gave 38 high hypnotisable participants a hypnotic induction and a suggestion to see a stranger in the mirror (we refer to this here as a 'Fully-Formed suggestion' because it specified the fully-formed experience of seeing a stranger). In response, 68% of participants reported seeing a stranger in the mirror. We also gave participants a series of challenges to determine the strength of the hypnotic delusion and its similarity to the clinical condition. For example, we asked participants to touch their nose while looking in the mirror and to explain why the person copied them. We found that, for many participants, the delusion was resistant to challenge. Overall, participants displayed features that were strikingly similar to the clinical condition. These findings were limited, however, by the overly prescrip-

tive nature of the suggestion. The suggestion directly specified the delusion to participants so it is unclear if their responses were simply due to this level of specification, rather than to any shared underlying processes with the clinical delusion (see Kihlstrom, 1979; Reyher, 1962). It is also unclear whether hypnosis itself is necessary for the analogue because previous research has shown that many high hypnotisable participants can experience hypnotic suggestions without a formal hypnotic induction (Kirsch & Braffman, 2001; McConkey, Szepe, & Barnier, 2001).

In another experiment, we made a first step in modelling the underlying processes of the delusion (Connors & Barnier et al., 2012). We gave separate suggestions for the two underlying deficits – impaired self-recognition (Factor 1) and impaired belief evaluation (Factor 2) – without specifically mentioning a stranger. Half the participants received the Factor 1 suggestion on its own and half the participants received both the Factor 1 and Factor 2 suggestions. To evaluate if hypnosis – itself known to disrupt belief evaluation (Bryant & Mallard, 2003; Shor, 1959) – might act as Factor 2, we also compared participants given the suggestions during hypnosis with participants given the suggestions outside hypnosis (in a wake control). We found that the Factor 1 suggestion alone was just as effective as the combined Factor 1 and Factor 2 suggestion in generating the delusion irrespective of condition. We also found that significantly more participants given the Factor 1 suggestion during hypnosis experienced the delusion than those given the same suggestion in the wake control. These findings implied that we could recreate a hypnotic analogue of the delusion from its components and that hypnosis itself could act as Factor 2. The findings were limited, however, by the possibility of alternative explanations for participants' responses. Some theorists, for example, have pointed out that the experimental context itself can invite certain responses in participants through the subtle pressures and roles of the social interaction (see Kihlstrom, 2002; Orne, 1959, 1971; Sheehan & Perry, 1976). It is unclear the extent to which social cues and role playing contributed to participants' responses in the hypnotic analogue.

There are three significant issues to resolve in order to show that hypnosis can successfully create a laboratory analogue of mirrored-self misidentification. First, it is important to directly compare the Fully-Formed suggestion with the Factor 1 (alone) suggestion to examine the role of the specific suggestion in generating the analogue. This is necessary because the two suggestions provide different amounts of information to participants. Whereas the Fully-Formed suggestion directly specifies the content of the delusion, the Factor 1 suggestion does not and instead requires participants to infer the content themselves from their experience of the suggestion. Second, it is important to compare the effects of the two suggestions given during hypnosis with those of the suggestions given outside hypnosis (in a wake control) to better evaluate the role of hypnosis in generating the analogue. Finally, it is important to rule out alternative explanations for the analogue, such as compliance or role playing.

## 2. Experiment 1

In Experiment 1, we gave participants either a Fully-Formed suggestion (“you will see a stranger in the mirror”) or a Factor 1 suggestion for impaired face processing (“you will see a face in the mirror that you will not be able to identify”) to recreate mirrored-self misidentification. It is important to bear in mind here that “seeing a stranger” is not necessarily implied by “not being able to identify the face in the mirror;” an individual might, for example, think that their own facial appearance has changed. We gave these suggestions either with hypnosis or without hypnosis (in a wake control). To test the delusion, we asked participants to look into a mirror and describe who they saw. We also included an additional measure of self-recognition based on the mark test that is used to assess self-recognition in infants and animals (Amsterdam, 1972; Gallup, 1970; Gallup, Anderson, & Shillito, 2002; Suddendorf & Butler, 2013). We surreptitiously marked participants' left cheek with black makeup before the suggestion. We were interested to see if participants touched the mark when they looked in the mirror and so showed evidence of self-recognition (it should be noted that this approach differs slightly from the formal mark test in that there was no baseline period involving prior exposure to the mirror without the mark and no condition where the mark is worn without exposure to the mirror; see Bard, Todd, Bernier, Love, & Leavens, 2006; Gallup, 1970). To evaluate the resilience of the delusion, based on our previous work we gave participants who reported seeing a stranger a series of graded challenges that provided evidence against the delusion. Finally, to index participants' subjective experiences, we conducted a detailed postexperimental inquiry using an adaptation of Sheehan and McConkey's (1982) Experiential Analysis Technique (EAT) in which the participants watched and commented on a video recording of the experimental session.

We compared the suggestions in terms of the number of participants reporting the delusion (the pass rate), qualitative features of participants' delusions, and participants' responses to challenge. In the hypnosis condition, we expected that both types of suggestion would produce the hypnotic delusion. However, we expected that the Fully-Formed suggestion might be more effective than the Factor 1 suggestion because the Fully-Formed suggestion directly specified the delusion, whereas the Factor 1 suggestion required that participants infer the belief themselves. In the wake condition, we expected that the Fully-Formed suggestion would produce the delusion because previous research has shown that participants can experience hypnotic suggestions without a formal hypnotic induction (Kirsch & Braffman, 2001; McConkey et al., 2001). We expected that the Factor 1 suggestion in the wake condition would not produce the delusion because the suggestion did not specify seeing a stranger and required a disruption in belief evaluation (Factor 2), provided by hypnosis, to generate the delusion from its component factors.

## 2.1. Method

### 2.1.1. Design and participants

Fifty-two high hypnotisable participants (34 female and 18 male) of mean age 19.23 ( $SD = 1.57$ ) years were tested in a 2 (condition: hypnosis vs. wake)  $\times$  2 (suggestion: Fully-Formed vs. Factor 1) between-subjects design. Participants were undergraduate psychology students at the University of New South Wales, who received either payment (\$25 for 2 h) or credit towards their psychology course for their involvement. Participants were carefully selected on the basis of their high scores on a 10-item modified version of the *Harvard Group Scale of Hypnotic Susceptibility, Form A* (HGSHS:A; [Shor & Orne, 1962](#)) and a 10-item tailored version of the *Stanford Hypnotic Susceptibility Scale, Form C* (SHSS:C; [Weitzenhoffer & Hilgard, 1962](#)).<sup>1</sup> All participants scored in the range 7–10 on the HGSHS:A ( $M = 7.56$ ,  $SD = 0.78$ ) and 7–10 on the SHSS:C ( $M = 7.95$ ,  $SD = 0.97$ ). Participants were asked not to participate in the experiment if they had any ongoing psychological condition, problems with substance abuse, or if they had ever suffered a serious head injury or neurological illness. Research was approved by the local human research ethics committee.

### 2.1.2. Materials and procedure

An experimenter tested participants individually in a 2 h session. This session consisted of an experimental session and a postexperimental inquiry. Both sessions were recorded using a video camera.

**2.1.2.1. Experimental session.** Before the experiment, the experimenter briefly explained the procedure and obtained participants' informed consent. Participants were randomly assigned to either a hypnosis condition ( $n = 26$ ) or a wake condition ( $n = 26$ ). In the hypnosis condition, the experimenter administered a standard induction procedure (approximately 10 min, based on the SHSS:C induction; [Weitzenhoffer & Hilgard, 1962](#)), which instructed participants to close their eyes, relax, and enter a "deep state of hypnosis" as the hypnotist counted from 1 to 20. In the wake condition, the experimenter explicitly told participants that no hypnosis was involved in the experiment. No further mention of hypnosis was made in this condition. In the place of an induction, the experimenter gave participants two puzzle tasks to complete in 10 min (see [Nogrady, McConkey, & Perry, 1985](#)) and then instructed them to close their eyes to minimise distractions.

The experimenter gave participants two suggestions from the SHSS:C ([Weitzenhoffer & Hilgard, 1962](#)) – arm levitation and arm rigidity. The experimenter then told participants he/she was examining the effect of hypnosis (or relaxation in the wake condition) on response to tickling. This was a cover story to allow the experimenter to mark participants' cheeks. While the participants' eyes were closed, the experimenter tickled the participants' left hand using a foam brush and asked them to rate how tickly the experience was. The experimenter then marked the participants' left cheek with black eye shadow makeup and a makeup brush under the guise of tickling the participant. Participants were asked to rate how tickly the experience was. Next, the experimenter gave participants a third suggestion from the SHSS:C – the mosquito hallucination.

The experimenter uncovered the mirror (approximately 40 cm  $\times$  50 cm) that was mounted on a wall next to the participants' reclining chair. Participants were randomly allocated to receive either the Fully-Formed suggestion ( $n = 26$ ) or the Factor 1 suggestion ( $n = 26$ ). Participants given the Fully-Formed suggestion were told:

You feel pleasantly and deeply hypnotised as you continue to listen to my voice. In a moment, I am going to ask you to open your eyes, and when you do, I would like you to lean forward and to look to your right. When you look to your right, there will be a mirror there, and you will see a person in it. The person you see in the mirror will not be you, it will be a stranger. When you open your eyes and turn your head to your right, whilst remaining as deeply relaxed and comfortably hypnotised as you feel now, you will see a stranger in the mirror.

Participants given the Factor 1 suggestion were told:

You feel pleasantly and deeply hypnotised as you continue to listen to my voice. In a moment, I am going to ask you to open your eyes, and when you do, I would like you to lean forward and to look to your right. When you look to your right, there will be a mirror there, and you will see a person in it. When you see this person in the mirror, you will not be able to recognise this person. When you open your eyes and turn your head to your right, whilst remaining as deeply relaxed and comfortably hypnotised as you feel now, you will see a face in the mirror that you will not be able to identify, as if you have never seen this face before.

To test the suggestion, the experimenter asked participants to open their eyes and look in the mirror. The experimenter asked participants who they saw in the mirror. If participants reported seeing someone other than themselves, the experimenter asked them if they had ever seen this person before and if there were any physical similarities or differences between themselves and this person. The experimenter also asked participants to explain what they saw (for more detail and verbatim wording, see [Connors & Barnier et al., 2012](#)).

<sup>1</sup> The 10-item modified HGSHS:A included: head falling, eye closure, hand lowering, finger lock, moving hands together, communication inhibition, experiencing of fly, eye catalepsy, posthypnotic suggestion, and posthypnotic amnesia; arm rigidity and arm immobilization items were removed to ensure that the procedure could be conducted within the time limits of a 1 h class. The 10-item tailored SHSS:C included: hand lowering, moving hands apart, mosquito hallucination, taste hallucination, arm rigidity, dream, age regression, arm immobilization, negative visual hallucination, and posthypnotic amnesia; anosmia and auditory hallucination items were removed to ensure that the procedure could be conducted within the time limits of a 1 h individual session.

If participants continued to report seeing a stranger, the experimenter challenged this belief (for more detail, see [Connors & Barnier et al., 2012](#)). In the first set of challenges, the appearance challenges, the experimenter asked participants how it was possible that they looked so similar to the person they saw and wore the same clothing. Next, the experimenter asked participants what a close friend or family member would say if they saw the stranger and how their friend or family member would be able to tell the stranger and them apart. In the second set of challenges, the behavioural challenges, the experimenter asked participants to touch their nose and then held a ball behind their shoulder so that it was only visible in the mirror and asked them to touch it. In the final set of challenges, the visual challenges, the experimenter moved position so that his reflection in the mirror was also visible to participants. The experimenter asked participants to identify who was in the mirror and then to identify who was in the room. The experimenter then gave participants a handheld mirror and asked participants to compare what they saw in the handheld mirror with what they saw in the mirror on the wall (this challenge was new and not used in [Connors & Barnier et al., 2012](#), or our previous work). Participants who said they saw themselves at any point during the challenges were administered the cancellation.

After the challenges, the experimenter cancelled the suggestion by telling participants they could see themselves in the mirror (see [Connors & Barnier et al., 2012](#)). In the hypnosis condition, the experimenter gave participants a standard hypnotic deinduction (based on [Weitzenhoffer & Hilgard, 1962](#)). In the wake condition, the experimenter asked participants to count aloud backwards from 20 to 1.

**2.1.2.2. Postexperimental inquiry.** The experimenter showed participants the recorded video of the experimental session on a TV screen and stopped the video at certain points to ask participants what they were experiencing at that time. This methodology was adapted from the Experiential Analysis Technique of [Sheehan and McConkey \(1982\)](#) and allowed a detailed examination of participants' experiences of the delusion. The experimenter asked participants what they experienced when they first looked at the mirror. The experimenter also asked participants to rate the extent to which they believed that there was a stranger in the mirror (1 = *not at all*, 7 = *completely*). If participants reported seeing a stranger, the experimenter showed them a replay of the challenges they received and asked about their experiences of each challenge. Finally, the experimenter debriefed participants and ended the session.

**2.1.2.3. Coding of responses.** The experimenter and a rater, who was blind to the aims of the experiment and the conditions in which participants were tested, independently examined the videotape records of the experimental session. The two raters scored whether participants experienced the delusion, whether participants reached for the mark on their cheek, and how participants described and interacted with the person in the mirror. If participants experienced the delusion, the raters also scored the point at which the delusion was breached. For all these variables, interrater reliability was 100%.

## 2.2. Results and discussion

### 2.2.1. Response to the suggestion

Participants were scored as passing the suggestion if they identified their reflection in the mirror as someone other than themselves. Overall, 15 (58%) participants in the hypnosis condition passed the suggestion, whereas only 7 (27%) participants in the wake condition passed the suggestion. In the hypnosis condition, 6 (46%) participants given the Fully-Formed suggestion and 9 (69%) participants given the Factor 1 suggestion experienced the delusion. In the wake condition, only 4 (31%) participants given the Fully-Formed suggestion and 3 (23%) participants given the Factor 1 suggestion experienced the delusion.

These findings show that more participants in the hypnosis condition passed the suggestion than in the wake condition and that the two suggestions were similarly effective. This was confirmed by a three-way loglinear analysis involving condition (hypnosis vs. wake), suggestion (Fully-Formed vs. Factor 1), and passing the suggestion (pass vs. fail). This produced a final model that retained only the two-way interaction between condition and passing the suggestion. The likelihood ratio of this model was  $\chi^2(4) = 1.63$ ,  $p = .804$ , showing that the model was a good fit to the data. The interaction between hypnosis condition and passing the suggestion was significant,  $\chi^2(1) = 5.14$ ,  $p = .023$ . Odds ratios indicated that participants were 3.7 times more likely to report seeing a stranger in the hypnosis condition than in the wake condition, 95% CI [1.2, 11.9], regardless of the suggestion they received. The findings were also confirmed by participants' ratings of belief in the postexperimental inquiry. A two-way ANOVA revealed that participants in the hypnosis condition ( $M = 3.58$ ,  $SD = 1.96$ ) believed more strongly that they were looking at a stranger than participants in the wake condition ( $M = 2.50$ ,  $SD = 1.77$ ),  $F(1, 48) = 4.17$ ,  $p = .047$ . There was no difference between suggestions,  $F(1, 48) = .34$ ,  $p = .562$ , and no interaction,  $F(1, 48) = .02$ ,  $p = .885$ . Consistent with previous research ([Connors et al., 2014](#)), posthoc analysis revealed that participants who passed the suggestion had higher hypnotisability scores as measured by the SHSS:C than participants who failed the suggestion,  $t(50) = 5.15$ ,  $p < .001$ , but did not differ on the HGSHS:A,  $t(50) = .99$ ,  $p = .329$ .

Participants' responses to the mark on their cheek corresponded to who they identified in the mirror. Of the participants who reported seeing a stranger, only 1 (5%) participant reached for the mark on their cheek when they first looked in the mirror. Nine (41%) participants in this group commented that there was a mark on the stranger's face. Participants, for example, said, "There is something wrong with their left cheek – like a smudge" and "The girl has a mark on her face." In contrast, of the participants who reported seeing themselves, 10 (33%) reached for the mark on their cheek. Seventeen (57%) participants in this group commented that there was a mark on their own face. Chi-square analysis revealed a significant



difference between these two groups in terms of reaching for the mark,  $\chi^2(1) = 6.31$ ,  $p = .012$ , but not in terms of observing the mark,  $\chi^2(1) = 1.26$ ,  $p = .262$ . During the challenges, two participants who breached the delusion also reached for the mark at the same time as when they reported seeing themselves. So, overall, although there was no difference in the likelihood of commenting on the mark, the nature of the comments was quite different between participants who passed and failed the suggestion: Participants who passed the suggestion described the mark as being on another person, whereas participants who failed the suggestion described the mark as being on themselves.

### 2.2.2. Qualitative features of the delusion

Participants who reported seeing a stranger in the mirror showed other evidence of a compelling experience. Participants made similar comments regardless of the condition they were in and the suggestion they received. Participants who reported seeing a stranger were asked if they had seen this person before. Of the 10 participants who passed the Fully-Formed suggestion, 4 (40%; 3 in hypnosis, 1 in wake) said they had seen this person before, 5 (50%; 3 in hypnosis, 2 in wake) said they had never seen the person before, and 1 (10%; 1 in wake) said they were unsure. The 12 participants who passed the Factor 1 suggestion showed a similar pattern of responses: 4 (33%; 3 in hypnosis, 1 in wake) said they had seen this person before, 6 (50%; 4 in hypnosis, 2 in wake) said they had never seen the person before, and 2 (17%; 2 in hypnosis) said they were unsure. Thus, regardless of how participants arrived at the delusion (in terms of induction and type of suggestion), if they passed the suggestion, their experiences were typically compelling.

Participants were asked how the person they saw looked similar and different to themselves. These questions breached the delusions of two participants who passed the Fully-Formed suggestion (1 in hypnosis, 1 in wake), so they did not receive any further questions or challenges. Of the 8 remaining participants who passed the Fully-Formed suggestion, all 8 (100%; 5 in hypnosis, 3 in wake) identified specific physical similarities and 6 (75%; 3 in hypnosis, 3 in wake) identified specific physical differences between themselves and the person in the mirror (other than the mark). The participants who identified differences made comments like, “We have different eyes,” “Their hair is longer,” and “Her hair colour is lighter and her face is longer.” Of the 12 participants who passed the Factor 1 suggestion, 10 (83%; 8 in hypnosis, 2 in wake) identified specific physical similarities and 6 (50%; 4 in hypnosis, 2 in wake) identified specific physical differences. These participants made comments like, “She looks older,” “Their whole face looks a little bit different,” and “It just doesn’t. I don’t know. It’s not me.” Four participants said that the person in the mirror resembled a relative of theirs and three said the stranger was trying to communicate with them.

Participants who reported seeing a stranger were asked to explain how this was possible. However, only one participant provided an explanation. This participant, who received the Fully-Formed suggestion with hypnosis, said, “Maybe it’s not real” but continued to report seeing a stranger. All other participants said they could not account for it. One participant, for example, who received the Fully-Formed suggestion without hypnosis, said, “Weird. . . I always thought mirrors reflected yourself, but I don’t know. . . There just seems to be something about this person that doesn’t seem to be me.” In the post-experimental inquiry, participants confirmed the difficulty they had in explaining their experience. One participant who received the Factor 1 suggestion with hypnosis, said, for example, “I couldn’t really think of anything. Even when you were asking me questions I felt I really couldn’t explain it. I was baffled.”

Participants’ comments in the postexperimental inquiry also indicate the compelling nature of the delusional experience. One participant, for example, given the Fully-Formed suggestion with hypnosis said, “I was like, ‘Is this right? I’m crazy.’ You’re supposed to see a mirror and find yourself in there but for some reason I saw this girl looking back at me. . . I was just thinking, how is this possible? I’m looking in a mirror and it’s supposed to be me looking back but it isn’t.” Participants who received the Factor 1 suggestion made similar comments about the perceived reality of their experience. One participant given the Factor 1 suggestion with hypnosis said, “I remember feeling a bit scared. . . all of a sudden there is this mysterious stranger who is wearing the same clothes as me. It was a bit freaky.” Another participant given the Factor 1 suggestion with hypnosis said, “I don’t know if you’ve ever had acid but it felt like that. . . I felt like my mind had been altered.”

### 2.2.3. Response to challenges

Table 1 shows the number of participants who maintained the delusion after each challenge according to the condition they were in and the suggestion they received. Consistent with previous research, if participants identified themselves in the mirror, they did not receive any further challenges. Chi square analysis indicated that there were no differences between the suggestions or conditions in response to the challenges.

Overall, 10 participants (50%; 3 given Fully-Formed, 7 given Factor 1) of the 20 participants who received the challenges maintained the delusion. All 10 participants given the behavioural challenges reached for the ball above their shoulder and so did not show signs of mirror agnosia (see Connors & Coltheart, 2011). Of these 10 participants, 6 (60%; 2 given Fully-Formed, 4 given Factor 1) identified the experimenter in the mirror during the visual challenges and 4 (40%; 1 given Fully-Formed, 3 given Factor 1) identified the experimenter as another stranger. Of the 10 participants who maintained the delusion, 7 (70%; 2 given Fully-Formed, 5 given Factor 1) identified themselves in the handheld mirror but not the mirror in the wall, whereas 3 (30%; 2 given Fully-Formed, 1 given Factor 1) said there was a stranger in both mirrors.

When interviewed in the postexperimental inquiry, many participants reported that they had continued to believe that they were looking at a stranger despite the challenges and that they had difficulty accounting for their experiences. A participant given the Fully-Formed suggestion with hypnosis, for example, said, “I was trying to answer you but I was having this conflict inside me about how to rationalise at first and give an answer where people wouldn’t think that I sound crazy.”

**Table 1**

The number of participants maintaining the delusion after each challenge in Experiment 1.

	Fully-Formed		Factor 1	
	Hypnosis	Wake	Hypnosis	Wake
Participants receiving the challenges	5	3	9	3
<i>Appearance challenges</i>				
Compare appearance to stranger	5 (100%)	3 (100%)	6 (67%)	3 (100%)
Explain to a friend what they can see	5 (100%)	3 (100%)	6 (67%)	3 (100%)
<i>Behavioural challenges</i>				
Touch their nose	5 (100%)	3 (100%)	6 (67%)	3 (100%)
Touch ball	3 (60%)	3 (100%)	5 (56%)	3 (100%)
<i>Visual challenges</i>				
Explain seeing hypnotist in the mirror	1 (20%)	2 (67%)	4 (44%)	3 (100%)
Compare hand-held mirror to mirror	1 (20%)	2 (67%)	4 (44%)	3 (100%)

Note. Percentages indicate the proportion of participants maintaining the delusion from the total number of participants who received the challenges in each condition.

Likewise, a participant given the Factor 1 suggestion with hypnosis said, “I was thinking that it seems like you were trying to tell me that we [the stranger and I] were the same, and I was thinking, ‘No, I didn’t know this person. I had never met her before,’ so it was a bit confusing at that time.” Another participant who received the Factor 1 suggestion with hypnosis said, “I was freaking out... I was trying to work out what was real and was not.”

After the cancellation, all participants reported seeing themselves in the mirror. No participants reported being distressed in the postexperimental inquiry or debriefing despite their reported reactions during the experimental session.

#### 2.2.4. Summary

Both the Fully-Formed and Factor 1 suggestions in the hypnosis condition were effective in generating a hypnotic analogue of mirrored-self misidentification. The two suggestions had similar pass rates and produced similar responses to questions and challenges. This confirms that the Factor 1 suggestion with hypnosis can be used to model the delusion. As in Connors and Barnier et al. (2012), significantly more participants in the hypnosis condition experienced the delusion than in the wake condition, regardless of suggestion, indicating that hypnosis can act as Factor 2 in this analogue. However, the small number of participants who experienced the delusion in the wake condition also showed remarkable persistence in their delusion despite the challenges. This indicates that a small proportion of high hypnotisable participants can experience the delusion without a formal hypnotic induction.

### 3. Experiment 2

To establish that we can model mirrored-self misidentification using the Factor 1 suggestion for impaired face processing and hypnosis as Factor 2, we need to rule out alternative explanations for participants’ responses (see Kihlstrom, 2002). This includes the possibility that participants are merely faking their responses or role playing in response to social cues. In Experiment 2, we used the real-simulating paradigm (Orne, 1959, 1971) to investigate the extent to which the demand characteristics of the test setting may have influenced participants. This paradigm compares the performance of high hypnotisable, hypnotised individuals (reals) with that of low hypnotisable, nonhypnotised individuals who are instructed to fake hypnosis (simulators). If reals and simulators respond similarly, we cannot rule out an explanation of the behaviour of reals in terms of demand characteristics alone. If reals and simulators respond differently, it is likely that factors other than demand characteristics, as indexed by the behaviour of simulators, are involved in the behaviour of reals (Sheehan & Perry, 1976). Research using this paradigm, for example, has found that whereas both reals and simulators given a suggestion for a sex-change delusion reported having the delusion, the two groups differed in their behavioural and verbal responses to challenges (Noble & McConkey, 1995). In particular, reals were more likely to maintain their sex-change delusion when shown a live video of themselves than simulators.

#### 3.1. Method

##### 3.1.1. Design and participants

Fourteen real, high hypnotisable participants (12 female and 2 male) of mean age 21.93 years ( $SD = 3.56$ ) and 14 simulating, low hypnotisable participants (8 female and 6 male) of mean age 19.86 years ( $SD = 1.56$ ) participated in the experiment. The design was a 2 (condition: real vs. simulating) between-subjects design. Participants were undergraduate psychology students at Macquarie University, who received payment for their participation (\$30 for 2 h). Participants were screened using the same procedures and exclusion criteria as Experiment 1.<sup>2</sup> Reals scored in the range 7–10 ( $M = 7.50$ ,

<sup>2</sup> An 11-item tailored SHSS:C was used to screen participants instead of the 10-item version that was used in Experiment 1. The 11-item version included the additional item of anosmia.

$SD = 0.76$ ) on the HGSHS:A and 7–11 ( $M = 8.64$ ,  $SD = 1.45$ ) on the SHSS:C. Simulators scored in the range 0–3 ( $M = 2.00$ ,  $SD = 1.04$ ) on the HGSHS:A and 0–3 ( $M = 1.71$ ,  $SD = 1.14$ ) on the SHSS:C.

### 3.1.2. Materials and procedure

The experiment used the same materials and procedures as Experiment 1 with the following three exceptions. First, only the Factor 1 suggestion was given and only in hypnosis as this condition was most critical to the hypnotic analogue. Second, the mark test was not used due to time constraints of the testing session that prevented the cover story and marking procedure being used. Third, the experiment used the real-simulating paradigm. This involved two experimenters: experimenter 1 and a hypnotist, who was blind to the real or simulating status of the participants. Experimenter 1 met participants and introduced the experiment. Experimenter 1 gave participants different instructions depending on their real or simulating status. Experimenter 1 told reals that their performance in the previous hypnosis sessions had been excellent and that a second experimenter (the hypnotist) would conduct the hypnosis session with them. In contrast, experimenter 1 told simulators that their task was to convince the hypnotist that they were deeply hypnotised. Experimenter 1 said that they could do this by using whatever they knew about hypnosis, whatever cues they got from the hypnotist, and whatever they learned from the situation to work out how a deeply hypnotised person would behave. Experimenter 1 also told simulators that the hypnotist would stop the experiment if he detected they were simulating and to keep simulating until experimenter 1 returned (see Orne, 1959, 1971, for more details and verbatim wording).

Experimenter 1 then called the hypnotist, who conducted the experimental testing. The hypnotist first rated whether he thought the participant was real or simulating. He then gave participants a hypnotic induction, the Factor 1 suggestion, and the series of challenges if participants reported seeing a stranger in the mirror. After the cancellation and deinduction, the hypnotist conducted a brief posthypnotic inquiry in which he asked participants to rate the extent to which they believed there was a stranger in the mirror (1 = *not at all*, 7 = *completely*). The hypnotist then rated again whether he thought the participant was real or simulating. Finally, the hypnotist called experimenter 1, who returned to conduct a detailed postexperimental inquiry as in Experiment 1. As in Experiment 1, the video of both the experimental session and postexperimental inquiry were examined by two independent raters (one of whom was blind to the experiment's aims and conditions). Inter-rater reliability was again 100%.

## 3.2. Results and discussion

### 3.2.1. Implementation of the real-simulating design

Two findings indicate that the real-simulating paradigm was implemented successfully. First, the hypnotist could not reliably detect who was simulating. At the beginning of the session, the hypnotist correctly identified 5 (36%) reals and 10 (71%) simulators; at the end of the session, the hypnotist correctly identified 6 (43%) reals and 4 (29%) simulators. There was no significant difference in the number of reals and simulators the hypnotist identified at either the beginning of the session,  $\chi^2(1) = 3.59$ ,  $p = .058$ , or at the end,  $\chi^2(1) = .62$ ,  $p = .430$ . Second, in the postexperimental inquiry, no simulators reported having experienced hypnosis and all indicated that they had faked the suggested effects.

### 3.2.2. Response to suggestion

Overall, 8 (57%) reals and 14 (100%) simulators passed the suggestion. Chi-square analysis indicated that significantly more simulators passed the suggestion than reals,  $\chi^2(1) = 7.64$ ,  $p = .006$ . This is consistent with previous research that has shown that simulators tend to overplay their responses (see Sheehan & Perry, 1976).

Reals and simulators gave similar responses when asked if they had seen the person in the mirror before. Of the 8 reals who passed the suggestion, 5 (63%) said they had never seen the person before, 2 (25%) said that they had seen the person before, and 1 (13%) said that they were unsure. Of the 14 simulators who passed the suggestion, 9 (64%) said they had never seen the person before, 3 (21%) said that they had seen the person before, and 2 (14%) said that they were unsure. Reals and simulators also gave similar responses when asked to describe the person in the mirror. Of the 8 reals, 7 (88%) identified specific physical similarities and 5 (71%) identified specific physical differences between themselves and the person in the mirror. Of the 14 simulators, 12 (86%) identified physical similarities and 9 (64%) identified physical differences. When asked to describe differences, reals made comments like, "I've got short hair," "They're smaller than me," and "Different face shape." Simulators made similar comments: for example, "He's got wider jaw and bigger ears," "They've got different hair," and "They've got a big nose."

Reals and simulators, however, gave different responses when asked to explain the stranger. Consistent with Experiment 1 and Connors and Barnier et al. (2012), no (0%) reals provided an explanation. In contrast, 10 (71%) simulators provided an explanation. Reals made comments such as, "I don't know" and "I don't know how to explain it." Simulators offered explanations like, "It's a window," "It's another room there," and "Camera tricks." In the postexperimental inquiry, reals confirmed that they had been unsure how to explain their experience. One real said, for example, "I didn't know why I was seeing this person. All I knew was that they were there."

Reals and simulators also behaved differently in front of the mirror. Reals who passed the suggestion tended to stare into the mirror and made few movements. No reals touched the mirror or moved their hands unless instructed. In contrast, simulators tended to move about of their own accord. Five simulators (36%) touched the mirror and three (21%) waved their hands in front of the mirror as if trying to work out what it was. Again, simulators tended to overplay their responses.



### 3.2.3. Response to the challenges

Participants' responses to the challenges are shown in Table 2. Reals and simulators showed somewhat different responses to the challenges overall. Reals seemed particularly sensitive to the visual challenge where the hypnotist appeared in the mirror. No reals maintained the delusion after this challenge. In contrast, the number of simulators maintaining the delusion decreased gradually over all the challenges and was not particularly affected by this challenge.

In the postexperimental inquiry, reals made comments about their experiences of the challenges. One real said, "I could see similarities to myself. It just didn't seem like me." Another real said, "I was dead-set certain that this person was just imitating everything I was doing. I thought it was funny." In contrast, simulators described how they worked hard to convincingly fake their responses. For example, one simulator said, "I was just thinking how am I going to fudge this one because all I could see in the mirror was myself." Another simulator said, "I was just giving really vague descriptions. But obviously it was me... I didn't want to say too much in case he caught on."

### 3.2.4. Posthypnotic and postexperimental inquiries

All reals and simulators rated their belief that they had seen a stranger in the mirror in the posthypnotic inquiry (to the hypnotist) and the postexperimental inquiry (to experimenter 1 after simulators had stopped simulating). A 2 (condition: real vs. simulating)  $\times$  2 (rating occasion: posthypnotic vs. postexperimental) mixed ANOVA found a significant interaction between condition and rating occasion,  $F(1,26) = 56.92, p < .001$ . Planned contrasts showed that reals' ratings of belief did not differ between the postexperimental inquiry ( $M = 3.43, SD = 2.62$ ) and the posthypnotic inquiry ( $M = 3.79, SD = 2.49$ ),  $t(13) = 1.44, p = .174$ . In contrast, simulators' ratings of belief were significantly lower in the postexperimental inquiry ( $M = 1.00, SD = .00$ ) than in the posthypnotic inquiry ( $M = 5.21, SD = 1.67$ ),  $t(13) = 9.43, p < .001$ . This is consistent with the view that whereas reals had a genuine experience, simulators faked their responses for the hypnotist.

Comments during the postexperimental inquiry also highlight the different subjective experiences of reals and simulators. Reals who passed the suggestion indicated the compelling nature of their experience. One real, for example, said: "It looked as if there was someone else in the mirror... It was very surreal. It really did feel like someone else." Another real said, "When I looked in the mirror... I felt as if I might know them, but I wasn't sure if I did or not... It was really weird." In addition, four of the seven (57%) reals who failed the suggestion reported a delay in recognising themselves in the mirror. These participants made comments like, "I actually didn't recognise myself for a couple of seconds, then I realised it was me" and "I knew it was me but it felt unfamiliar." In contrast, simulators indicated that they had been faking their responses. Simulators, for example, made comments like, "I saw myself. I just pretended that I was seeing someone else" and "I saw myself but I tried to make it look like I was looking at a stranger." Simulators also reported a number of strategies that they had used to deceive the hypnotist. Simulators, for example, said, "I just described general characteristics, but nothing specific," "I just tried to look like I'm half-dazed," and "I was trying not to blink... Blinking makes you look more awake."

### 3.2.5. Summary

Consistent with the paradigm, some reals reported a compelling experience, whereas simulators reported faking their responses. Simulators, however, tended to overplay their responses. More simulators passed the suggestion than reals, and more simulators made physical movements in front of the mirror than reals. There were other subtle differences between reals and simulators. First, whereas reals did not provide reasons for their experience, simulators did. Second, reals and simulators seemed to show an overall different pattern of response to the visual challenges whereby reals tended to breach the delusion suddenly and simulators tended to either maintain the delusion or breach the delusion more gradually over the course of all the challenges. Overall, these findings suggest that the responses of reals cannot solely be attributed to demand characteristics.

**Table 2**  
The number of participants maintaining the delusion after each challenge in Experiment 2.

	Real	Simulator
Participants receiving the challenges	7	14
<i>Appearance challenges</i>		
Compare appearance and clothes to stranger	6 (86%)	11 (79%)
Explain to a friend what they can see	6 (86%)	11 (79%)
<i>Behavioural challenges</i>		
Touch their nose	5 (71%)	9 (64%)
Touch ball	4 (57%)	8 (57%)
<i>Visual challenges</i>		
Explain seeing hypnotist in the mirror	0 (0%)	5 (36%)
Compare hand-held mirror to mirror	0 (0%)	3 (21%)

Note. Percentages indicate the proportion of participants maintaining the delusion from the total number of participants who received the challenges in each condition.

## 4. General discussion

In Experiment 1, the Factor 1 suggestion was as effective as the Fully-Formed suggestion in generating a hypnotic analogue of mirrored-self misidentification. The two suggestions had similar pass rates and produced similar responses to questions and challenges despite providing different amounts of information about the delusion to participants. In addition, significantly more participants in the hypnosis condition experienced the delusion than in the wake condition. In Experiment 2, the differences between reals and simulators imply that we can rule out an alternative explanation for participants' behaviour, namely that participants were merely acting or faking their responses to comply with the hypnotist. Overall, this indicates that a Factor 1 suggestion based on the delusion's hypothesised underlying processes (in this case, impaired face recognition) can produce a compelling analogue of mirrored-self misidentification in some hypnotised participants.

### 4.1. Recreating the surface features

Our analogue met the criteria we specified for a successful analogue. We were able to recreate the core features of mirrored-self misidentification in some participants. The majority of high hypnotisable participants in Experiments 1 and 2 given the Factor 1 suggestion in hypnosis identified their reflection as someone other than themselves and a proportion of these participants maintained this belief despite the challenges. Consistent with the delusion, the participants in Experiment 1 who reported seeing a stranger also tended to fail the mark test and instead attributed the mark on their cheek to the stranger. In addition, like patients whose delusion resulted from impaired face processing, participants also showed an intact procedural understanding of mirrors during the challenges yet continued to report that their reflection in the mirror was a stranger (Breen et al., 2001). Finally, our analogue modelled aspects of the delusion's resistance to challenge. In Experiment 1, around 45% of participants who reported seeing a stranger in the mirror continued to maintain this belief through all the challenge procedures. The persistent challenging used in this experiment is unusual in hypnosis research and was based on procedures Breen et al. used with their clinical patients. The fact that some participants maintained the delusion in the face of these challenges indicates how compelling the hypnotic delusion can be.

Interestingly, the analogue also generated the heterogeneity and idiosyncratic responses typically seen in clinical patients. Participants, like clinical patients, varied in terms of how similar they thought the stranger was to themselves (see Breen et al., 2001; Spangenberg et al., 1998), whether or not they passed the mark test (Biringer & Anderson, 1992), whether or not they recognised the experimenter in the mirror (see Breen et al., 2001), and whether or not they could identify their own reflection in a small handheld mirror (see Kumakura, 1982; Spangenberg et al., 1998). In addition, four participants reported that the person in the mirror resembled a relative of theirs (like a patient reported by Villarejo et al., 2011) and three participants said the stranger was trying to communicate with them (like a patient reported by Breen et al., 2001). These similarities indicate that hypnosis may be able to model subtle features of the delusion. However, the cause of this variability, in both the clinical and hypnotic delusions, is not immediately clear. Future research could examine whether shared mechanisms, such as pre-existing individual differences, could account for the variability in both clinical and hypnotic delusions (see Connors et al., 2014).

### 4.2. Recreating the delusion from components

We were able to model the delusion from its hypothesised two-factor components. We showed that hypnotic suggestion can generate the content of the delusion and act as Factor 1. Our findings were consistent with those of Connors and Barnier et al. (2012) in showing that the Factor 1 suggestion with hypnosis as Factor 2 is effective in recreating the delusion. We found that there was little difference in success between this suggestion and the Fully-Formed suggestion in recreating the delusion. This is notable because the Factor 1 suggestion is less explicit than the Fully-Formed suggestion as it does not directly specify seeing a stranger. In particular, these findings show that we can model the delusion by attempting to simulate its putative underlying deficits, without needing to specify the experience directly.

We also showed that the hypnotic context can act as Factor 2 in the analogue (see Connors & Barnier et al., 2012). We found that significantly more participants in the hypnosis condition experienced the delusion than in the wake condition. In the current experiment, we found that hypnosis was also necessary for the Fully-Formed suggestion. This indicates that hypnosis may serve two roles when modelling the delusion from its components: Hypnosis is necessary for participants to experience the specific suggestion (i.e., generate Factor 1) but may also serve to disrupt belief evaluation more generally (Factor 2). The difference between the hypnosis and wake conditions is also consistent with other research that demonstrates a hypnotic induction enhances participants' response to delusion suggestions (Cox & Barnier, 2009; McConkey et al., 2001). The difference is also consistent with previous research which has found that a hypnotic induction reduces the ability of highs to distinguish between suggested and real events (Bryant & Mallard, 2003), alters cognitive processing (Crawford & Allen, 1983), and affects brain areas involved in attention, absorption, and critical thinking (Oakley, 2008; for further discussion about the role of a hypnotic induction in hypnosis, see Polito, Barnier, & McConkey, in press).

Although the majority of participants required both a suggestion and a hypnotic induction to experience the delusion, a small number of participants developed the delusion without a formal induction. This raises important questions about the two-factor framework that we have adopted in these experiments because these participants developed the delusion

without Factor 2. One possible explanation is that the participants interpreted the context to be hypnotic and so experienced some hypnotic effects (Nash, 2005). Previous research has shown, for example, that highs can respond often very similarly to suggestions outside of a formally-defined hypnotic context as within one (Kirsch & Braffman, 2001). An alternative explanation is that some individuals may not require any disruption to their ordinary belief evaluation to develop a delusion. Previous research has shown that people in general often make errors in reasoning (Gilovich, 1991). It is thus possible that pre-existing differences in belief evaluation could act as Factor 2 and predispose certain individuals to delusions without the need for an acquired deficit. This is an important issue for future research in both clinical patients and hypnotic models.

Finally, we showed that the hypnotic delusion was unlikely to be explained in terms of faking or role playing. The differences between reals and simulators, however, were subtle and warrant discussion. One important difference was that reals did not provide an explanation for seeing a stranger, whereas simulators did. Despite failing to provide an explanation, reals attributed their experience to external reality and reported actually believing there was a stranger. Reals, for example, did not attempt to explain their experience in terms of the suggestion given to them, which would have indicated insight into the cause of their experience and so an alteration in perception without any delusional belief. Instead, reals responded in a similar way to clinical patients and treated their reflection as another person. Indeed, some clinical patients also fail to offer explanations for seeing a stranger in the mirror (Breen et al., 2001), so the hypnotic model is consistent with this feature. It is also consistent with predictions of the “cold-control” theory of hypnosis, which posits that hypnosis is characterised by the absence of higher order thoughts (Barnier, Dienes, & Mitchell, 2008). The tendency for hypnotised participants to interpret the stranger as physically real illustrates how hypnotically-suggested experience can approach “virtual reality” for many high hypnotisable participants (Bryant & Mallard, 2003; McConkey, 2008; Noble & McConkey, 1995; Woody & Szechtman, 2011).

Another difference between reals and simulators was in their response to challenges. For reals, the visual challenge where the experimenter appeared in the mirror was particularly effective in breaching the delusion. The effectiveness of this challenge with hypnotised participants is consistent with Barnier et al. (2011), who also found this challenge to be particularly effective. However, the fact that we did not find clear differences between challenges in Experiment 1 and in Connors and Barnier et al. (2012) implies that the relative effectiveness of individual challenges on hypnotised participants may not be clear-cut and might depend on the order and context in which they are presented.

The overall responses of reals and simulators are consistent with other research that has shown that simulators tend to overplay their responses (Sheehan & Perry, 1976) and respond differently to reals when challenged (Noble & McConkey, 1995). Nevertheless, despite using the Factor 1 suggestion, which did not directly specify seeing a stranger, simulators were still able to arrive at the delusion. This indicates that the overall task requirements were clear to participants and illustrates a dilemma when using hypnosis to model a clinical condition. To model a condition, one needs to specify the desired experience clearly, but in so doing, one also increases the experimental demands. Hypnosis is a top-down process and the suggestion needs to make sense to participants for them to be able to experience the desired effects. Whereas reals use this information and translate it into a compelling experience, simulators use the information to fake their responses (see Oakley & Halligan, 2009). Although similar outward responses may result, subtle differences may also emerge, such as those found in the current experiment, due to the different phenomenal experiences of reals and simulators and the different processes involved.

### 4.3. Implications

It is important to note the cognitive approach we have taken here to studying delusions. Although hypnotic and clinical mirrored-self misidentification have different aetiologies (hypnotic suggestion vs. organic brain damage) and occur in different contexts and with different durations (hypnosis laboratory vs. everyday life), Langdon and Coltheart's (2000) two-factor approach predicts that the two types of delusions should have similar features because both involve disruptions at a cognitive level. This does not imply that hypnotic suggestion recreates the organic pathology but instead suggests that it produces similar phenomenal experiences and behaviours, which make it useful as a laboratory model (Oakley & Halligan, 2009, 2013; Woody & Szechtman, 2011). The possibility of closer neural resemblance should not be rejected, however, and it is interesting to note that hypnotic analogues of conversion disorder, pain, achromatopsia, and auditory hallucination show very similar patterns of brain activation to the actual clinical disorders (for reviews, see Oakley & Halligan, 2009, 2013). Ultimately, though, the model's ability to achieve an exact likeness of the delusion may be less important than its usefulness for testing hypotheses and generating new ideas for research (Woody & Szechtman, 2011).

These two experiments demonstrate that we can use hypnosis and a hypnotic suggestion for impaired face processing to create a compelling analogue of mirrored-self misidentification in the laboratory. Not all participants responded equally to the suggestion, however, and an important direction for future research is to examine the source of this variability (see Connors et al., 2014). Future research could also examine the specific nature of the face processing impairment responsible for some cases of mirrored-self misidentification by using suggestions to model different types of deficits and using formal neuropsychological tests. Some theorists, for example, have argued that the content of mirrored-self misidentification – when it is due to impaired face processing – is caused by a deficit in self-face recognition (Phillips et al., 1996), while others have proposed that it is caused by a general deficit in updating stored representations of faces (Breen et al., 2001; Langdon, 2011). Hypnotic models could be used to compare these two accounts. Other research we have conducted has shown that we can also use a suggestion for mirror agnosia, the alternative Factor 1 responsible for mirrored-self misidentification, in

combination with hypnosis as Factor 2 to produce an analogue of the delusion (Connors, Cox, Barnier, Langdon, & Coltheart, 2012; Connors, Barnier, et al., in press). Future research could use a similar approach to model other types of clinical delusions and test different accounts of their hypothesised contributory factors.

In addition to its value in studying delusions, this use of hypnosis and suggestion has direct relevance to studying other aspects of consciousness. There is evidence, for example, that self-recognition in mirrors and photographs is dissociable (Butler, Mattingley, Cunnington, & Suddendorf, 2012). Indeed, some patients with mirrored-self misidentification continue to recognise themselves in photographs (Breen et al., 2001; Connors & Coltheart, 2011; Phillips et al., 1996). Future research could test whether hypnotic disruptions in self-recognition extend across different visual media and examine how specific cues, such as parts of participants' body and the environment, contribute to self-recognition. Likewise, some theorists have argued that self-recognition provides evidence for a sense of self (for a discussion, see Suddendorf & Butler, 2013). Future research could use hypnotic suggestion to independently disrupt self-recognition and self-awareness to examine their inter-relationship. Finally, given recent attention towards identifying the neural correlates of self-recognition (Devue & Brédart, 2011) and the sense of self (Northoff, Qin, & Feinberg, 2011), future research could investigate the neural impact of hypnotic suggestions designed to disrupt these processes. In these ways, hypnosis could be used as a tool to investigate broader questions relating to consciousness, selfhood, and identity.

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