

REASONING IN SCHIZOPHRENIA. REVIEW AND ANALYSIS FROM THE COGNITIVE PERSPECTIVE

Valentina Cardella, Amelia Gangemi

Abstract

A long tradition of research on schizophrenia has considered defects in logical reasoning one of the core features of this mental disorder. According to this view, reasoning in schizophrenia is severely impaired. Nevertheless, an increasing amount of data coming from the cognitive perspective is making this conclusion more controversial, and seems to be heading in the same direction as a very different kind of tradition, that of psychiatric phenomenology. This approach considers the typical features of schizophrenia in terms of an enhancement of logic, rather than a defect of it (cf. Minkowski 1927, Binswanger 1956, Blankenburg 1971). In this paper, we will bring together these two different perspectives in order to explain why the “lack of logic” paradigm seems to fail to understand schizophrenics’ reasoning abilities.

Key words: schizophrenia, syllogistic reasoning, conditional reasoning, probabilistic reasoning, psychiatric phenomenology, cognitive studies

Declaration of interest: none

Valentina Cardella, Amelia Gangemi
Dipartimento di Scienze Cognitive, della Formazione e degli Studi Culturali
Università di Messina

Corresponding author

Valentina Cardella
vcardella@unime.it

Introduction

Schizophrenia is one of the most severe forms of mental disorder. According to the DSM V (APA 2013), the common signs of schizophrenia are delusions, hallucinations, disorganized thinking, negative symptoms and disorganized behavior. Delusions are false beliefs, usually bizarre, which are not open to change in the light of conflicting evidence. In some cases, they involve extraordinarily bizarre beliefs, e.g. having a completely see-through mind, with telepathically accessible thoughts, or having a microchip in the brain by which alien entities control what the subject says or does. The hallucinations are more common in the auditory form, and they are one of the most distressing symptoms of schizophrenia (patients can hear voices almost constantly). The term “disorganization” refers to a group of various symptoms that comprise the loosening of thought associations, disorganized speech, and bizarre behavior. The loosening of thought associations is the lack of an obvious connection between one thought and the next, and it has been regarded as the core symptom of schizophrenia since Bleuler’s time (Bleuler 1911). Schizophrenia also involves alterations in language and behavior, with both often becoming incoherent, poor, bizarre, and incomprehensible (in other words, disorganized). The negative symptoms involve a withdrawal or lack of a number of functions or traits, as in anhedonia – the inability to experience pleasure; catatonia – motor immobility, and abulia – impaired ability to perform voluntary actions.

Given that schizophrenics suffer from different

kinds of severe symptoms, they have difficulties in keeping the connection between thoughts, they show thought disorder and hold bizarre beliefs, the question is: to what extent do these deficits impair their reasoning abilities? And, moreover, do these symptoms cause a clear deficit in rationality? Delusional beliefs, in fact, with their somewhat absurd topics, and with their persistency, seem to be a clear proof of schizophrenics’ lack of rationality (Huq et al. 1988, Garety et al. 1991, Garety and Hemsley 1994, Bentall 1994).

Thus, schizophrenics should probably be very bad in formal reasoning. But, as we are going to see, new research has made this conclusion more controversial. According to some authors, it is not that easy to show that a failure to reason by standard logical rules is typical of schizophrenia. In this article, we will try to investigate schizophrenics’ reasoning abilities particularly focusing on the perspective of cognitive psychology. We will separate these studies on the basis of the ability analyzed: syllogistic reasoning, conditional reasoning and probabilistic reasoning. The aim of this work is to provide an overview of reasoning abilities in schizophrenia, in order to explore whether this form of mental disorder is actually characterized by specific reasoning deficits.

1. Syllogistic and conditional reasoning

Syllogistic reasoning is a form of deductive reasoning where a quantified statement of a specific form (the conclusion) is inferred from two (or more) other statements (the premises). Von Domarus (1944)

opened research on schizophrenic reasoning with a study on syllogisms that not only showed that schizophrenics break the rules of standard logic, but that assumed that this defect in reasoning abilities is the true cause of the disorganization typical of this disease. In particular, the author hypothesized a severe impairment in schizophrenics, the so-called von Domarus principle: a principle of identity which entails a false assumption of the identity of two subjects made on the basis of identical predicates. In other words, people with schizophrenia would draw conclusions that are grounded on the identity of the predicates, rather than on the identity of the subjects. For example, from the premises “a has the property x” and “b has the property x”, a schizophrenic would conclude “a is b”. Arieti (1955) would later clarify this principle through an example that would become very famous in the international literature. One of his schizophrenic patients thought she was the Virgin Mary, because of this kind of reasoning: The Virgin Mary was a virgin; I am a virgin; therefore, *I am the Virgin Mary*. Arieti (1955) claimed that schizophrenia was marked by paleological thought, which breaks the rules of Aristotelian logic, such as the principle of non-contradiction, according to which, “it is impossible to hold the same thing to be and not to be”, or the principle of identity, “A = A”, “a being is what it is”; these are the reasons why schizophrenic thought appears incorrect, obscure and meaningless. Arieti called this form of thought paleological because it would be an archaic way of thinking, shared with some primitive cultures.

Because of the von Domarus principle, schizophrenics would show many difficulties in syllogistic reasoning, in that they would draw invalid conclusions grounded on the identity of the predicates, rather than on the identity of the subjects. But, already in the Sixties, Gottesman and Chapman, though agreeing with the hypothesis of the defect in syllogistic reasoning, showed that there is no difference between schizophrenic and normal subjects in the tendency to identify two subjects on the basis of identical predicates: thus, the von Domarus principle would not be true for schizophrenics (Gottesman and Chapman 1960; see also Williams 1964).

But, apart from the von Domarus principle, do schizophrenics have specific defects in deductive reasoning? According to some authors, they do: Goel et al. (2004), for example, administered syllogisms that were either emotionally salient (e.g. “No drunks are saints; Some Irishmen are Saints, Some Irishmen are not drunks”) or emotionally neutral (“All crunchy tubers are vegetables; Some carrots are crunchy tubers, Some carrots are not vegetables”) to schizophrenic patients. They found schizophrenics’ performance to be very poor in all sorts of tests, also in the emotionally neutral variant, where healthy controls performed better (in fact, performance in the control group improved in the nonsalient trials, while patient performance was unaffected by saliency). But, as noticed by Mirian et al. (2011), this study was weakened by a clear floor effect in the patient group.

Actually, when schizophrenics and controls are matched for education and I.Q., the differences in their performance become very small, as showed, for example, by the work of Williams (1964), Belvin (1964) and Maher (1992). In a revealing study by Kemp and colleagues (Kemp et al. 1997) schizophrenic patients with delusion and control subjects showed no differences in performance on syllogistic reasoning tasks. More precisely, this task tested the capacity to judge the validity of forty syllogisms, whose content was believable (e.g. “No priests are criminals; Some

religious people are criminals, Some religious people are not priests”) or unbelievable (“No religious people are criminals; Some priests are criminals, Some priests are not religious people”), in a group of relatively intelligent delusional schizophrenics (currently delusional, with an average IQ of 108). Their performances did not differ from those of the control subjects, so they were able to judge the validity of a syllogism even if they were delusional.

In a recent study, based on a survey of previous works and on the results of different syllogistic reasoning tasks, Mirian and colleagues (2011) concluded that, when schizophrenic patients make mistakes about the judgment of a syllogism’s validity, they do so because of a general weakness in cognitive performance (e.g., a lower I.Q.), rather than a specific impairment of reasoning abilities in schizophrenia. In other words, they make mistakes when they have a lower IQ or some other cognitive deficit.

Moreover, it has been recently highlighted that, in some cases, schizophrenics are even more logical than normal subjects. For example, Owen and colleagues (2007) tested both “pure reasoning”, the ability to evaluate a syllogism’s validity (thus using valid and invalid syllogisms), and common sense, sound practical judgement, using syllogistic content that conformed to practical knowledge or departed from practical knowledge. Two series of syllogisms were presented to schizophrenic patients, each with a conflict between deductive truth and commonsense truth; the first series contained valid syllogisms that were non-common sense (e.g. “all buildings speak loudly; a hospital does not speak loudly; therefore, a hospital is not a building”). The second series contained common sense syllogisms that were invalid (e.g. “if the sun rises, then the sun is in the east; the sun is in the east; therefore, the sun rises”). Subjects were asked to accept the premises of each syllogism as true and then to decide on the truth or falsity of the third sentence. Results show that, under conditions where common sense and logic conflict, people with schizophrenia reason more logically than healthy individuals. In fact, they seem to perform even better than normal controls in the second series of syllogisms, the non-common sense ones (e.g., that conclude with “a hospital is not a building”); that is quite intriguing, because they do not get diverted by the content, which is counter-intuitive, and they apply logical rules better than controls, recognizing the validity of an argument also when its conclusion goes against common sense.

According to Owen, we can interpret these results in two ways: either people with schizophrenia are better at logic, or they are worse at common sense. The authors lean towards the last hypothesis, but they claim, however, that “concepts of rationality that prioritize theoretical reasoning over and above practical reasoning might apply more accurately in a pathological example of human thinking than in a healthy one” (Owen et al. 2007, p. 454).

Thus, these recent studies seem to confirm what philosophical psychiatry claimed long ago; that, regarding logic, psychotic subjects err on the side of the excess rather than on the side of the lack. Minkowski (1927), for example, used the expression “*morbid rationalism*” to identify that excess of rationality which leads schizophrenic patients to act in a very cold, hyperlogical way. The hypertrophy of the rational aspects of thought is what makes them perceive the world in a very rigid, intellectual way. Binswanger (1956), on the other hand, suggested that schizophrenics’ behavior is guided by a rigid consequentiality, a logic that is

brought to the extreme and that makes their actions very bizarre. But we will come back to this topic later, when we focus on clinical phenomenology.

Kemp et al. (1997) also used 40 reasoning tasks with the “if P, then Q” form to test schizophrenic ability in conditional reasoning. Conditional reasoning is a form of deductive logic based on the structure “if... then...”. We can draw two valid inferences from premises that have this structure: the modus ponens (given p, one can conclude q), and the modus tollens (given not-q, one can conclude not-p). Kemp and colleagues used reasoning tasks with different alternatives. Each alternative offered a choice of responses: true, false, and can’t say, and subjects were asked to tick the correct one. The content was either neutral (e.g. “If she meets her friend, then she will go to a play. She goes to a play – what follows?”) or emotional (“If she is raped then she will go to the police. She goes to the police – what follows?”). Results showed no relevant difference in the performance of schizophrenic patients and controls in the neutral conditionals. But, when the content was emotional, even if both groups performed worse than in the neutral content condition, delusional patients were more “sensitive”, and they made an increased number of fallacies. This result is consistent with the data of a growing literature, which focuses on the link between emotions and delusions (Bentall 1994, Freeman and Freeman 2008) and shows the presence of a deep relationship between the confirmatory reasoning that is typical of delusions, and negative emotions, which seem to be a sort of trigger of the delusion itself. However, Kemp et al. (1997, p. 402) notice that “the manipulation of emotional content appears to make the normal subjects behave more like the deluded subjects, suppressing more valid inferences and fewer fallacies”. Thus, when the content recalls a negative emotion, all subjects perform worse, but delusional ones are even more sensitive than controls.

Other studies seem to show that schizophrenic patients can be even better than healthy participants in conditional reasoning. Mellet et al. (2006) administered a demanding reasoning task to 26 schizophrenic patients and 26 healthy participants, known to promote a bias (i.e., a reasoning error) in healthy subjects, triggered by misleading context. Subjects were instructed to falsify conditional rules such as “If there is not a red square on the left, then there is a yellow circle on the right”. The vast majority of normal subjects produce an incorrect response in juxtaposing a red square on the left and a yellow circle on the right. The correct answer requires ignoring the figures quoted in the rule (e.g., keep the antecedent true: not a red square; make the consequent false: not a yellow circle). But the context of the task acts here as a trap: the presence of the word “not” together with the visual presentation of the figures quoted in the rule serves as a trigger to activate the “not-heuristic”, consisting of matching the item that is negated (Evans 1998). In most everyday situations, using an item or performing an action preceded by not is indeed a good way to break the rule (for example, when we touch an object we are not supposed to touch). However, in the particular case of conditional rules having “not” in the antecedent, this leads to a matching strategy that induces an incorrect answer. Schizophrenic patients presented a surprising imperviousness to the reasoning bias and had significantly better logical performance than their paired healthy participants. According to the authors, patients are better because of their deficit in the context processing that usually impairs them, but that, in this case, gives them a cognitive advantage over healthy controls.

2. Probabilistic reasoning

There is a large amount of research on probabilistic reasoning in psychotic patients, because these studies aim to explain the basis of one of the most studied psychotic symptoms, delusions, both in schizophrenia and paranoia. Paranoia, also called delusional disorder, is a psychiatric condition characterized by the presence of non-bizarre delusions, such as persecutory or grandiose ones, in the absence of other psychotic symptoms; therefore, anyone who wants to study delusions must deal with paranoid patients, as well. Many authors, among which Bentall (Bentall 1994, Bentall et al. 2001), Garety (Garety et al. 1991, Garety and Hemsley 1994, Garety et al. 2005), Freeman (Freeman et al. 2002, Freeman 2008), and Langdon (Langdon et al. 2010) have focused on schizophrenic and paranoid patients with persecutory delusions, and identified a hypothetical deficit in data gathering, called jumping to conclusions. Individuals with delusions seem to request minimal information in situations where information is available, and to report a high level of confidence in their decisions (Peters et al. 2008). The task used to test this bias is the “beads in jars” (Philips and Edwards 1966, Garety and Freeman 1999) in which individuals are presented with two jars each containing 100 colored beads. There are 60 beads of one color (e.g. black) and 40 beads of another (e.g. yellow) in one jar, while the other jar contains beads in opposite proportions (i.e. 40 black and 60 yellow). The jars are then removed from view. Upon request from the participant, beads will be presented, one at a time, from just one of the jars in a predetermined order. Participants can view as many beads as they want until they are certain from which jar the beads have been drawn. The number of beads requested before making a decision seems to be significantly lower in delusional patients (1-2, versus 3-4 of healthy subjects).

But these results still remain controversial. For example, Menon and colleagues (2006) did not find a link between delusions and jumping to conclusions; they only found a tendency to jump to conclusions in schizophrenia. In other words, delusional subjects do not always show this kind of bias. But, even if these data would disconfirm the link between delusion and jumping to conclusions, they could possibly confirm the presence of a link between schizophrenia and jumping to conclusions. But this is not the case. Even in schizophrenic patients, this cognitive style disappears when the role of memory is taken into account; when a variant of the task, with a memory aid, was carried out, there was in fact no difference between the performance of the schizophrenics and the controls. Just as in the case of syllogistic reasoning, where the differences in performance between patients and controls disappeared when the IQ variable was included, in data gathering the differences can decrease when the test includes other variables, like memory. Thus, this probabilistic reasoning bias may not be causally related to either delusions or schizophrenia, but might instead be partly due to a weakened memory or to a combination of impaired memory and some deficit in executive functions.

But there is another element that we have to consider. The jumping to conclusions bias, when present, seems to make the performance of the subjects even better. For example, Conway et al. (2002) presented paranoid patients with two reasoning tasks. The first one was the beads in jars; the second was a more complex gambling task. Subjects were asked to choose cards from four different decks; each card could either cause them to

win some money or to lose some money. Some decks were “bad decks” (leading to losses), and other decks were “good decks” (leading to gains). After some time, subjects were expected to learn which decks were the good ones. In both tasks, paranoid patients showed the jumping to conclusions bias, requesting less information than controls, but the interesting fact is that in the vast majority of cases, these hasty conclusions were correct (that is to say, they identified the right-coloured jar or the good deck).

The authors claim that a cognitive style which allows to draw conclusions as soon as possible and starting from a limited number of elements not only is not pathological in itself, but could rather be useful in some conditions, as showed by a large amount of research in cognitive psychology (Friedrich 1993, Trope and Liberman 1996, Smeets et al. 2000). This mechanism is usually triggered by a feeling of danger, when we sense a potential threat. In these cases we activate a strategy that is known in the literature as *better safe than sorry* (cf. for example Johnson-Laird et al. 2006): we usually tend to confirm our fears and jump to conclusions. For instance, if there is the smell of something burning, we automatically get alarmed and open the windows, without even checking whether something is actually burning. If we were wrong, we opened the windows in vain, but it is better to act in vain than underestimate danger and waste precious time checking the data. Coming back to psychopathology, it is a matter of fact, that those who hold persecutory delusions (be they schizophrenic or paranoid) see dangers and threats everywhere; a subject can look at two people whispering and jump to the conclusion that they are plotting against him and making an attempt to his life, and he can, therefore, quickly run away in order to leave them behind. If he was not right, he ran away unnecessarily, but if he was right, he fled to safety. So, this reaction is far from being irrational.

Many authors who claim that people with delusions have a jumping to conclusions bias, also claim that they have another bias in probabilistic reasoning: these patients (for example according to Kaney et al. 1997), would tend to judge negative events happening to themselves as more likely than controls. But in the same study by Kaney and colleagues, patients with schizophrenia and persecutory delusions also reported greater estimates of the likelihood of negative events happening to other people, and this would simply indicate a generally negative world-view, rather than a specific bias. The theories we have considered thus far, concerning the deficits in probabilistic reasoning, seem to be a bit controversial. But what we found quite intriguing about this kind of reasoning in schizophrenia comes again from Kemp and colleagues (1997). The authors tested probabilistic reasoning in schizophrenia by administering descriptions like the following one:

“Sally is 29 years old. She ran away from home at the age of 15 because she got pregnant. She is sexually attractive and has had many partners. Recently, she has lost a lot of weight and has had to go into hospital for tests”.

After the description, subjects were asked to judge the likelihood of these different alternatives: Sally... (a) is a famous high court judge; (b) is a teacher in a primary school; (c) is a teacher in a primary school and has AIDS. In this example, the first alternative is improbable, the second is possible although unlikely (the correct choice), and the third combines the second alternative with a likely description. Normals tend to choose the response that contains contextual information which accords with the schema they have

created on the basis of the vignette (in this case, the response 3, where the word “AIDS” is mentioned). In other words, normal people rely on representativeness to make judgments (the representativeness heuristic), that is, they think that something is more likely because it is more representative (Tversky and Kahneman 1982). However, in this specific case this means that two events are judged as more likely than one of the events alone (a logical impossibility known as the conjunction fallacy). The results reveal a slightly higher rate of conjunction fallacies in the controls, while schizophrenics have more correct responses; four of the deluded subjects chose the correct response, versus one of the controls; they seem therefore to be less sensitive to this conjunction fallacy. Thus, also in probabilistic reasoning, as for the syllogistic and conditional one, not only specific deficits in schizophrenia remain to be shown, but in some cases, schizophrenic patients seem to reason even better than controls.

3. Conclusions: are schizophrenics bad at reasoning?

What is the difference, then, between schizophrenics and healthy subjects in reasoning abilities? Do schizophrenic patients follow the formal rules of logic or do they make more mistakes than normal subjects? At this point, we have to say something more about the notion of rationality. A lot of research seems to show that normal people do not usually follow the formal rules of logic (e.g., Wason 1966; Kahneman et al. 1982; Johnson-Laird 1983; Evans 1989, 2002; Johnson-Laird and Byrne 1991; Plous 1993; Rips 1994; Newstead and Evans 1995; Osherson 1995; Evans and Over 1996; Baron 1998; Shafir and Tversky 1995; Johnson-Laird 2006). The content of the single task, the context it activates, the beliefs it involves, all of this seems to influence human performance; we try to be rational, but in many cases we can't. Human reasoning appears to be ‘belief sensitive’, and ‘goal sensitive’, in that its strategies also depend on the perceived utilities, and thus, we can commit more logical errors than expected (Manktelow and Over 1991; de Jong et al. 1997, 1998; Smeets et al. 2000).

On the other hand, studies on reasoning in anxiety and mood disorders (e.g., obsessive-compulsive disorder, hypochondria, depression) seem to show that people who suffer from psychological disorders are not bad at reasoning, rather they follow the same rules as healthy people, and patients could become expert reasoners in the domain of their disorder (cf. Smeets et al. 2000, Harvey et al. 2004, Johnson-Laird et al. 2006).

In line with this research, recent literature shows that even a severe mental illness like schizophrenia does not involve a deficit in reasoning abilities. When these are tested, differences in performance between controls and schizophrenics become surprisingly small when patients are matched for I.Q. or for other cognitive abilities. And, as regarding probabilistic reasoning, the jumping to conclusions, which is present in many schizophrenics, is likely a dependent variable as well, since it tends to disappear when the role of memory is taken into account.

What we would like to stress, however, is that under certain circumstances, schizophrenic subjects seem to reason even better than healthy ones (except for their greater sensitivity to emotional content). We could now return to the research tradition we mentioned above: that of psychiatric phenomenology. The approach of this kind of psychiatry is completely different to that

of cognitive psychology, and of clinical psychiatry, as well. It is inspired by existentialism on one hand, and phenomenology on the other, and it aims to describe the basic structures of subjective experience in people suffering from mental disorders. The way the patient perceives and experiences the world has to be completely understood in order to find a reason in his behavior, no matter how strange it might seem. Many authors that embrace this perspective claim that the problem in schizophrenic reasoning is not the lack of logic, but the excess of it, a sort of intellectual attitude toward the world. Binswanger (1956), for example, suggested that the most bizarre actions are sometimes due to an excess of logic, such as when a schizophrenic patient gives his daughter (who is terminally ill) a coffin as a Christmas present. This action, that appears as something that is totally absurd and inhuman, actually derives from a sort of “syllogistic” reasoning: a present has to be useful, and for a dying daughter the only useful thing is a coffin; then, the only gift that the patient conceives is a coffin. The logic in this reasoning is faultless, but the result of this kind of logic is a behavior that is striking for its strangeness and lack of empathy. Schizophrenic patients seem to have no choice, they see no alternatives, and can’t help but grasp on to logic because nothing else is left (cf. Pennisi 1998).

Stanghellini and Ballerini, following Minkowski, noted in schizophrenic patients “an intellectualistic attitude that consists in governing one’s own life according to abstract principles and renouncing the non-rational feelings of harmony with oneself and the outer world” (2011a, p. 173). This attitude is even more evident in social situations, when they usually try to elaborate methods to understand people, for example building explicit algorithms. These methods rely “either on the ‘ethological’ observation of human behaviours (‘I am like an anthropologist’, ‘I spend my afternoons in the gardens watching how they manage to interact with each other’) or on the ‘scientific’ analysis of the working of ‘intelligent’ mechanisms (‘It’s some mechanism, yeah, like a watch; I know it because it’s always the same’). Our patients often endorsed a mechanistic, and in some way ‘mathematizable’ conceptualization of sociality (‘I’ve studied a system to intervene at the right moment in conversations’)” (Stanghellini and Ballerini 2011b, p. 188).

An increasing amount of data coming from the cognitive perspective seems to reach the same conclusion of phenomenological psychiatry; that the problem of schizophrenics is not that they are irrational. As we have seen, in some cases schizophrenics are more logical than healthy people, they are able to judge the validity of a syllogism without being distracted by its content, they falsify conditional rules without being diverted by heuristic traps, and they are usually less sensitive to a number of reasoning biases. Still, in everyday life, being more logical does not always pay. In fact, the excess of logic makes the life of schizophrenics much more complicated.

Thus, we agree with Owen and colleagues (2007) when they suggest a new concept of rationality: we cannot assume that schizophrenic patients are bad in reasoning, because they break formal rules less often than normal subjects, and maybe what is wrong with them, what makes their thinking so peculiar, is the predominance of theoretical reason over practical reason. Therefore, it appears to us that these words, written fifty years ago, are still true: “in psychotherapeutic work with intelligent schizophrenics one is tempted, again and again, to conclude that they would be much better off, much more ‘normal’, if they

could only somehow blunt the acuity of their thinking and thus alleviate the paralyzing effect it has on their actions” (Watzlawick et al. 1967, p. 222).

Investigating schizophrenic reasoning through the methodology of both phenomenology and cognitivism, and thus establishing links between the persons’ subjective experience and experimental measures of mental deficits (Stanghellini, Ballerini 2011a), may represent the right way to evaluate schizophrenic reasoning abilities, and may also throw a new light into our concept of rationality.

References

- American Psychiatric Association (APA) (2013). *Diagnostic and Statistical Manual of Mental Disorders Fifth Edition*. American Psychiatric Association, Washington.
- Arieti A. (1955). *Interpretation of schizophrenia*. Brunner, Oxford.
- Baron J (1988). *Thinking and deciding*. Cambridge University Press, Cambridge
- Belvin WE (1964). Deductive reasoning in schizophrenia. *The Journal of Abnormal and Social Psychology* 69, 1, 47-61.
- Bentall RP (1994). Cognitive biases and abnormal beliefs: Towards a model of persecutory delusions. In David A and Cutting J (eds) *The neuropsychology of schizophrenia*. Lawrence Erlbaum Associates Ltd., Hove, UK.
- Bentall RP, Corcoran R, Howard R, Blackwood N, and Kinderman P (2001). Persecutory delusions: a review and theoretical integration. *Clinical Psychology Review* 21, 8, 1143-1192.
- Binswanger L (1956). *Drei Formen missglückten Daseins. Verstiegtheit, Verschrobenheit, Manieriertheit*. Niemeyer, Tübingen.
- Blankenburg W (1971). *Der Verlust der natürlichen Selbstverständlichkeit*. Ferdinand Enke Verlag, Stuttgart.
- Bleuler E (1911). *Dementia Praecox oder Gruppe der Schizophrenie*. Deuticke, Leipzig.
- Conway CR, Bollini AM, Graham BG, Keefe RS, Schiffman SS, and McEvoy JP (2002). Sensory acuity and reasoning in delusional disorder. *Comprehensive Psychiatry* 43, 3, 175-8.
- de Jong PJ, Mayer B, and van den Hout M (1997). Conditional reasoning and phobic fear: Evidence for a fear-confirming pattern. *Behaviour Research and Therapy* 35, 507-516.
- de Jong PJ, Haenen M, Schmidt A, and Mayer B (1998). Hypochondriasis: the role of fear-confirming reasoning. *Behaviour Research and Therapy* 36, 65-74.
- Evans JSBT (1989). *Bias in human reasoning: Causes and consequences*. Lawrence Erlbaum Associates Ltd, Hove, UK.
- Evans JSBT, and Over DE (1996). *Rationality and reasoning*. Psychology Press, Sussex, UK.
- Evans JSBT (1998). Matching bias in conditional reasoning. Do we understand it after 25 years? *Thinking and Reasoning* 4, 45-82.
- Evans JSBT (2002). Logic and human reasoning: an assessment of the deduction paradigm. *Psychological Bulletin* 128, 978-996.
- Freeman D, Garety PA, Kuipers E, Fowler D, and Bebbington PE (2002). A cognitive model of persecutory delusions. *British Journal of Clinical Psychology* 41, 4, 331-347.
- Freeman D (2008). The assessment of persecutory ideation. In Freeman D, Bentall R and Garety P (eds) *Persecutory Delusions*. Oxford University Press, Oxford.
- Freeman D and Freeman J (2008). *Paranoia: The 21st Century Fear*. Oxford University Press, Oxford.
- Friedrich J (1993). Primary Error Detection and Minimization (PEDMIN) strategies in social cognition: A reinterpretation of confirmation bias phenomena. *Psychological Review*

- 100, 298-319.
- Garety PA, Hemsley DR, and Wessely S (1991). Reasoning in deluded schizophrenic and paranoid patients: Biases in performance on a probabilistic inference task. *Journal of Nervous and Mental Disease* 179, 194-201.
- Garety PA, and Hemsley DR (1994). *Delusions: investigations into the Psychology of Delusional Reasoning*. Oxford University Press, Oxford.
- Garety PA, and Freeman D (1999). Cognitive approaches to delusions: A critical review of theories and evidence. *British Journal of Clinical Psychology* 38, 113-154.
- Garety PA, Freeman D, Jolley S, Dunn G, Bebbington PE, Fowler D, Kuipers E, and Dudley R (2005). Reasoning, emotions and delusional conviction in psychosis. *Journal of Abnormal Psychology* 114, 373-384.
- Goel V, Bartolo A, St Clair D, and Venneri A (2004). Logical reasoning deficits in schizophrenia. *Schizophrenia research* 66, 1, 87-88.
- Gottesman L, and Chapman LJ (1960). Syllogistic reasoning errors in schizophrenia. *Journal of Consulting Psychology* 24, 3, 250-255.
- Harvey A, Watkins E, Mansell W, and Shafran R (2004). *Cognitive behavioural processes across psychological disorders: A transdiagnostic approach to research and treatment*. Oxford University Press, Oxford.
- Huq SF, Garety P, and Hemsley DR (1988). Probabilistic judgements in deluded and non-deluded subjects. *Quarterly Journal of Experimental Psychology* 40A, 801-812.
- Johnson-Laird PN (1983). *Mental Models: Towards a Cognitive Science of Language, Inference, and Consciousness*. Cambridge University Press, Cambridge.
- Johnson-Laird PN (2006). *How We Reason*. Oxford University Press, Oxford.
- Johnson-Laird PN and Byrne RMJ (1991). *Deduction*. Lawrence Erlbaum, Hillsdale.
- Johnson-Laird PN, Mancini F, and Gangemi A (2006). A Hyper Emotion Theory of psychological illnesses. *Psychological Review* 113, 4, 822-841.
- Kahneman D, Slovic P and Tversky A (eds) (1982). *Judgment under uncertainty: Heuristics and biases*. Cambridge University Press, Cambridge.
- Kanay S, Bowen-Jones K, Dewey ME, and Bentall RP (1997). Two predictions about paranoid ideation: Deluded, depressed and normal participants: subjective frequency and consensus judgments for positive, neutral and negative events. *British Journal of Clinical Psychology* 36, 3, 349-364.
- Kemp R, Chua S, McKenna P, and David A (1997). Reasoning and delusions. *The British Journal of Psychiatry* 170, 398-405.
- Langdon R, Ward PB, and Coltheart M (2010). Reasoning anomalies associated with delusions in schizophrenia. *Schizophrenia Bulletin* 36, 2, 321-330.
- Maher BA (1992). Models and methods for the study of reasoning in delusions. *Revue Européenne de Psychologie Appliquée* 42, 97-102.
- Manktelow KI, and Over DE (1991). Social roles and utilities in reasoning with deontic conditionals. *Cognition* 39, 85-10.
- Mellet E, Houdé O, Brazo P, Mazoyer B, Tzourio-Mazoyer N, and Dollfus S (2006). When a schizophrenic deficit becomes a reasoning advantage. *Schizophrenia Research* 84, 359-364.
- Menon M, Pomarol-Clotet E, McKenna PJ, and McCarthy RA (2006). Probabilistic reasoning in schizophrenia: A comparison of the performance of deluded and non-deluded schizophrenic patients and exploration of possible cognitive underpinnings. *Cognitive Neuropsychiatry* 11, 521-536.
- Minkowski E (1927). *La schizophrénie. Psychopathologie des schizoïdes et des schizophrènes*. Payot, Paris.
- Mirian DR, Heinrichs W, and McDermid Vaz S (2011). Exploring logical reasoning abilities in schizophrenia patients. *Schizophrenia Research* 127, 178-180.
- Newstead SE, and Evans JBT (eds) (1995). *Perspectives on thinking and reasoning*. Erlbaum, Hove, UK.
- Osherson DN (1995). Probability judgment. In: Smith EE and Osherson DN (eds) *Thinking*, vol. 3. MIT Press, Cambridge.
- Owen GS, Cutting J, and David AS (2007). Are people with schizophrenia more logical than healthy volunteers? *British Journal of Psychiatry* 191, 453-454.
- Pennisi A (1998). *Psicopatologia del linguaggio*. Carocci, Roma.
- Peters ER, Thornton P, Siksou L, Linney Y, and MacCabe JH (2008). Specificity of the jump-to conclusions bias in deluded patients. *British Journal of Psychology* 47, 239-244.
- Philips LD, and Edwards W (1966). Conservatism in a simple probabilistic inference task. *Journal of Experimental Psychology* 72, 346-354.
- Plous S (1993). *The psychology of judgment and decision making*. McGraw-Hill, New York.
- Rips LJ (1994). *The psychology of proof*. MIT Press, Cambridge.
- Shafir E, and Tversky A (1995). Decision making. In: Smith EE and Osherson DN (eds) *Thinking*. MIT Press, Cambridge.
- Smeets G, De Jong PJ, and Mayer B (2000). If you suffer from a headache, then you have a brain tumour: domain-specific reasoning 'bias' and hypochondriasis. *Behaviour Research and Therapy* 38, 8, 763-776.
- Stanghellini G, Ballerini M (2011a). What is like to be a person with schizophrenia in the social world. A First-Person Perspective Study on Schizophrenic Dissociality – Part 1: State of the Art. *Psychopathology* 44, 172-182.
- Stanghellini G, Ballerini M (2011b). What is like to be a person with schizophrenia in the social world. A First-Person Perspective Study on Schizophrenic Dissociality – Part 2: Methodological Issues and Empirical Findings. *Psychopathology* 44, 183-192.
- Trope Y, and Liberman A (1996). Social hypothesis testing: Cognitive and motivational mechanism. In: Higgins ET, and Kruglanski AW (eds) *Social psychology: Handbook of basic principles*. Guilford Press, New York.
- Tversky A, and Kahneman D (1982). Evidential Impact of Base Rates. In: Kahneman D, Slovic P, and Tversky A (eds) *Judgment under Uncertainty: Heuristics and Biases*. Cambridge University Press, Cambridge.
- von Domarus E (1944). The specific laws of logic in schizophrenia. In Kasanin JS (ed) *Language And Thought In Schizophrenia*. University of California Press, Berkeley.
- Wason PC (1966). Reasoning. In Foss BM (ed) *New horizons in psychology*. Penguin, Harmondsworth.
- Watzlawick P, Beavin JH, and Jackson DD (1967). *Pragmatics of human communication. A study of Interactional patterns, Pathologies and Paradoxes*. Norton and Company, New York.
- Williams BE (1964). Deductive reasoning in schizophrenia. *The Journal of Abnormal and Social Psychology* 69, 1, 47-61.