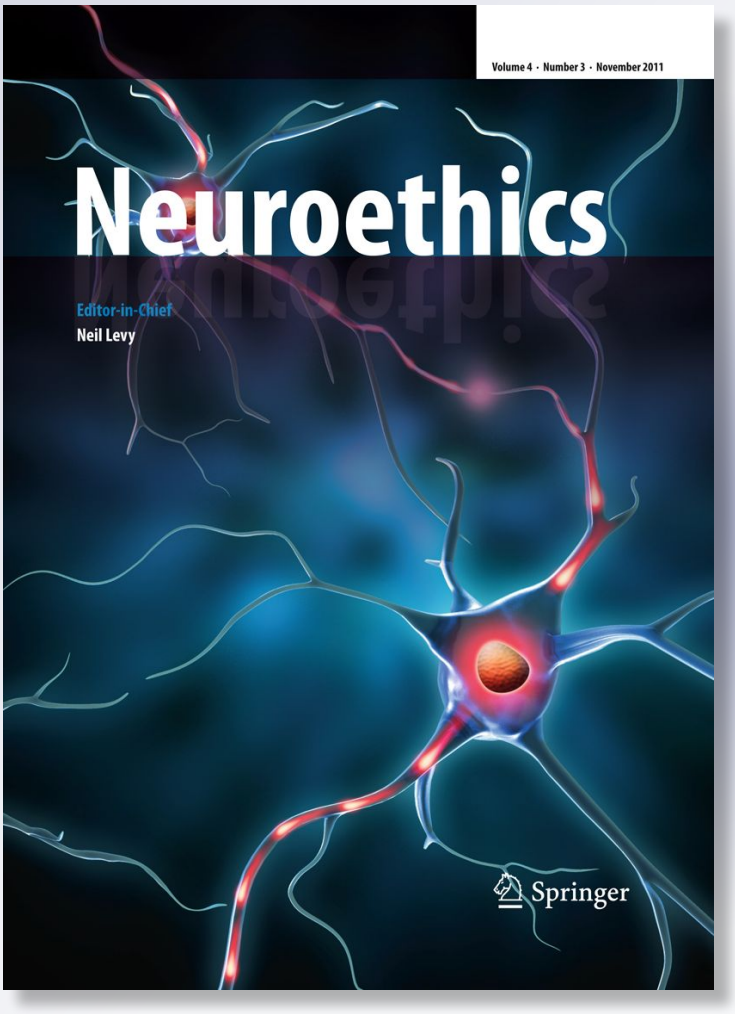
Delusions as Forensically Disturbing Perceptual Inferences

Jakob Hohwy & Vivek Rajan

Neuroethics

ISSN 1874-5490
Volume 5
Number 1

Neuroethics (2012) 5:5-11
DOI 10.1007/s12152-011-9124-6



Springer

Neuroethics (2012) 5:5–11
DOI 10.1007/s12152-011-9124-6

ORIGINAL PAPER

Delusions as Forensically Disturbing Perceptual Inferences

Jakob Hohwy · Vivek Rajan

Received: 1 December 2010 / Accepted: 14 February 2011 / Published online: 1 July 2011

Abstract Bortolotti's *Delusions and Other Irrational Beliefs* defends the view that delusions are beliefs on a continuum with other beliefs. A different view is that delusions are more like illusions, that is, they arise from faulty perception. This view, which is not targeted by the book, makes it easier to explain why delusions are so alien and disabling but needs to appeal to forensic aspects of functioning.

Keywords Delusions · Illusions · Belief · Perceptual inference · Forensic

Introduction

The early work on delusion formation by Maher [1]), Campbell [2] and by Davies & Coltheart [3] ignited a decade long debate involving an exciting interdisciplinary blend of researchers. Bortolotti's *Delusions and Other Irrational Beliefs* (*DOIB*) treats masterly some of the core parts of this debate. Bortolotti's main claim is that delusions are beliefs. She shows, convincingly, that none of the extant anti-belief arguments based on the rationality constraint work. Either they fail to apply to delusions or they unexpectedly apply to supposedly normal, paradigmatic instances of beliefs.

J. Hohwy (✉) · V. Rajan
Philosophy Department, Monash University,
Melbourne, Australia
e-mail: Jakob.Hohwy@monash.edu

In the light of Bortolotti's arguments is will be very hard indeed to use interpretationist considerations to resurrect the claim that delusions are not beliefs. This work has two immediate, important consequences. It reflects back on decades of philosophy of mind and language, showing that many of its sophisticated positions, in particular those of an interpretationist, rationality-centric bent, are problematic. It is delightful to learn that, if we wish to treat delusions as non-beliefs on the basis of interpretationist criteria, then we risk being unable to ascribe beliefs to ourselves. It also promises to save delusional individuals from the kind of damning label of insanity that comes from harbouring totally alien mental states. This is laudable but also, as we shall discuss, comes with the risk of trivialising these disabling conditions.

Our agreement with Bortolotti's arguments on their own terms notwithstanding, it seems to us that some aspects of the framework of *DOIB* stands in the way of achieving a deeper understanding of the nature of delusions. There are powerful reasons for aligning delusions with illusions and thus with perception rather than belief. But these reasons are not readily visible on a framework that deals primarily with rationality as it applies to belief-desire reasoning and explicit evaluation of perceptual evidence for or against belief.

The link to illusions and perceptual inference more widely suggests an alternative framework which to some extent undermines the standard notion of belief, it gives an attractive account of delusions and it gives centre stage to personal, affective and forensic aspects of delusions.

Are Delusions on a Continuum from Healthy Beliefs?

The view that delusions are not beliefs seeks to explain the difference between healthy beliefs and delusions. It discharges this task by placing delusions in a different class of mental states than beliefs. *DOIB's* argument that delusions are beliefs places delusions on a continuum with healthy beliefs and so risks not being able to explain the difference.

Some explanatory mileage can come from stressing that delusions are at an extreme end of the doxastic continuum. But this is a heavy explanatory burden to lift. The debate about continuum of psychosis is complex [4] and controversial [5]. At the extreme, irrational end of the continuum lies beliefs such as those of violent religious fanatics, paedophile predators and their institutional protectors, alien abductees, climate sceptics, and those of us who go about our normal domestic chores even though the planet is being accelerated towards its heat death. These are indeed very odd beliefs, which deeply baffles us when we are confronted with them. Perhaps some delusions belong quite naturally here but equally naturally some delusions seem recalcitrant:

1. A lady in her 50ies [reports that] she is Christus Filip, since Christus is her grandad and Filip is her dad. He was a Danish doctor and army general. She is herself the Law and the Danish world mother, her sons are Kings of Denmark. She has never had her own head, it has been kept back and has been "put in Russia for ever long times". She has three snakes in her belly and speaks through soul telephones with "resting members".
2. A patient reports that his children have been killed, cut up and served hidden in the food.
3. A lady [reports that she] is plagued by wireless phones, the blue is put upon her. She has, under hypnosis had many children with "astronomas". Astronomas are different people, who are mutually identical, namely police officer Y, dr. X, and Jesus in the woods. These astronomas speak to her and can perform "indications". That is what one sees. If the doctor kills you, they can perform an indication. The others have the power to perform the indication that one is put in a deep sleep.
4. A patient [reports that he] spits up the brain, all the cells in the brain are opening, and liquids come out through the forehead, he has a soft taste of brain in the mouth, pain in all ganglia cells.
5. For a patient, "a nerve in the intestine is torn, the blood is rotten"—all a consequence of the patient being a "liar, a lowly creep, God's swine" but in the same breath he characterises with some self-satisfaction his case as "unique and world renowned".
6. A 34 year old male on a disability pension never goes out and people avoid him. He is in no doubt this is for good reason: he stinks of faeces. The reason for this is clearly that his deformed spine puts pressure on his belly such that the faeces cannot get out. There is a hole in the intestines and the faeces seeps into the abdomen. At times he worries he will literally explode. He feels he is full of faeces and rot inside, and it is circulated through the entire organism in the blood. Brown sweat trickles through the skin, and that of course causes a disgusting smell of faeces. He washes very frequently but the smell returns at once; he can also feel it in his nose and mouth, even though he tries to keep it down with chewing gum and sweets.

   (Case 1–3: [7] p145; Case 4–5: [6] p304; Case 6: [8] p226. Translation from the Danish by JH).

These delusions are very alien and seem different in nature from the beliefs at the extreme end of the continuum. The Jasperian temptation to classify them as different from beliefs states is understandable, and labelling them 'beliefs' can easily seem merely notional. Treating them as just irrational beliefs risks trivialising them and makes it difficult to recognise why they are so disabling for people with schizophrenia. Cases like these provide a challenge to many of the arguments in *DOIB*: in contrast to the non-delusional beliefs at the extreme end of the continuum, it is difficult to see how any exacerbation of the irrational tendencies and biases that are widespread in the healthy population could lead to the formation of these delusional mental states.

In fact, in some of these delusional cases, there seems to be more procedural, epistemic and agential rationality than in some of the examples of non-delusional beliefs

at the extreme end of the continuum. Chewing gum is reasonable in the light of a faeces taste in the mouth, and if you are scared the doctor will kill you it is wise to let her know that astronomas will indicate the deed. This pulls us in the direction of a view like Maher's [1] on which delusions are rational responses to unusual experiences. The cost of this view is that it glosses over the fact that delusions seem to be paradigms of irrationality [9].

This indicates something with the shape of a dilemma: on the one hand, it is difficult to characterise the irrationality of delusions in terms of procedural, epistemic or agential notions of irrationality. On the other hand, it is difficult to account for the irrationality if delusions are viewed as rational responses to unusual experiences. We think that this underlies some of the tension evident in *DOIB's* concluding remarks where the categorical distinction between beliefs and delusions is rejected in favour of a continuity view and yet it is pointed out that delusions are in many ways more puzzling than other irrational beliefs.

The looming dilemma can be avoided if perceptual experience itself can be irrational. The idea that perception is unconscious Bayesian perceptual inference allows this. We will briefly sketch this kind of view and how it is distinct from the doxastic view of delusions defended in *DOIB*. We begin with the idea that delusions are in critical respects just like illusions.

Delusions and Illusions

Bortolotti briefly mentions the temptation to pursue the idea that delusions are faulty perceptual inferences on a par with perceptual illusions (p123). The idea is not developed more, however. Though understandable within the scope of the project this means that a candidate non-belief view of delusions is not dealt with.

One problem with aligning delusions with perceptual inference is that is seems to put delusions on a par with benign illusions such as the Müller-Lyer illusion and the ventriloquist illusion (where it seems a voice is "thrown" to a doll or more generally a sound is mislocated to a visual stimulus). Illusions are examples of unusual experiences arising as a result of faulty perceptual inference [10] but they are not delusions. It is however possible to bite the bullet on this issue [11]. There are in fact striking similarities between illusions and delusions and if we dismiss the idea out of hand we risk overlooking this. Moreover, there are possible responses to deal with their dissimilarities.

Many illusions are unrevisable. No matter how many times one measures the Müller-Lyer lines with a ruler, one cannot revise the perceptual inference that they are of unequal lengths. This is similar to delusions against which normal reality testing is powerless. If the unrevisability of illusions is due to some kind of cognitive impenetrability specific to low level sensory processes, then the same may be the case for delusional content.

The perceptual content of illusions is not "as if". Higher level beliefs about them might be cast in "as if" terms but that reflects the longer term regularities in the world than the immediate sensory attributes (involving how rulers work, or the possibilities of talking dolls, and so on) not the experience itself. You might say, for example, "it is as if the voice comes from the doll, that is how I hear it but of course it cannot really be the case". This may be replicated in delusions such that the core delusional perceptual inference persists even though at times patients will genuinely try to impose an "as if" structure on them.

Once we realise an illusion is in fact just an illusion it is possible to circumscribe it to some degree such that it does not infect other internal models. For example, we do not revise our overall models of the capabilities of animate and inanimate matter when we experience the ventriloquist illusion or the rubber hand illusion where a touch is felt to be administered on a rubber hand [12] (though in the latter case we revise our beliefs about how closely the sensation of touch is affiliated with the body's actual position). Neither do we act as if dolls can speak and rubber hands feel touch (though we laugh at the doll's insults and experience our hands to have drifted towards the rubber hand). Some delusions also have a degree of circumscription, such as the case of mirrored self-misidentification where the patient merely avoids mirrors rather than is utterly freaked by the presence of a strange lookalike in the mirror. Sometimes the circumscription associated with illusions is confined to a broader but still limited region, just as it can be in some cases of delusions (in a study of the rubber hand illusion [13] participants momentarily entertain the hypothesis that fingers had supernatural invisible extensions because that was what best explained the current, illusory, sensory input).

Other illusions are not circumscribed. There are many instances of the ventriloquist that we don't notice and the content of which are incorporated into our belief system and acted upon (vision captures sounds in many cases, for example when we watch TV; the Müller-Lyer is a result of our useful capacity for seeing one kind of edge as further away and therefore bigger than closer edges, [14]. Illusions are probably much more widespread and hard to detect than we think. That is, it may be difficult, and counterproductive, to reality test for illusions. Similarly, some delusional perceptual inference infect the wider belief system and agency (e.g., chewing gum to avoid the taste of faeces). There will probably be different causes for such differing degrees of integration, but many delusions seem to begin with sensory malfunction in sensory domains for which it is difficult to apply concrete reality testing methods (emotional, bodily, self-related, sexual, etc. domains; see [15]).

The analogy with illusions in respect of circumscription may go deeper. In the ventriloquist illusion there is mislocation of the auditory source in the presence of a (less noisy) visual input: the heard source is perceived as closer to the seen source than it really is. This mislocation disappears when the sound is heard on its own. The illusory mislocation results from optimal Bayesian sensory integration [16]. Something similar may be in play in delusions. We suggest this on the basis of anecdotal evidence from a case of Capgras [17]. The patient had the delusion when seeing his mother but not when talking to her on the phone. It is puzzling that the mother's voice did not counteract the illusion when the patient also saw her but this puzzle may be explained in terms of capture of the auditory input under a more general, integrative model weighted in favour of affective responses to visual input. These deeper analogies between illusions and delusions strike us as an exciting future research area.

There may thus be a more than passing analogy between delusions and illusions. This would remove delusions from the domain of beliefs and align it closer with perception. *DOIB's* arguments against uses of the rationality constraint on belief are still good ones. But it need not be that constraint which in the first instance motivates a non-belief view of delusions.

The alignment of delusions with illusions means treating delusions as a kind of perceptual state. We now turn to issues provoked by this perceptual turn.

Beyond the One-factor vs. Two-factor Distinction

Bortolotti discusses the distinction between Maher-style one-factor theories, on which delusions arise as rational responses to unusual experiences, and two-factor theories, on which delusions arise when in addition to unusual experiences there is a deficit or pathological bias in general reasoning competence (e.g., [18]). She aligns *DOIB* more closely with the two-factor theories (p35). This makes sense because most of the non-belief accounts of delusions central to the argument of the book operate at the level of propositional reasoning competence, that is, at the level of the supposed second factor.

But it is time to put this distinction behind us. It is part of the source of the looming dilemma discussed above and it prevents us from learning about the mind from the special case of delusions. The distinction relies heavily on the idea that perceptual content is generated in low level unconscious mechanisms subject to one set of processes and fed to belief systems subject to another set of processes.

The two-factor theory is problematic for a variety of reasons. It posits a domain general deficit of reasoning competence so it predicts that patients should have widespread delusions and yet patients with monothematic delusions do not. It also predicts that delusions are constantly present, instead of being, as seems to be the case, more dynamically shifting states. It predicts that patients but not healthy controls should develop delusions in response to unusual experiences such as perceptual illusions (or unusual unconscious sensory processing) but, though there is very little evidence on this, it doesn't seem to be the case.

The two-factor theory can respond to some of this by positing a partial deficit such that, for example, the ability to reject a belief is restored when the counterevidence is of a certain magnitude [18]. Even though the brain in some sense is driven by evidence accumulation, this move seems ad hoc. The belief that one's kids have been killed, chopped and hidden in the food already has a mountain of evidence against it, it would be odd if a few comments from carers could be what overcomes the reasoning deficit.

The main consideration in favour of the two-factor account and against the one-factor theory is that a second factor is needed to explain the occurrence of people without delusions but with unusual experiences seemingly similar to the experiences hypothesised to

drive delusions. It seems that a one-factor theory cannot accommodate this. In general the one-factor theory seems to predict that anyone with an unusual experience should develop delusion-like states, which does not seem the case. When people experience sensory illusions, such as the ventriloquist effect they do not think that the ventriloquist is really having a conversation with a wooden doll. However, as we mentioned above, delusions may be more like illusions than most are prepared to acknowledge—it is possible to bite the bullet on this. There are also further possible responses to this kind of problem [15, 19]. However, rather than resting on a Maher-style one-factor theory, these further responses essentially appeal to a more sophisticated Bayesian theory, which goes beyond the one- vs. two-factor view.

Competence Failure vs. Performance Failure, and Their Different Predictions

The difference between the one-factor theory and the two-factor theory can be cast in terms of the role of the domain-general reasoning process. On the two-factor account this process is deficient or biased such that *all* perceptual content it gets as input is processed such that the output is an irrational belief. This would give the mentioned prediction that patients would have widespread delusions. That is to say, the deficit or bias concerns reasoning *competence*. On the one-factor account there is still a role for domain general reasoning processes: the output is still an irrational state but this output is caused by there being a deficient input to the reasoning process. This gives the prediction that patients only develop delusions for *some* experiences, but that everyone would develop delusions for such deficient input experiences. That is to say, the deficit or bias concerns something prior to the reasoning process and there is only an issue of reasoning *performance*, given the deficient input.

Bortolotti argues that since the output in the case of the delusion is the same there is not much difference between the competence and performance failure accounts (p132). But there is a rather large difference since different distributions of delusional output are predicted on each account, as shown above. This matters for our understanding of delusion formation on these two accounts and it matters for the central topic of *DOIB*. It is easier to defend the position that delusions are of a kind with other irrational beliefs if they are generated by a reasoning competence failure than if they, in contrast to other irrational beliefs, are generated by deficient sensory processing plus intact reasoning competence. The choice of alliances in this debate is thus relevant for how we evaluate the conclusions of *DOIB*.

Bortolotti rightly points out that the distinction between performance and competence failure is not always sharp (p132). On the one-factor account there needs to be a competence failure somewhere too but this is posited to be lower in the cortical hierarchy. The question then arises how this failure can be kept distinct from the higher-level reasoning competence. There is bound to be an element of context-dependence in how one makes these distinctions. A key element will, as discussed, be which predictions are generated. Ultimately this issue relies on very general questions about functional segregation and functional integration in the brain [20, 21]. The best answer, we think, once again pushes us beyond the one-factor vs. two-factor distinction.

Believing is Perceiving

We have gestured at the idea that in some way it would be good to go beyond the simple distinction between the one-factor and the two-factor theories and towards the idea that delusions are faulty perceptual inferences. A relevant, promising and actively pursued theory of delusion formation is that it relies on failures of predictive coding [19, 22–24]. This theory is actively pursued and there is empirical evidence in its favour (see, e.g., [25]). This theory is a special case of what is proposed as a general principle of brain function, ultimately based in free energy minimisation [26]. On this account the same kind of prediction error minimisation mechanism is replicated throughout the cortical hierarchy, with the main difference between levels in the hierarchy being the time scale at which regularities in the environment are processed (millisecond time scales at low sensory levels, then seconds, and so on up to very stable causal relations at higher levels of the cortex). Pairs of levels in the cortical hierarchy are distinct mechanisms that receive input from levels below and transmit output to levels above. Higher levels serve as modulating control parameters for lower levels, such that longer term regularities can inform processing of shorter term

regularities. The whole system is subject to the stricture of prediction error minimisation such that top-down modulation of perceptual inference always is limited by the ability to minimise prediction error. The issue of procedural and epistemic rationality becomes just the matter of how well, overall, the system manages to suppress prediction error: integration into a belief system is a matter of how well higher level control parameters work on lower levels, epistemic sensitivity is a matter of Bayesian predictive coding.

Within this theoretical framework belief itself must, like perception, be a matter of prediction error minimisation. The difference between belief and perception lies in the time scale of the represented processes and their degree of invariance or perspective independence. There is no further special difference between them and the issue of rationality applies equally to perception and belief. From this perspective it is therefore easy to see how perception can be irrational. Given that the same computational mechanism is replicated throughout the system, it is also likely that the same kinds of failures, biases and deficits can occur at different levels and time scales, giving rise to different kinds of perceptual and doxastic phenomena. From this perspective there can be a number of combinations of low and high level types of malfunctions such that intuitions behind both one-factor and two-factor accounts in principle can be accommodated for different cases.

This computational framework in fact supports the central tenet of *DOIB*. It allows that delusions in some sense can be a belief state. But this is only because perception and belief are instantiations of the same epistemic mechanism for prediction error minimisation. Belief, and perception, on this view is the state whichever it is which at any time best suppresses prediction error. There can be such a state even if failures of epistemic and procedural rationality makes the state massively mistaken.

Agential rationality also fits into this framework. Agency is a way of changing the world to minimise free energy, or the discrepancy between internal models and the incoming sensory data at different time scales. The system has to learn the right balance between updating internal models, which is perception and belief, and changing the world to fit the models, which is agency. If malfunction interferes with this learning, for example such that the current state of the system is ambiguous (as in the case of Capgras' delusion "this looks like my husband but is really an impostor, though she can't be an impostor"), then agential irrationality can ensue.

This framework provides, as mentioned, the theoretical backdrop for the idea that delusions arise in the first instance as a result of faulty perceptual inference. If this is right, then it is not a given that they are irrational beliefs, on a par with other irrational beliefs. Some delusions could very well be better understood as irrational perceptual inferences.

What Makes Delusions Delusions? A Forensic Aspect

We thus think that some of the key aspects of delusions are in fact shared with illusions, and are set within a percetual inference framework. But just as aligning delusions with other irrational beliefs risks trivialising them, so does aligning them with illusions. We must also be able to explain how delusions are so different from innocuous illusions such as the Müller-Lyer. A key difference is that illusions seem to arise from processing demands that are generally very useful to have (e.g., in the way we process edges, on Gregory's interpretation, even though it gives rise to the Müller-Lyer), whereas delusions seem to arise from malfunction of some kind.

Bortolotti early on acknowledges that it would be "an attractive move" to view delusions as the upshot of a combination of epistemic features plus disruptive functioning (p24). She cites views (such as [27]) arguing for a distinction between everyday and psychotic delusions, where the latter are those that come with disruptive functioning. This theme is not pursued much throughout the book but we think it is crucial. Moreover, if this view is right, then the question for Bortolotti is whether the thesis that delusions are beliefs holds for everyday or psychotic delusions, or both.

It will be crucial for this line of reasoning to say what it is for functioning to be disruptive to a psychotic extent. An obvious candidate is when the content of the perceptual inference is in a personal, intimate or threatening domain. We don't care that we falsely see two lines as of unequal length or if by and large the sensory impression of watching TV is illusory. But we do care if we smell of faeces or if our head is not the right one.

An underexplored element here is the *forensic* consequences of having unusual perceptual inference

in these domains: we are most prepared to attribute delusions and initiate clinical arrangements when there is impairment to decision-making, autonomy and responsibility. In fact this seems to be the watershed between delusions and other delusion-like states, whether we think these states are beliefs or some other kind of mental state. Consider belief in alien abduction, for example, which may arise on the basis of experiences of sleep paralysis (and, perhaps, in combination with abuse) [28]. This is certainly an extreme mental state not that different from a patient's belief in visiting, "indicating" astronomas, but in many cases it has little significant forensic consequences so is not treated as clinically relevant. If this is right, then it serves as a warning to reductionist, biomedical accounts of delusions such as the one we have endorsed here, and also to *DOIB's* analysis of delusions as beliefs. They might be beliefs, or perceptual inferences more generally, but they are much more than that.

References

1. Maher, B.A. 1974. Delusional thinking and perceptual disorder. *Journal of Individual Psychology* 30: 98–113.
2. Campbell, J. 1999. Schizophrenia, the space of reasons and thinking as a motor process. *The Monist* 82(4): 609–625.
3. Davies, M., and M. Coltheart. 2000. Introduction: pathologies of belief. *Mind and Language* 15(1): 1–46.
4. Linscott, R.J., and J. van Os. 2010. Systematic reviews of categorical versus continuum models in psychosis: evidence for discontinuous subpopulations underlying a psychometric continuum. Implications for DSM-V, DSM-VI, and DSM-VII. *Annual Review of Clinical Psychology* 6(1): 391–419.
5. Lawrie, S.M., J. Hall, et al. 2010. The 'continuum of psychosis': scientifically unproven and clinically impractical. *The British Journal of Psychiatry* 197(6): 423–425.
6. Wimmer, A. 1936. *Speciel klinisk Psykiatri for Studerende og Læger*. Copenhagen: Levin & Munksgaard.
7. Strømgren, E. 1956. *Psykiatri*. Copenhagen: Munksgaard.
8. Bjerg Hansen, E. 1976. *Paranoia Hypocondriaca*. Copenhagen: Frederiksbjerg Bogtrykkeri.
9. Gold, I., and J. Hohwy. 2000. Rationality and Schizophrenic Delusion. *Mind and Language* 15: 146–167.
10. Gregory, R.L. 1980. Perceptions as hypotheses. *Philosophical Transactions of the Royal Society, London, Biological Sciences B* 290(1038): 181–197.
11. Rajan, V. (2010). Delusions in the light of illusions. Philosophy Department, Monash University. **Honours Thesis**.
12. Botvinick, M., and J. Cohen. 1998. Rubber hands 'feel' touch that eyes see. *Nature* 391(6669): 756–756.
13. Hohwy, J., and B. Paton. 2010. Explaining away the body: experiences of supernaturally caused touch and touch on non-hand objects within the rubber hand illusion. *PloS One* 5(2): e9416.
14. Gregory, R.L. 1998. *Eye and Brain*. Oxford: Oxford University Press.
15. Hohwy, J., and R. Rosenberg. 2005. Unusual experiences, reality testing, and delusions of control. *Mind & Language* 20(2): 141–162.
16. Alais, D., and D. Burr. 2004. The ventriloquist effect results from near-optimal bimodal integration. *Current Biology* 14: 257.
17. Hirstein, W., and V.S. Ramachandran. 1997. Capgras syndrome: a novel probe for understanding the neural representation of the identity and familiarity of persons. *Proceedings of the Royal Society: Biological Sciences B* 264: 437–444.
18. Coltheart, M. 2007. Cognitive neuropsychiatry and delusional belief. *Quarterly Journal of Experimental Psychology* 60: 1041–1062.
19. Hohwy, J. (2009). The hypothesis testing brain: some philosophical implications. *9th Conference of the Australasian Society for Cognitive Science, Sydney*: Macquarie Centre for Cognitive Science., Macquarie Centre for Cognitive Science.
20. Friston, K. 2002. Functional integration and inference in the brain. *Progress in Neurobiology* 68: 113–143.
21. Hohwy, J. 2007. Functional integration and the mind. *Synthese* 159(3): 315–328.
22. Fletcher, P.C., and C.D. Frith. 2009. Perceiving is believing: a Bayesian approach to explaining the positive symptoms of schizophrenia. *Nature Reviews Neuroscience* 10(1): 48–58.
23. Stephan, K. E., K. J. Friston, et al. (2009). Dysconnection in Schizophrenia: From Abnormal Synaptic Plasticity to Failures of Self-monitoring. *Schizophrenia Bulletin* 35(3): 509–527.
24. Corlett, P. R., J. R. Taylor, et al. (2010). Toward a neurobiology of delusions. *Progress in Neurobiology* 92(3): 345–369.
25. Teufel, C., A. Kingdon, et al. 2010. Deficits in sensory prediction are related to delusional ideation in healthy individuals. *Neuropsychologia* 48(14): 4169–4172.
26. Friston, K. 2009. The free-energy principle: a rough guide to the brain? *Trends in Cognitive Sciences* 13(7): 293–301.
27. Hamilton, A. 2007. Against the belief model of delusion. In *Reconceiving Schizophrenia*, eds. M.C. Chung, K.W.M. Fulford, and G. Graham, 217–234. Oxford: Oxford University Press.
28. Clancy, S. A. (2007). *Abducted: how people come to believe they were kidnapped* by Aliens. Harvard, Mass: Harvard University Press.