



Cognitive Neuropsychiatry

Publication details, including instructions for authors and subscription information:

<http://www.tandfonline.com/loi/pcnp20>

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Michael H. Connors^a, Rochelle E. Cox^a, Amanda J. Barnier^a,
Robyn Langdon^a & Max Coltheart^a

^a ARC Centre of Excellence in Cognition and its Disorders,
Macquarie Centre for Cognitive Science, Macquarie University,
Sydney, Australia

Version of record first published: 08 Sep 2011

To cite this article: Michael H. Connors, Rochelle E. Cox, Amanda J. Barnier, Robyn Langdon & Max Coltheart (2012): Mirror agnosia and the mirrored-self misidentification delusion: A hypnotic analogue, *Cognitive Neuropsychiatry*, 17:3, 197-226

To link to this article: <http://dx.doi.org/10.1080/13546805.2011.582770>

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Mirror agnosia and the mirrored-self misidentification delusion: A hypnotic analogue

Michael H. Connors, Rochelle E. Cox, Amanda J. Barnier, Robyn Langdon, and Max Coltheart

ARC Centre of Excellence in Cognition and its Disorders, Macquarie Centre for Cognitive Science, Macquarie University, Sydney, Australia

Introduction. Mirrored-self misidentification is the delusional belief that one's reflection in the mirror is a stranger. Current theories suggest that one pathway to the delusion is mirror agnosia (a deficit in which patients are unable to use mirror knowledge when interacting with mirrors). This study examined whether a hypnotic suggestion for mirror agnosia can recreate features of the delusion.

Method. Ten high hypnotisable participants were given either a suggestion to not understand mirrors or to see the mirror as a window. Participants were asked to look into a mirror and describe what they saw. Participants were tested on their understanding of mirrors and received a series of challenges. Participants then received a detailed postexperimental inquiry.

Results. Three of five participants given the suggestion to not understand mirrors reported seeing a stranger and maintained this belief when challenged. These participants also showed signs of mirror agnosia. No participants given the suggestion to see a window reported seeing a stranger.

Conclusion. Results indicate that a hypnotic suggestion for mirror agnosia can be used to recreate the mirrored-self misidentification delusion. Factors influencing the effectiveness of hypnotic analogues of psychopathology, such as participants' expectations and interpretations, are discussed.

Keywords: Delusion; Hypnosis; Instrumental hypnosis; Mirror agnosia; Mirror sign; Mirrored-self misidentification.

Correspondence should be addressed to Michael H. Connors, ARC Centre of Excellence in Cognition and its Disorders, Macquarie Centre for Cognitive Science, Macquarie University, Sydney, NSW 2109, Australia. E-mail: michael.connors@mq.edu.au

We are grateful to Peter Halligan, Irving Kirsch, and an anonymous reviewer for helpful comments on an earlier version of this paper, and to Vince Polito and Alena Rahmanovic for their assistance in conducting the research.

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<http://www.psypress.com/cogneuropsychiatry> <http://dx.doi.org/10.1080/13546805.2011.582770>

INTRODUCTION

Patients with the mirrored-self misidentification delusion believe that their reflection in the mirror is a stranger (Breen, Caine, & Coltheart, 2001). These patients may treat their reflection as a companion (e.g., Phillips, Howard, & David, 1996), act indifferently towards it (e.g., Breen et al., 2001), or become suspicious and paranoid about “the stranger” (e.g., Cummings, 1985; Mendez, 1992). Many patients cover up all mirrors to avoid seeing the stranger and some even throw objects at their reflection (Gluckman, 1968). The delusion can occur despite an intact semantic knowledge of mirrors (e.g., being able to define their properties and function; Breen et al., 2001). In addition, some patients continue to be able to accurately recognise other people’s reflections in the mirror (e.g., Breen et al., 2001; Feinberg & Shapiro, 1989; Mendez, 1992; Spangenberg, Wagner, & Bachman, 1998). The delusion usually occurs in the presence of advanced global dementia, though it can appear before other symptoms of dementia are evident (Breen et al., 2001; see also Foley & Breslau, 1982; Förstl et al., 1994; Mendez, Martin, Smyth, & Whitehouse, 1992). Epidemiological studies have found that between 2% and 10% of patients suffering from Alzheimer’s disease misidentify their own reflection in the mirror (Burns, Jacoby, & Levy, 1990; Deutsch, Bylsma, Rovner, Steele, & Folstein, 1991; Förstl, Burns, Jacoby, & Levy, 1991; Hyodo et al., 2005; Mendez et al., 1992; Rubin, Drevets, & Burke, 1988). The delusion has also been reported in patients with schizophrenia (Gluckman, 1968) and after right frontal ischemic stroke (Villarejo et al., 2011).

Theories of the delusion

The delusion can occur without any other unusual beliefs and is an example of a monothematic delusion, a delusion confined to a single topic. An influential theory of monothematic delusions is the two-factor account proposed by Langdon and Coltheart (2000; see also Coltheart, 2007; Coltheart, Langdon, & McKay, 2011; Davies, Coltheart, Langdon, & Breen, 2001; McKay, Langdon, & Coltheart, 2005). According to this theory, two factors are jointly responsible for a delusional belief. The first factor (Factor 1) generates the delusion’s content and typically involves a neuropsychological anomaly affecting perceptual and/or emotional processing. In the case of mirrored-self misidentification delusion, Factor 1 can be either mirror agnosia (an inability to use mirror knowledge when interacting with mirrors) or a deficit in face processing (which leads to a difficulty in recognising one’s own face in the mirror). Both of these deficits can lead a patient to develop the hypothesis that there is a stranger in the mirror. These two deficits were identified by Breen et al. (2001) in their study of two delusional patients: One

patient, TH, had mirror agnosia and the other patient, FE, had a deficit in face processing. However, a second factor (Factor 2) is necessary to account for why the delusional hypothesis is accepted as belief because not all patients with Factor 1 deficits are delusional (see Connors & Coltheart, 2011, and Ellis & Florence, 1990, for a description of patients with mirror agnosia and deficits in face processing without the delusion). This second factor is thought to involve a deficit in belief evaluation. Thus, patients with both Factor 1 (either mirror agnosia or a deficit in face processing) and Factor 2 (a deficit in belief evaluation) will develop the delusion.

This paper focuses on the mirror agnosia pathway to the mirrored-self misidentification delusion. Patients with mirror agnosia are unable to distinguish between real and reflected space, and so perceive objects reflected in the mirror as located in or behind the mirror (Ajuriaguerra, Strejilevitch, & Tissot, 1963; Binkofski, Buccino, Dohle, Seitz, & Freund, 1999; Connors & Coltheart, 2011). In one test, for example, patients with mirror agnosia sit facing a mirror and an object is held up behind one of their shoulders so that they can only see the object by its reflection in the mirror. When asked to touch the object, patients reach toward the mirror, scratching on its surface or reaching behind it in an attempt to grasp the object. They typically repeat this behaviour over many trials and remain unable to correct this tendency (Binkofski et al., 1999). Although some patients can still verbally define what mirrors are and recognise that they are looking at a mirror, they continue to interact with mirrors as if they were windows (Ajuriaguerra et al., 1963).

Breen et al. (2001; see also Breen, Caine, Coltheart, Hendy, & Roberts, 2000) described the case of TH, a 77-year-old man with mirrored-self misidentification where mirror agnosia was the likely Factor 1. TH demonstrated mirror agnosia: When an object was held over his shoulder so that it was only visible to him by its reflection in the mirror, he repeatedly reached into the mirror and scratched on its surface in an attempt to grasp the object. Although he was able to verbally define mirrors, he was not able to use this semantic knowledge when interacting with them. Below is a transcript of TH as he described a stranger in the mirror with the same first name as him (Tom; see Breen et al., 2000, p. 89):

Examiner: When you look in here [*indicating to the mirror*] tell me what you see?

TH: I can see your reflection and I can see Tom's reflection.

Examiner: Tom who?

TH: I don't know his second name. He's been unable to tell me what his second name is apparently.

Examiner: Is that because he doesn't talk to you?

TH: He doesn't talk to anyone.

Examiner: Doesn't he?

TH: [*Addressing his own reflection*] Is that right? Do you talk to anyone? Can

you talk? Can you talk or have you got trouble talking or you didn't learn to talk, you weren't taught? I don't know.

Breen et al. (2001) suggested that TH might have referred to "Tom's reflection" because he had received extensive coaching about mirrors from his family, who repeatedly told him that he was looking at a reflection when he looked into a mirror. Breen et al. (2001) also gave TH a series of challenges to test the resilience of his belief. For example, they asked TH to touch his nose while he looked in the mirror. TH reported that the stranger copied him and that the stranger usually did what he did. In another challenge, the examiner stood next to TH so that her reflection was also visible. TH indicated that he believed the experimenter's reflection was the experimenter's friend who arrived at the testing session with her.

Using hypnosis to recreate delusions

Delusions can be difficult to study because they frequently cooccur with other symptoms and impairments. Mirrored-self misidentification is particularly difficult to study because of the global and extensive cognitive deterioration associated with dementia, the condition in which it is most frequently seen. The instrumental use of hypnosis, however, provides an additional means of studying the delusion. Hypnosis temporarily alters people's perceptual and cognitive experiences (Kihlstrom, 1985; Nash & Barnier, 2008) and these features can be used to create a laboratory model of the disorder in otherwise healthy participants (Kihlstrom, 1979). According to Oakley and Halligan (2009), such an approach creates "virtual patients" (p. 266), temporary analogues of clinical conditions that researchers can study to better understand the conditions themselves. This approach allows researchers to isolate and manipulate clinically relevant factors in the hypnotic model and examine their impact on the model under controlled conditions. For this reason, hypnosis has been used to model many different clinical disorders (for reviews, see Barnier & Oakley, 2009; Oakley, 2006; Oakley & Halligan, 2009).

As we have discussed elsewhere (Connors, Barnier, Coltheart, Cox, Langdon, 2011), hypnosis is particularly suited to modelling delusions for two reasons. First, delusions and hypnosis share many features (Cox & Barnier, 2010; Sutcliffe, 1961). Both, for example, are characterised by distorted beliefs about reality and both involve alterations in cognitive processing (Kihlstrom & Hoyt, 1988; Noble & McConkey, 1995). Second, the two-factor theory of delusions is a general cognitive model (Coltheart, 2007). According to this view, any type of disruptions to the cognitive

processes underlying belief generation (Factor 1) and belief evaluation (Factor 2) should generate a delusional belief. Hypnosis can produce such disruptions. Specific hypnotic suggestions can generate anomalous experiences (similar to Factor 1), while hypnosis itself can disturb the normal evaluation of these experiences (similar to Factor 2; Connors et al., 2011).

Given this suitability, Barnier, Cox, et al. (2008) used hypnosis to recreate the mirrored-self misidentification delusion. They gave 12 high hypnotisable participants a hypnotic induction and one of three versions of a hypnotic suggestion to experience the delusion. These suggestions were: (1) to see a stranger in the mirror, (2) to see the mirror as a window, or (3) to see the mirror as a window with a view of a stranger on the other side. In response to the suggestion to see a stranger in the mirror, many participants reported seeing a stranger when they looked in the mirror, confabulated specific physical differences between themselves and the “strangers”, and maintained their stranger belief when challenged. This study was replicated by Barnier, Cox, Connors, Langdon, and Coltheart (2011), using a larger sample of 38 participants, a more extensive series of challenges, and the most effective suggestion from the Barnier, Cox, et al. (2008) study, the suggestion to see a stranger in the mirror. Barnier et al. (2011) found that 68% of high hypnotisable participants given this suggestion experienced the delusion and that for many participants the delusion was resistant to challenge. Overall, participants displayed features that were strikingly similar to the clinical condition (see also Bortolotti, Cox, & Barnier, 2011, for a discussion).

Connors et al. (2011) followed up this latter study by attempting to recreate the delusion from its Factor 1 and Factor 2 components. They focused on impaired face processing as Factor 1 and gave separate hypnotic suggestions for impaired face processing (Factor 1) and impaired belief evaluation (Factor 2) without specifically mentioning a stranger. The Factor 1 suggestion was: “You will see a face in the mirror that you will not be able to identify.” The Factor 2 suggestion was: “You will search for explanations to account for it. Any explanation you come up with will seem plausible.” This particular Factor 2 suggestion was informed by a model of the second factor that proposes delusional patients have difficulty checking the plausibility of unusual candidate-beliefs (Turner & Coltheart, 2010). Half of the participants received the Factor 1 suggestion on its own and half received both the Factor 1 and Factor 2 suggestions. To evaluate if the hypnotic state—itsself known to disrupt belief evaluation (e.g., Bryant & Mallard, 2005)—might act as a Factor 2, they also compared participants given the Factor 1 suggestion during hypnosis and other participants who received the Factor 1 suggestion outside hypnosis (in a wake control). Connors et al. found that the Factor 1 suggestion with hypnosis was sufficient to generate the delusion without the additional Factor 2 suggestion and 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 suggest that we can recreate a hypnotic analogue of the delusion from its components. In particular, the findings show that the hypnotic state itself is necessary for the analogue and that it can play the role of Factor 2.

Current study

Mirrored-self misidentification can develop from two different pathways: Mirror agnosia or a deficit in face processing can act as Factor 1 to provide the content of the delusion (Breen et al., 2001). Thus far, we have used hypnotic suggestions to model the overall delusional experience of seeing a stranger in the mirror (ignoring the Factor 1 pathways; Barnier et al., 2011) and to recreate the delusion from the deficit in face-processing Factor 1 pathway (Connors et al., 2011). Research has not yet examined whether it is possible to recreate mirrored-self misidentification from the mirror agnosia Factor 1 pathway. This was the aim of the current experiment. We compared two different suggestion designed to generate mirror agnosia as Factor 1. There was no mention of a stranger in either suggestion, so participants needed to infer this idea in order to experience the delusion. We were thus interested to see whether the suggestions for mirror agnosia would also produce the delusion. We took a case study approach, examining in detail the responses of a small number of carefully selected high hypnotisable participants.

In the first suggestion for mirror agnosia, the hypnotist told participants, "You will not understand how mirrors work." This was based on the suggestion for scissor agnosia used in the Stanford Profile Scale of Hypnotic Susceptibility: Form II (Weitzenhoffer & Hilgard, 1963; see also Hilgard, 1965), which tells participants that they will no longer understand what scissors are. In the second suggestion for mirror agnosia, the hypnotist told participants, "You will see a window" and showed them the mirror. This suggestion was taken from Barnier, Cox, et al.'s (2008) original study and was based on the phenomenology of patients with mirror agnosia who experience mirrors as windows (e.g., Ajuriaguerra et al., 1963). Importantly, there was no mention of the word "mirror" in this second suggestion to recreate the experience a patient might have of simply seeing a window. Barnier, Cox, et al. found that only one of the four participants given this suggestion experienced the delusion. They thought this might have been because their questions, which focused on the participants' reflections, did not fit with the experience of looking into a window and may have interfered with participants' responses. Accordingly, in this study we changed these initial questions to fit the experience of looking through a window.

After each suggestion, we uncovered the mirror and asked participants to describe what they saw from the oblique angle at which they sat. We then asked participants to lean forward and look directly into the mirror. This approach, in which participants were asked to look at the mirror first at an oblique angle and then directly, was designed to be gradual and better fit the experience of looking through a window. We then gave participants who reported seeing a stranger a series of challenges based on those that Breen et al. (2001) gave to TH and the challenges used in previous hypnosis studies of the delusion (Barnier et al., 2011; Connors et al., 2011). Following this, we conducted a postexperimental inquiry using the Experiential Analysis Technique (EAT; Sheehan & McConkey, 1982), in which participants watched a videotape playback of their hypnosis session with a second experimenter and commented in detail on their experiences during the hypnotic delusion.

METHOD

Design and participants

We tested 10 carefully selected high hypnotisable participants (nine female and one male) of mean age 23.50 ($SD = 8.64$) years in a between-subjects design (suggestion: not understand mirrors vs. see a window). Participants were undergraduate psychology students at Macquarie University who received payment (\$30 for 2 hours) for their involvement. Participants were 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 an 11-item tailored version of the Stanford Hypnotic Susceptibility Scale, Form C (SHSS:C; Weitzenhoffer & Hilgard, 1962).¹ All participants scored in the range 7–10 on the HGSHS:A ($M = 8.10$, $SD = 0.99$) and 8–11 on the SHSS:C ($M = 9.00$, $SD = 0.94$). Participants were asked not to participate in the experiment if they had problems with substance abuse, if they had ever suffered a serious head injury or neurological illness, or if they were receiving treatment for any chronic,

¹The 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 immobilisation items were removed to ensure that the procedure could be conducted within the time limits of a 1 hour class. The 11-item tailored SHSS:C included: hand lowering, moving hands apart, mosquito hallucination, taste hallucination, arm rigidity, dream, age regression, arm immobilisation, anosmia, negative visual hallucination, and posthypnotic amnesia; the auditory hallucination item was removed to ensure that the procedure could be conducted within the time limits of a 1 hour individual session.

ongoing psychological condition. Research was approved by the Macquarie University Human Research Ethics Committee.

Apparatus

Both the experimental session (hypnosis) and the EAT session were recorded using a video camera linked to a computer. The video recording of the hypnosis session was shown on a computer screen to participants during the EAT session. The video recordings of both the hypnosis session and the EAT were later transcribed for analysis. During the experiment, participants were asked to look at a square mirror (approx. 28.5 cm × 28.5 cm framed with a 2.5 cm wooden border), which was mounted on a wall next to the participants' reclining chair. The mirror was positioned so that participants could look directly into it by turning their head to the left and leaning slightly forward. Before the suggestion and after the cancellation, the mirror was covered with a white screen. A plastic green ball, slightly larger than a tennis ball, was used in the test of mirror agnosia.

Procedure

Each participant was tested individually in a single 2 hour session. The session consisted of a hypnosis session conducted by the first experimenter ("the hypnotist") and a postexperimental EAT inquiry conducted by the second experimenter ("the inquirer").

Experimental session. The hypnotist 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, listen to the hypnotist's voice, and enter a "deep state of hypnosis" as the hypnotist counted from 1 to 20.

Hypnotic suggestions. The hypnotist gave participants three simple hypnotic suggestions, including moving hands apart (from the SHSS:C; Weitzenhoffer & Hilgard, 1962), verbal inhibition (from the Stanford Hypnotic Susceptibility Scale, Form A; Weitzenhoffer & Hilgard, 1959) and heat hallucination (from the Stanford Profile Scale of Hypnotic Susceptibility: Form II; Weitzenhoffer & Hilgard, 1963; see also McConkey, 2008). The hypnotist then uncovered the mirror and said:

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 look at the wall to your left.

The hypnotist gave participants one of two suggestions for mirror agnosia. Participants were randomly assigned to receive either a suggestion to not understand mirrors ($n = 5$) or to see a window ($n = 5$). Participants given the suggestion to not understand mirrors were told:

When you look to your left, you will find that you do not understand how mirrors work. That's right, you will not understand how mirrors work. So, when you open your eyes, whilst remaining comfortably relaxed and deeply hypnotised, you will not understand how mirrors work. I will ask you to describe what you see as you look at the wall to your left.

Participants given the suggestion to see a window were told:

When you look to your left, you will see a window. That's right, you will see a window. So, when you open your eyes, whilst remaining comfortably relaxed and deeply hypnotised, you will see a window on the wall to your left. I will ask you to describe what you see as you look through this window.

After each suggestion, the hypnotist checked that participants understood and asked them to open their eyes and look at the mirror from where they sat:

Do you understand? Okay. Now, just remaining comfortably relaxed in the chair, I would like you to slowly open your eyes and look to your left.

At this point, participants could not see their reflection in the mirror. The hypnotist asked them to describe what they could see from the oblique angle at which they viewed the mirror.

Test of the suggestion. The hypnotist then instructed participants to lean forward to look directly at the mirror. The hypnotist asked participants what they saw. Participants who reported seeing someone other than themselves were asked to describe what they saw in more detail (see Appendix for further details and verbatim instructions).

Test of mirror understanding. All participants were then tested on their understanding of mirrors. First, the hypnotist asked participants to define a mirror. Next, the hypnotist tested the participants' procedural understanding of mirrors. The hypnotist held a ball over the participants' shoulders so that the ball was visible to them only by its reflection in the mirror. The hypnotist asked participants to touch the ball and noted whether they reached above their shoulder to touch the ball or whether they reached towards the ball's reflection (as in mirror agnosia; see Connors & Coltheart, 2011).

Challenges. If participants continued to report seeing a stranger, the hypnotist challenged this belief. Participants who said they saw themselves in the mirror at any point during the challenges were told, “That’s fine. You see yourself in the mirror” and administered the cancellation. In the first set of challenges, the appearance challenges, the hypnotist asked participants how it was possible that they looked so similar to the person they saw. Next, the hypnotist asked participants to compare what they were wearing with what the person was wearing. Finally, the hypnotist 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 them apart. In the second set of challenges, the behavioural challenges, the hypnotist asked participants to touch their nose and asked participants to explain why the person in the mirror copied them. In the final set of challenges, the visual challenges, the hypnotist moved position so that his reflection in the mirror was also visible to participants. The hypnotist asked participants to identify who was in the mirror and then to identify who was in the room. The hypnotist then touched participants on the shoulder and asked who he touched—the participant or the stranger. See Appendix for verbatim instructions.

Cancellation and deinduction. Following this, the hypnotist cancelled the suggestion (see Appendix). The hypnotist then gave participants a standard hypnotic deinduction (based on Weitzenhoffer & Hilgard, 1962).

Postexperimental EAT inquiry. The hypnotist introduced participants to the second experimenter, the inquirer, who conducted the postexperimental EAT inquiry. The inquirer explained to participants that she would play a video recording of the experimental session and ask questions about their experiences (this procedure was adapted from Sheehan & McConkey, 1982). The inquirer first showed the section of the video when the participant was receiving the suggestion, before they opened their eyes, and asked: (1) “What did you expect to happen?” Next, the inquirer showed participants the section of the video when they first looked directly into the mirror. The inquirer asked: (2) “What did you experience when you looked directly in the mirror?” (3) “On a scale of 1 to 7, to what extent did you believe there was a stranger in the mirror (1 = ‘not at all’, 7 = ‘completely’)?” (4) “On a scale of 1 to 7, how surprising was it for you to look in the mirror (1 = ‘not at all surprising’, 7 = ‘extremely surprising’)?” (5) “On a scale of 1 to 7, how distressing was it to look in the mirror (1 = ‘not at all distressing’, 7 = ‘extremely distressing’)?” If participants passed the suggestion, the inquirer showed a replay of the challenges they received and asked about their experiences of each challenge. Finally, the inquirer debriefed the participants and ended the session.

Coding of responses. After testing all participants, the videotape records of the experimental session were examined independently by the hypnotist and a rater who was blind to the aims of the experiment and the conditions in which participants were tested. The two raters scored whether or not participants experienced the delusion and, if so, at what point it was breached. For both experiencing the delusion and response to the challenges, interrater reliability was 100%.

RESULTS

Overview

For participants given the suggestion to not understand mirrors, three of the five (60%) reported seeing a stranger when they looked directly into the mirror. One of these participants initially said that he saw himself, but very quickly became convinced that it was someone else (this participant was scored as a partial pass). A fourth participant in this condition identified herself but during the EAT inquiry said she thought she was looking at herself through a window and reported being very disoriented. The fifth participant failed the suggestion and reported seeing herself in the mirror.

When asked to define mirrors, the three participants who reported seeing a stranger said they did not know or stammered and remained silent. When asked to touch the ball held above their shoulder, one participant reached directly into the mirror and tried to grasp the ball. The other two participants correctly touched the ball above their shoulder but indicated that there was another ball behind the “window” they could see. One of these participants then tried to reach into the mirror to touch the second ball. The other two participants given the suggestion to not understand mirrors, who formally failed the suggestion, were able to define mirrors and correctly reached for the ball above their shoulder.

For participants given the suggestion to see a window, none of the five (0%) reported seeing a stranger. One participant reported that she could see a view of hills and trees without any people, through what she took to be a window, even when she was looking directly into the mirror. This participant was able to define mirrors, but reached directly into the mirror when asked to touch the ball above her shoulder. All other participants given this suggestion correctly defined mirrors and reached for the ball above their shoulder.

For participants given the suggestion to not understand mirrors, their mean rating of belief that they were looking at a stranger (provided during the EAT) was 4.70 ($SD = 2.33$); for participants given the suggestion to see a window, their mean rating of belief was 1.00 ($SD = 0.00$). Thus, participants given the suggestion to not understand mirrors believed more strongly in the

existence of a stranger than participants given the suggestion to see a window, $t(8) = 3.54$, $p = .008$. For participants given the suggestion to not understand mirrors, their mean rating of surprise was 4.70 ($SD = 2.22$) and their mean rating of distress was 4.30 ($SD = 2.49$). For participants given the suggestion to see a window, their mean rating of surprise was 2.30 ($SD = 1.99$) and their mean rating of distress was 2.00 ($SD = 2.24$). These ratings did not differ between the two suggestions: for surprise, $t(8) = 1.80$, $p = .110$; for distress, $t(8) = 1.54$, $p = .163$.

Only the four participants who reported seeing a stranger or a view out of a window received the challenges. Overall, two of the three participants who reported seeing a stranger maintained their delusion throughout all the challenges. The third participant (the same participant who initially reported that he saw himself before describing a stranger) only breached the delusion on the final challenge, when the hypnotist stood so that his reflection was also visible in the mirror. The participant in the window condition who reported seeing a view with no people maintained this experience throughout all the challenges. The contents of the view she reported, however, changed over the course of the challenges from hills and trees to another room similar to the one she was in. What follows are more detailed descriptions of the individual participants who responded to the delusion suggestion.

Case studies

Case 1 (not understand mirrors; pass). AK was a 20-year-old female given the suggestion to not understand mirrors. In response, she reported seeing a stranger through what she took to be a window into the next room. AK reported that she had never seen this person before, although she acknowledged that there were some similarities between her and this person. She said that it could not be her because the other person was in the next room:

Hypnotist: I would like you to lean forward. Tell me about what you see now.

AK: There's a person there standing up, with long hair and a necklace and a shirt. And there's a camera in there as well. It's very similar to our room [*looks around the room she is in*].

Hypnotist: I would like you to tell me more about the person.

AK: She's staring back at us, frowning. She's got a headband and she's wearing earrings and yeah, a black and white striped shirt and a necklace. Yeah, what else?

Hypnotist: What do they look like?

AK: Just a person. She's got dark skin and brown eyes, and her hair is very dark.

Hypnotist: Have you ever seen this person before?

- AK: Mmm, no.
 Hypnotist: Do they remind you of anybody?
 AK: No, not really.
 Hypnotist: In what ways does the person look like you?
 AK: Yeah, she looks . . . she's . . . she's . . . well she's not me because that's . . . that's . . . she's got dark hair like me, and I have very similar jewellery and top, but I'm here [*frowns, looks confused*].
 Hypnotist: In what ways does the person look different to you?
 AK: Well, she's not me because I'm here.
 Hypnotist: Any other differences?
 AK: She looks different.

In the EAT, AK reported a highly compelling experience. She said she completely believed she was looking at a stranger: "I knew it wasn't me . . . it was some strange person that kind of did look like me but wasn't me." AK said she believed that this stranger was in the next room: "I actually physically thought it was a window and was kind of like, 'that is a strange place to have a window,' but . . . well there's another room in there."

AK was not able to define mirrors. When the hypnotist held a ball above her shoulder to test her procedural understanding of mirrors, AK looked up towards the hypnotist as he was giving the instructions, saw the ball, and then reached for it. She indicated, however, that there was a second ball in what she thought was the next room. She reached into the mirror to grasp it, scratching at the mirror's surface, but said that she could not touch it because there was glass in the way. She reported that as she reached for the ball, the stranger in the next room copied her movements. In the EAT, AK reported that this was also a very compelling experience. She said she really did not know what mirrors were at the time and thought that the person copying her was some sort of setup as part of the experiment.

AK maintained her delusion through all the challenges. In response to the appearance challenges, AK reported that the stranger was wearing the same clothes as her and that a friend or family member would also think that the two of them looked quite similar:

- Hypnotist: So how is it possible that you look so similar?
 AK: I used to know a girl who looked like me. But, just genetics.
 Hypnotist: What are you wearing?
 AK: Jeans, and a black and white striped shirt.
 Hypnotist: What is the person wearing?
 AK: The same shirt as me.
 Hypnotist: How do you explain that they are wearing the same clothes?
 AK: They went to the same shop as me?
 Hypnotist: If a close friend or family member came into the room right now, what do you think they would say about what they can see?

- AK: . . . I don't know, they would say . . . probably like the fact that we're kind of similar and the fact that we're not.
- Hypnotist: How would they be able to tell you apart from the person you see?
- AK: Well, I'm me and that's not, and they know me.
- Hypnotist: How would you explain to them what they see?
- AK: I would say that they are seeing into another room, and that she happens to look a lot like me and shops at the same shops as I do.

In the EAT, AK said that, although the person she saw looked like her, "I was here, I couldn't be there . . . I can't define the difference . . . it's not something I can physically see, but I know she's not me." AK explained her belief further: "That's not me . . . Everything stemmed from there. You know, this is not where I am, this is another room. I physically can't be in two rooms at once." AK also reported that her belief that she was looking at a stranger in another room became even stronger over the course of the challenges.

In response to the behavioural challenges, AK similarly maintained her delusion. After touching her nose, she said the person copied her. She reported that she did not know why the person was copying her but suggested, "There's somebody else in the room—maybe he's telling her to copy me." In response to the visual challenges, AK maintained her delusion. When the hypnotist stood next to AK so that his reflection was visible next to hers, AK reported that she could see another person in the room with the stranger. Although the person looked like the hypnotist, AK said, "That can't be you—you're here" and said she thought that the hypnotist might have had a twin. When the hypnotist touched AK on the shoulder, she reported that this person touched the other stranger at the same time:

- Hypnotist: [*Hypnotist moves so he is visible in the mirror*] Who do you see now?
- AK: There's another person in the room.
- Hypnotist: Do you know this person?
- AK: He looks a lot like you.
- Hypnotist: Are there any differences between me and him?
- AK: You're here. You can't, I mean I don't know, I mean, you're kind of a bit back to front, but, you're here.
- Hypnotist: [*Hypnotist touches AK's shoulder*] Who did I touch?
- AK: They're copying.
- Hypnotist: Who did I touch?
- AK: You touched me. And the you in there touched the other one.
- Hypnotist: How do you explain what you see?
- AK: Well I don't know, it's another room where there's other people, or I don't know, there's a development of alternate realities or something. . .

Overall, AK reported a very compelling experience. In the EAT, AK reported that she had felt confused and frustrated during the hypnosis session. In particular, she said that she had not understood why the hypnotist

was asking her so many questions about the person she saw because she thought he could answer them himself just by looking through the window (“Why is he asking more details about something that’s really obvious?”). She reported that she had felt somewhat upset at the time because she did not understand what was going on. In the EAT, AK rated her belief that she was looking at another person as 7 out of 7. AK, like all the participants, was thoroughly debriefed after the experiment. She reported that she was no longer distressed at all and that she had found the experiment to be very interesting.

Case 2 (not understand mirrors; pass). KT was a 21-year-old female given the suggestion to not understand mirrors. She reported seeing another room when she looked to her left and was shocked when she leaned forward to see a stranger copying her. KT reported that the person looked just like her:

- Hypnotist: Tell me more about what you can see?
 KT: There’s someone else in there! [*Touches face*].
 Hypnotist: Tell me more about the person you see.
 KT: [*Moves around*] They’re copying me! ... She looks like similar ...
 Hypnotist: What do they look like?
 KT: Me.
 Hypnotist: Have you seen this person before?
 KT: No.
 Hypnotist: Do they remind you of anybody?
 KT: Me.
 Hypnotist: What is it about them that reminds you of you?
 KT: Everything [*leans back, leans forward again*].
 Hypnotist: In what ways does the person look like you?
 KT: Hair. Everything.
 Hypnotist: In what ways does the person look different to you?
 KT: I don’t know. Not really different. It’s like a photo.

KT said that she knew what mirrors were but when asked to provide a definition she stammered and looked puzzled. When the hypnotist held the ball above her shoulder and asked her to touch it, KT reached directly into the mirror and tried to grasp the ball. She appeared confused as to why she was unable to reach it and looked around the room. KT reported that the stranger was copying what she was doing but that she did not know why the stranger was doing that.

KT maintained her delusion through all the challenge procedures. In the appearance challenges, KT reported that the person was wearing the same clothes as her and that a friend or family member might think that she and the stranger were twins. When asked to touch her nose in the behavioural

challenges, KT seemed very surprised when the stranger copied her. She said that the stranger copied her because the stranger might also have heard the hypnotist's instructions to touch her nose. When the hypnotist asked her why the person copied everything she did, KT said, "They're playing." In the visual challenges, KT likewise maintained her delusion. When the hypnotist stood next to KT so that his reflection was also visible next to hers, KT reported that she could see "somebody else" next to the stranger. When the hypnotist touched KT on the shoulder, she reported that this person touched the stranger at the same time that the hypnotist touched her.

In the EAT, KT reported that she could not remember any of her experiences after the suggestion. KT said that she had similarly not been able to remember her experience of hypnosis the two previous times she had been hypnotised (the HGSHS:A and SHSS:C screenings). Previous research has shown that a small proportion of hypnosis participants experience spontaneous amnesia after hypnosis (Cooper, 1979; Hilgard, 1966; Hilgard & Cooper, 1965). KT reported being amused and embarrassed watching the video footage of the experiment, but said that she still had no memory of the experience ("I honestly don't even remember it happening"). She said that she appeared very confused in the video. She pointed out that she was touching her lip a lot, which is a habit she has when she is nervous. She said that it appeared that she really believed that she was looking at a stranger. Based on watching the video of herself (and not her memory of the experience), she rated her belief that she was looking at a stranger as 6 out of 7.

Case 3 (not understand mirrors; partial pass). ES was a 19-year-old male given the suggestion to not understand mirrors. ES reported seeing a window when he first opened his eyes. When ES leant forward, he initially said that he saw himself but then insisted that it was a stranger who looked like him but that he had never seen the person before. ES described his first experiences of looking in the mirror as "a whole lot of confusion. I wasn't sure if it was me or someone else. You know, the first thing it was a window, and then I look in to see someone." In the EAT, ES said that he continued to be confused by what he was seeing over the course of the experiment: "I thought it was some sort of video camera and television screen, then I thought someone else dressed and looked exactly the same and did the same thing. It didn't make sense . . ."

ES was not able to define a mirror. When the hypnotist held the ball above his shoulder to test his procedural understanding of mirrors, ES looked up at the ball above his shoulder and touched it. He reported, however, that the stranger "touched the ball over his shoulder too" but that he did not know why. In the EAT, ES said he was surprised because it was "the first time I could see that the other person had done the same thing as me."

ES maintained his delusion in response to the appearance challenges. ES said that he might be dreaming or looking at a television screen. He said he was not sure how a friend or family member would be able to tell him apart from the stranger.

Hypnotist: How is it possible that you look so similar?

ES: I don't know. Must be dreaming.

Hypnotist: What are you wearing?

ES: [*Looks down at himself*] The same thing.

Hypnotist: How do you explain that they are wearing the same clothes?

ES: Video? TV screen maybe?

Hypnotist: If a close friend or family member came into the room right now, what do you think they would say about what they can see?

ES: Not too sure.

Hypnotist: How would they tell you apart from the person that you see?

ES: I don't think they could [*frowns, looks around mirror*].

Hypnotist: How would you explain to them what they see?

ES: Someone's wearing the same clothes as me . . . and is doing the same thing as me [*looks at mirror, then down at self*].

In the EAT, ES reported a compelling experience. He said, "I honestly thought it was a window through to the room next door." ES said, "I was tripping out. I thought that . . . I don't know. I don't know what I was thinking. It just didn't make sense at all. I thought I was dreaming for a second." ES also maintained his delusion in response to the behavioural challenges. ES touched his nose and said that the stranger copied him because the stranger probably also heard the hypnotist's instructions. While touching his nose, ES moved his finger from side to side, which he said later was an attempt to catch the person out. ES said he found the experience both confusing and amusing, "That was weird, I thought that it was someone . . . I just thought it was pretty funny that the other person was doing that as well."

In response to the visual challenges, however, ES breached his delusion. When the hypnotist stood next to ES, ES identified the hypnotist's reflection in the mirror ("It's you"). ES looked around the room and reported that the hypnotist touched him on the shoulder. When asked to explain what he saw, ES said he must be looking at himself. In the EAT, ES said that the challenge led him to believe that he was looking at himself:

It sort of led me to realise that he [the hypnotist] is here [in the room] and then when he touched me it sort of made even more sense, because he touched him over there [*points to mirror*] and me at the same time . . . it sort of made me stop thinking about the other person because I felt it and saw it at the same time.

In the EAT, ES rated his overall belief that he was looking at a stranger as 4 out of 7.

Case 4 (not understand mirrors; fail). OK was an 18-year-old female given the suggestion to not understand mirrors. OK did not experience the delusion: When asked who she saw, she said, "I see myself." OK also did not show signs of mirror agnosia: She defined mirrors appropriately ("for seeing reflections") and correctly reached for the ball above her shoulder. In the EAT, however, OK reported that even though she recognised herself, she still believed that she was looking through a window. OK said: "It actually seemed like I was looking through a wall into another room . . . I could see myself but it didn't register as a reflection. I felt like I was in the other room as well . . . And then when he asked me how I knew it was me, I had serious difficulty answering that question." OK did not receive the challenges because she reported seeing herself in the mirror. In the EAT, OK rated her overall belief that she was looking at a person through a window as 5.5 out of 7.

Case 5 (see a window; fail). EC was a 23-year-old female given the suggestion to see a window. EC did not experience the delusion but reported seeing a view of "green hills and a tree on the hill" though a window. She reported that she could not see any people, even when looking directly into the mirror. She said the window was dirty and had a lot of glare, so that she could also see part of the reflection of the room she was in. In the EAT, EC described her experience as like "when it's night and the reflection comes back so that you can't look through the window. So although I knew I was in this room, I could still see what was outside the window. I wasn't thinking it was a mirror at all." In the challenge procedures, EC reported that the view through the window changed. She no longer reported seeing hills but could see the room next door, which resembled the room she was in but it did not have any people in it. EC was able to provide a definition of a mirror. When asked to touch the ball held above her shoulder, however, EC reached directly into the mirror to try to grasp the ball. EC maintained her experience of looking through a window despite all the challenges.

DISCUSSION

These results show that a hypnotic suggestion to not understand mirrors can recreate features of both mirror agnosia and the mirrored-self misidentification delusion. Three of the five participants given the suggestion to not understand mirrors developed a hypnotic delusion that their reflection was a stranger and maintained this belief when challenged. Two of these

participants also showed signs of mirror agnosia. In contrast, the suggestion to see a window was not effective in recreating the delusion. No participants in this condition reported seeing a stranger (although one reported seeing a window). This implies that the suggestion to see a window may have been too general or too difficult for participants to interpret, at least in terms of recreating mirrored-self misidentification.

Recreating the delusion

This study adds to earlier work in demonstrating the value of using hypnosis to model clinical conditions (Oakley & Halligan, 2009). Our findings are consistent with previous research that has used hypnosis and hypnotic suggestion to model the mirrored-self misidentification delusion (Barnier, Cox, et al., 2008; Barnier et al., 2011). The findings are consistent also with research that has used hypnosis and hypnotic suggestion to model this delusion by attempting to impair face processing (Connors et al., 2011). In this study, we produced mirror-self misidentification by instead disrupting mirror knowledge. We used a suggestion to not understand mirrors without specifically mentioning a stranger and, despite our small sample size, found that most participants given this suggestion reported seeing a stranger in the mirror. Participants identified their own reflection as a stranger, maintained the delusion when challenged, and reported highly compelling experiences.

These three participants in our study also showed a number of distinct similarities to the clinical case of TH (see Breen et al., 2001). First, the participants reported that the strangers they saw looked very similar to themselves, wore the same clothes as them, and made the same movements as they did. The participant KT even said that the stranger could be her twin, something which TH said of his own reflection (Breen et al., 2000). In contrast, other cases in the literature, who may not have had mirror agnosia as Factor 1, described the stranger as looking very different to themselves (e.g., Spangenberg et al., 1998). Second, the participant ES initially reported that he saw himself before insisting that it was a stranger, which is very similar to how TH originally responded to his reflection in testing. Breen et al. (2000, p. 87) reported TH's first responses as follows:

Examiner: What do you see there?

TH: I see my face in there, a reflection of it.

Examiner: And can you describe what that reflection looks like?

TH: Just like that bloke there [*points to his own reflection*].

Examiner: What does he look like? . . .

TH: Well, the only way I could describe him is that he looks like me.

Like TH, participant ES reported being confused by his experience. Finally, participants KT and ES showed signs of covert recognition that they were looking at themselves by proposing that they were looking at a photo or a video. TH also showed signs of covert recognition: When the examiner asked TH whether the person in the mirror was bald, TH replied, “Yes, he’d have to be” (see Breen et al., 2000, p. 87). Unlike TH, but consistent with other cases reported in the literature (e.g., Cummings, 1985; Gluckman, 1968; Mendez, 1992), both participants AK and KT showed signs of being worried or suspicious of the stranger. For participant AK, the experience was so compelling that she reported being puzzled and frustrated that the examiner was asking her questions because she thought that he could see the stranger for himself. Overall, then, the participants showed remarkable similarities to TH and other clinical cases.

Importantly, the suggestion to not understand mirrors recreated features of the delusion that are specific to patients with a Factor 1 deficit of mirror agnosia, and which may not be evident in patients who have a Factor 1 deficit in face processing (note, however, that Breen et al., 2001, did not directly test for mirror agnosia in the face-processing-deficit case of mirrored-self misidentification, FE). Two hypnosis participants experiencing the delusion reached into the mirror to touch a ball held over their shoulder and demonstrated an impaired ability to distinguish between real and reflected space. This is in contrast to participants in Connors et al.’s (2011) experiment, which modelled the delusion from its impaired face processing pathway; all participants correctly reached for the ball above their shoulder. The three participants in the current study who experienced the delusion were also unable to verbally define mirrors. This is unlike patients with mirror agnosia who are impaired procedurally with mirrors but retain an intact semantic understanding of mirrors (Connors & Coltheart, 2011). This implies that participants interpreted the suggestion to not understand mirrors literally, and so experienced effects more pervasive than clinical cases of mirror agnosia.

The two participants who maintained their delusion in response to the challenges also identified the experimenter’s reflection as another person. This is consistent with the clinical case of TH, who identified the experimenter’s reflection as another person, but contrasts with the clinical case of FE, whose Factor 1 was a deficit in face processing and who appeared able to recognise other people in the mirror (Breen et al., 2001). Coltheart (2007) argued that clinical patients respond to each type of Factor 1 differently and this accounts for the difference in their ability to recognise other people in the mirror. In other words, for patients with a deficit in face processing—which might selectively affect their self-face processing abilities more than their general face processing abilities (Langdon, 2011; Phillips et al., 1996)—their problems are specific to recognising themselves. So they

remain able to recognise other people in the mirror. Patients with mirror agnosia, however, experience reflections as extensions of space and so see all people in the mirror as strangers in another part of space to themselves. Interestingly, our hypnotic analogues are consistent with this idea. Connors et al. (2011) found that most participants given a Factor 1 suggestion for impaired face processing were able to identify the experimenter's reflection, despite reporting that their own reflection was a stranger. In the current experiment, participants given a Factor 1 suggestion to not understand mirrors reported that the experimenter's reflection was another stranger. This parallel between clinical cases and hypnotic analogues is striking and highlights the ability of hypnosis to model quite subtle aspects of the delusion.

Like Connors et al. (2011), we found that a specific suggestion for Factor 1 in hypnosis was sufficient to generate the delusion. This supports our proposal that the hypnotic context can act as Factor 2 (Connors et al., 2011). The finding is also consistent with other research from Australian laboratories that demonstrates a hypnotic induction influences participants' response to delusion suggestions (e.g., Cox & Barnier, 2009; McConkey, Szeps, & Barnier, 2001). Although some participants may be able to experience hypnotic effects without a formal induction, participants typically rate these effects as less vivid and less compelling as when they are experienced following an induction (McConkey et al., 2001; see also Barnier, Dienes, & Mitchell, 2008). This difference may be particularly pronounced for complex delusory items, such as in this experiment, as opposed to simple ideomotor suggestions, which may not be so influenced by an induction.

Across the different studies using hypnosis to model mirrored-self misidentification, the findings seem to indicate that suggestions designed to generate Factor 1 (mirror agnosia or impaired face processing) can work just as well as a suggestion for the fully-formed delusional experience (see Barnier et al., 2011; Connors et al., 2011). Given the predictions of the two-factor theory that any cognitive disruptions to Factor 1 and Factor 2 processes should generate a delusion (see Coltheart, 2007; Cox & Barnier, 2010), future research could directly compare these three types of suggestions (mirror agnosia, impaired face processing, and fully formed delusion) to assess their relative pass rates and resistance to challenging. In this and the previous studies, there was no difference in the hypnotisability scores of participants who developed and maintained the delusion compared to those who did not. Future research could examine if individual differences—such as proneness to delusional ideation or schizotypy—predict which participants develop and maintain the delusion. Future research could also investigate the demand characteristics of the suggestion by using a real-simulating paradigm (e.g., Orne, 1959, 1972), where the responses of

hypnotised participants are compared to the responses of low hypnotisable participants instructed to fake hypnosis.

Comparing the suggestions for mirror agnosia

Although the suggestion to not understand mirrors was successful in recreating the delusion, it was also somewhat paradoxical. This is because one presumably has to know what a mirror is before one can block this knowledge from awareness. This paradox is apparent in a range of other hypnotic phenomena that involve inhibiting some aspect of experience or knowledge, such as hypnotic blindness, hypnotic deafness, and hypnotic anaesthesia (Kihlstrom & Hoyt, 1988). In each case, the targeted stimulus must be registered and processed at some level in order for the hypnotised person to not consciously experience it. The paradox may thus reflect a dissociation between explicit experience (the conscious experience of looking at a mirror but not seeing a mirror) and implicit knowledge (the unconscious recognition of a mirror being present), which is a characteristic of hypnosis (see Kihlstrom, 1985, 2007). Interestingly, the ability to suppress certain aspects of experience from conscious awareness in hypnosis may tap into important cognitive processes that keep distracting and irrelevant stimuli from intruding into consciousness in everyday life (Mendelsohn, Chalamish, Solomonovich, & Dudai, 2008; see also Levy & Anderson, 2002). Hypnosis thus may offer a way to study this more general cognitive mechanism. Recent neuroimaging research on posthypnotic amnesia suggests that suppressing memories is associated with heightened activity in the left rostrolateral prefrontal cortex (Mendelsohn et al., 2008). Future research could examine whether similar neural mechanisms are involved in suppressing other knowledge, like that of mirrors, from awareness during hypnosis.

Consistent with the paradoxical nature of the suggestion, some participants' responses indicated idiosyncratic ways of resolving the conflict between both recognising that a mirror was present and not understanding mirrors. Participant ES, for example, initially reported seeing himself before describing a stranger. One possible explanation is that ES experienced a delay in inhibiting his knowledge of mirrors. His first experience was of seeing himself; however, once his knowledge of mirrors was inhibited, he experienced the reflection as someone else. Hung (2008) reported a similar delayed onset of a hypnotic suggestion in the case of a participant who was able eventually to modulate the Stroop effect after a colour hallucination suggestion. Participant OK showed a different way of dealing with the paradox. She reported that she could see herself but that she still believed that she was looking through a window. OK was able to hold these two contradictory beliefs simultaneously and, in so doing, could both recognise

herself and experience the mirror as a window. In the hypnosis literature, this behaviour is known as “trance logic”, defined as the “apparently simultaneous perception and response to both hallucinations and reality without any apparent attempts to satisfy a need for logical consistency” (Orne, 1959, p. 295; see also McConkey, Bryant, Bibb, & Kihlstrom, 1991). This ability to hold contradictory beliefs has been shown in delusional patients like TH, for example, who reported that the stranger he saw in the mirror never talked to him but that he had also told him that his name was “Tom” (Breen et al., 2001).

In contrast to the success of the suggestion to not understand mirrors, the suggestion to not see a window was ineffective in producing the delusion. No participants reported seeing a stranger: Four of the five participants immediately recognised themselves and one participant passed the literal suggestion, reporting a view through a window of hills and trees, but did not develop the delusion. This finding is consistent with Barnier, Cox, and colleagues (2008), who also found that a window suggestion was ineffective. We used the suggestion because it seemed the most direct way of recreating the phenomenological experience of a clinical patient with mirror agnosia (of interpreting mirrors as windows) and because the Barnier, Cox, et al. version of the suggestion was flawed. They suggested that participants would see a window, but then asked questions about a person. So the questions conflicted with the suggestion and might have actually interfered with participants’ experience. Although in this study we changed the questions to better fit with the experience of looking through a window, this suggestion still proved ineffective.

Its failure instead may reflect participants’ difficulty in interpreting what the suggestion was intended to achieve. The suggestion to see a window did not mention mirrors nor did it attempt to alter participants’ ability to recognise mirrors. Moreover, all the participants given this suggestion reported in the EAT that they did not expect to see a mirror: Two said they expected to see an actual window and three said they expected to see a blank wall on which they were meant to hallucinate a window. In contrast, all participants given the suggestion to not understand mirrors said they expected to see a mirror. So when participants given the suggestion to see a window saw a mirror instead of what they expected (a window or a wall), this may have disrupted and interfered with their experience. Consistent with this, participant ES, who reported seeing a view out of the window, said that she found the glare of the window (i.e., the mirror’s reflective surface) to be very frustrating. Previous research has shown that conflicting reality information interferes with some hypnotic participants’ ability to experience a suggestion (Bryant & McConkey, 1989, 1990). For example, in a study of hypnotic blindness, Mallard and Bryant (2006) found that increasing the brightness of a visual stimulus during hypnosis led to participants reporting decreased

hypnotic blindness. It thus seems that successful suggestions need to prepare participants that they will be looking at a mirror even if they do not recognise it as such.

This study highlights the need to carefully consider the hypnotic suggestion used to model a condition. Based on our findings, it seems that suggestions that directly specify the intended experience of Factor 1 (e.g., mirror agnosia or impaired face processing), allow for components of actual reality, and require minimal interpretation are the most successful. Suggestions that involve a large inferential leap between the information it contains and its intended effect are less likely to be successful. Participants given the suggestion to see a window, for example, were not expecting to see a mirror and so either did not experience the suggestion or, as in the case of participant ES, literally saw a window in a way that was very different to the experience of mirrored-self misidentification. The suggestion to not understand mirrors, which provided more information to participants, was consequently more successful, although its effect was more general than mirror agnosia.

Overall, our findings illustrate that hypnosis participants are not mere passive recipients of suggestions, but instead are actively involved in interpreting them. Hypnosis involves top-down processing and suggestions need to make sense to participants in order for them to experience their effects. Previous research has shown that hypnosis participants actively work to interpret and experience the suggestions given to them (e.g., Barnier, Dienes, & Mitchell, 2008; Lynn & Sivec, 1992; McConkey, 1991; Sheehan, 1991; Sheehan & McConkey, 1982; Spanos, 1981; White, 1937, 1941). This is reflected, for example, in research showing that high hypnotisable participants often respond to what they perceive to be the hypnotist's intention rather than the literal suggestion (e.g., Green et al., 1990; Lynn et al., 1990; Sheehan, 1971, 1980). As McConkey (1991) observed, this involvement of participants "should not be viewed in terms of simple acquiescence or compliance, but rather as a position of cognitive readiness by the subjects to construct incoming information in a way that allows them to experience the suggested effect" (p. 555). Thus, it is the participants' interpretation of the suggestion, rather than the suggestion itself, which determines the effect (McConkey, 1991, 2008). These conclusions point to the importance of understanding participants' expectations and interpretations when designing hypnotic analogues of clinical conditions as these elements ultimately shape the hypnotic responses that occur and determine the extent to which these responses match the features and processes of the conditions they seek to model (Barnier & Oakley, 2009; Oakley & Halligan, 2009).

As Sutcliffe (1960, 1961) noted 50 years ago, hypnotised participants are temporarily deluded on matters that relate to the external world and their experience of it. Participants, for example, believe that they do not

understand mirrors and see a stranger when both of these ideas are evidently false. Almost uniquely, however, hypnotic suggestion allows us to create, and reverse, delusions at will in the laboratory. In so doing, this approach offers us a tool for understanding not only delusions but more general mechanisms involved in belief formation, self-awareness, and consciousness itself.

Manuscript received 19 August 2010
 Revised manuscript received 12 April 2011
 First published online 7 September 2011

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APPENDIX: VERBATIM TEST OF THE SUGGESTION, CHALLENGES, AND CANCELLATION

Test of the suggestion

1. What do you see?
2. Tell me more about what you can see.
- 3a. Can you see any people?
If yes: 3b. Tell me more about the person/people/stranger.
4. Now I would like you to sit forward in your chair so that you are looking directly into the window/mirror. [*Direct participant to sit forward*] Tell me about what you see now.
If participant reports seeing themselves: Go to Cancellation.
If participant reports seeing a stranger: Continue to 5.

Questions about the stranger

5a. I would like you to tell me more about the person you can see.

If gender not specified: 5b. Is the person you can see male or female?

6. What do they look like?

7a. Have you ever seen this person before?

If yes: 7b. Who is this person?

7c. What is it about the person that makes you think they are ...?

7d. How do you explain being able to see this person?

If no: 7b. Do they remind you of anybody? If so, who do they remind you of?

7c. What is it about the person that reminds you of ...?

8. In what ways does the person you see look like you?

9. In what ways does the person you see look different to you?

Test of mirror understanding

1. Do you know what mirrors are for?

2a. [*Hold ball over participant's right shoulder*] I would like you now to touch the ball.

2b. What did the person do?

2c. Why did they do that?

Appearance challenges

1. How is it possible that you and the person you see look so similar?

2a. What are you wearing?

2b. What is the person wearing?

If clothing is the same: 2c. How do you explain the fact that they are wearing the same clothes as you?

3a. If a close friend or a member of your family came into the room right now and looked at you and looked at the person you see, what would they say?

3b. How would they be able to tell you apart from the person you see?

3c. How would you explain to them what they see?

Behavioural challenges

1a. I would like you now to touch your nose ... [*wait for the participant to touch their nose*] ... What did the person do?

1b. Why did they do that?

2. How do you explain that the person you can see always does exactly what you do?

Visual challenges

1a. [*Hypnotist to move so that their reflection is also visible to the participant*] Who is that?

If participant says they see the hypnotist: 1b. So if that is me [*Point to reflection of self*], who must that be? [*Point to reflection of the participant*]

2. [*Hypnotist to touch the participant on shoulder*] Who did I just touch?

Cancellation

For the suggestion to not understand mirrors. That's fine. Now, lean back, close your eyes and relax. You're comfortably relaxed and deeply hypnotised. You will become even more relaxed and hypnotised as you pay close attention to my voice and my words. Now you will find that you can understand how mirrors work again. That's right. You understand perfectly how mirrors work. In a moment I will ask you to open your eyes and look to your left and you will see a normal mirror hanging on the wall. Everything is back to normal and you understand how mirrors work. Now just slowly open your eyes, lean forward and look to your left and tell me what you see . . . That's right, it's a normal mirror and you can see your reflection in it. Everything is back to normal. Just lean back and close your eyes again. You are becoming more and more relaxed. Comfortably relaxed and deeply hypnotised.

For the suggestion to see a window. That's fine. Now, lean back, close your eyes and relax. You're comfortably relaxed and deeply hypnotised. You will become even more relaxed and hypnotised as you pay close attention to my voice and my words. Now you will find that the window to your left is turning back into what it has always been—a mirror. That's right. The window is turning back into a mirror that reflects things exactly as they are. In a moment I will ask you to open your eyes and look to your left and you will see a normal mirror hanging on the wall. Everything is back to normal and there is no longer a window on your left. Now just slowly open your eyes, lean forward and look to your left and tell me what you see . . . That's right, it's a normal mirror and you can see your reflection in it. Everything is back to normal. Just lean back and close your eyes again. You are becoming more and more relaxed. Comfortably relaxed and deeply hypnotised.