

3 Emotion, reasoning, and psychopathology

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Summary

This chapter addresses the two main mysteries of psychopathology: what causes psychological illnesses and what maintains them. One prevalent view is that both result from faulty reasoning. Yet, healthy individuals also err in their reasoning. The chapter outlines an alternative account, the hyper-emotion theory that attributes these illnesses to emotions of a pathological intensity. These hyper-emotions enhance patients' reasoning, which in turn prolongs their illnesses. Empirical studies corroborate this theory. They show that basic emotions tend to occur at the onset of psychological illnesses, that psychiatrists and patients can identify the strategies of reasoning in different illnesses, even when the content is held constant, and that patients suffering from a psychological illness reason better than control participants about contents pertinent to their illnesses. Psychological illnesses are accordingly disorders in emotion, not intellect.

For a man who is in great joy or in great pain, in his unseasonable eagerness to attain the one and to avoid the other, is not able to see or to hear anything rightly, but he is mad and is at the same time utterly incapable of any participation in reason.

– Plato, *Timaeus*, 86b

I'm afraid of the little pain I feel in my abdomen on the same side as my liver. It could be a symptom of cancer, cancer of the liver. I remember an uncle of mine who died from liver cancer after suffering a lot. In the beginning, his symptoms were the same as mine. He had a similar stomach ache. He didn't care, and the doctors told him that he wasn't ill. But, meanwhile the cancer was spreading. Now, in the same way the cancer may be spreading in my abdomen. Indeed, my symptoms seem to have become worse during the last few weeks. Nobody believes me, and nobody takes me seriously. When they

do start to treat me, it will be too late! Moreover, it seems to me that I look unhealthy; my tongue is dirty; sometimes my mouth tastes bitter. I seem to be pale, and I could have anaemia. What a trauma it will be for me and my family when the cancer is correctly diagnosed, and it will be too late! Afterwards, my life will be one of suffering, drugs, medical tests, checks, and surgical operations. The best I can do is to go back to my doctor.

The photographer must have been close to Rock Hudson because the photograph was a “close up.” So, the photographer himself might have been contaminated. So, when he developed the negative, he could have contaminated it. The negative was in contact with the print of the photograph and so could have contaminated it. The man in charge of printing the newspaper used the photograph, and so, he could have passed its contamination on to the newspaper’s printer. The printing press could have passed the contamination on to the picture in every newspaper. So, when I touched the newspaper, I may have been contaminated with the HIV virus.

It is several months now since Anna left me. I’m missing her terribly. I feel very lonely. I could try and ring Giovanna. Perhaps we can become friendlier, even go out together. After all, she has always shown that she likes me. Yes, but even if she were willing to go out with me, what use would it be to me? She is not like Anna: Anna is brilliant. We were very close. It wouldn’t be the same with Giovanna. She doesn’t have Anna’s smile. She doesn’t give me the same lovely and powerful feelings. There is no point in calling Giovanna; in no way could it ever be the same thing. I can’t live without Anna: I must absolutely get her back. Perhaps she misses me too, and perhaps she is not happy with this other guy she lives with now. If I ring her and ask her out she might accept. No, there is no chance of her being willing ... I will never find another woman whom I like as much, or who can take Anna’s place in my heart. I shall be alone for the rest of my life.

These three individuals thinking aloud about their predicaments are based on real cases under treatment from the second author. The protocols characterize psychological disorders more vividly than the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV-TR, American Psychiatric Association, 2000). Hypochondria, as in the first case, is characterized by a focus on bodily feelings, an inference about the possibility of illness, which is resolved only by the decision to go back to the doctor once more: it’s better to be safe than sorry. Obsessive-compulsive disorder, as in the second case, is characterized by anxiety about possible contamination, potential guilt, and ritualized cleansing behaviors or compulsive checking. Depression, as in the third case, is characterized by profound sadness, pessimism, inability to enjoy life, and reluctance or inability to act.

The protocols illustrate the two deepest mysteries that confront clinicians (Mancini & Gangemi, 2002; Salkovskis, 1996; Seligman, 1988). First, how is it possible for human beings to so misread their circumstances that they have a pathological reaction to them? They draw far too negative conclusions about themselves: *I may have cancer; I may have the HIV virus; I shall be alone for the rest of my life*. Second, how is it possible for their attitudes to persist in the face of strong evidence to the contrary? In short, what are the immediate causes of psychological disorders and what maintains them?

No consensus exists among professionals about these matters. Psychoanalysts attribute the cause of mental illnesses to unconscious conflicts in childhood (Freud, [1916–1917] 1973). Cognitive therapists attribute it to false beliefs and faulty reasoning (Beck, 1976). And hard-nosed psychiatrists attribute it to defects in brain chemistry (Veenstra-VanderWeele, Anderson, & Cook, 2002). Expert knowledge of psychological disorders is akin to knowledge of diseases such as cholera in the early 19th century. There are specific diseases but no agreement about their cause, pathology, or treatment (see the successive editions of the DSM). Ignorance, however, is no deterrent to treatment, and the lack of a definitive aetiology is a recipe for therapeutic profligacy: hundreds of different psychotherapies exist (MacLennan, 1996). Medicine until recent times was a succession of fallacies of the form *post hoc ergo propter hoc* (Porter, 1997), and the one certainty about psychological disorders is that many individuals recover from them regardless of the psychotherapeutic analogues of cupping, bleeding, and leeching.

Our aim in the present chapter is to report some progress in solving the twin mysteries of the cause and maintenance of psychological disorders. We begin with earlier studies of psychopathology and reasoning to set the scene for the initial observations that led to our skepticism about standard accounts. We outline the theory that we developed to resolve the twin mysteries (Johnson-Laird, Mancini, & Gangemi, 2006). We describe evidence corroborating the theory. It comes in four separate strands: (1) studies of emotions at the onset of these illnesses; (2) studies of how emotions affect the reasoning of healthy individuals; (3) studies of how well patients reason; and (4) studies of the reasoning strategies in different sorts of psychological illness. Finally, we draw some conclusions about mental disorders.

Psychopathology and reasoning

The idea that mental illnesses are disorders in rationality goes back at least to Plato in the Western tradition (see the epigraph above). The good life depends on health and the ability to reason. This tradition is pervasive and influenced studies of psychopathology in the 20th century. Schizophrenics, it was argued, infer that two classes are identical if they have a property in common (Von Domarus, 1944; but cf. Owen, Cutting, & David, 2007). Neurotics, it was argued, can express the subject matter of a repressed thought only on condition that it is negated—for instance, when a patient asserts of a dream figure, “it was

not my mother,” he means it *was* his mother (Freud, 1925). In jurisprudence, insanity also rests on irrationality. The influential M’Naghten rule states that a legal defence on grounds of insanity demands a proof that the accused party “was labouring under such a defect of reason, from disease of mind, as not to know the nature and quality of the act he was doing; or ... that he did not know he was doing what was wrong.”

The same point of view underlies cognitive theories of psychopathology. They postulate that irrational inferences lead to psychological illnesses (Beck, 1976; Garety & Hemsley, 1997; Harvey, Watkins, Mansell, & Shafran, 2004), and the resulting biases help to maintain the disorders (e.g., Bögels & Mansell, 2004; Clark & McManus, 2002; de Jong, Weertman, Horselenberg, & van den Hout, 1997; Hirsch & Clark, 2004). Hence, patients should be more irrational in reasoning about their illnesses than about other topics. Logic is the antidote (Leahy, 2004), and so cognitive therapies aim to correct the inferential errors that lead to dysfunctional beliefs (Smeets & de Jong, 2005; Young & Beck, 1982).

Doubtless, individuals with mental illnesses often reason badly, but are they any worse than healthy individuals? Despite a tradition of over 2000 years, only in the last decade have psychologists compared the inferences of patients with those of healthy individuals. The results break the Platonic link between rationality and mental health.

Common observation suggests that human beings often fail to be sensible or rational. Yet, they function quite well, and so mistakes in reasoning are not too maladaptive and are sometimes beneficial (Smeets, de Jong, & Mayer, 2000; Taylor & Brown, 1988). The ability to reason well is not essential for survival—as shown by the evolutionary success of many creatures that make systematically invalid inferences. One example from many is that honey bees violate transitivity in their preferences, preferring flower A to B, B to C, and C to D, and yet preferring D to A (e.g., Shafir, 1994). Nevertheless, the notion that human reasoners err is anathema to many psychologists, and so for every claim of irrationality there are counterclaims of rationality. Here is the nub of the issue.

In the best of circumstances, human reasoners are capable of rational thinking: otherwise, mathematics, science, and much else besides, could not exist. Indeed, people outside these disciplines enjoy exercising their logical competence, as shown in the world-wide popularity of Sudoku puzzles, which depend on pure deduction (Lee, Goodwin, & Johnson-Laird, 2008). Arguments that humans are rational in a broad conception of rationality, such as a probabilistic one, have an element of truth in them (Oaksford & Chater, 2007), but evidence also shows that human reasoners make systematic errors in reasoning (e.g., Johnson-Laird & Byrne, 1991; Johnson-Laird, Legrenzi, Girotto, & Legrenzi, 2000; Johnson-Laird, Lotstein, & Byrne, 2012). One pertinent form of irrationality is the failure to test hypotheses properly. Wason (1960) studied how participants tested their own hypotheses about the principle governing triples of digits, such as 2-4-6. Given a participant’s hypothesis, *even ascending numbers*, a rational test selects a negative instance of the hypothesis, such as 1-2-3, because tests of positive instances cannot falsify the hypothesis if it is a special case of the true principle.

In fact, 1-2-3 is an instance of the true principle, and so it refutes the participant's hypothesis. Yet, they seldom select negative instances of their hypotheses, and so quite often fail to discover the true principle, which is *any ascending triple of numbers*. Wason supposed that individuals are biased to confirm their hypotheses, but another possibility is they are biased to test positive instances of their hypotheses with any intention of confirming them (Klayman & Ha, 1987). In either case, the failure is irrational.

Granted that healthy individuals err in reasoning, the one hope for the Platonic doctrine is that mental illnesses yield more egregious errors. Yet, anecdotal observation suggested to us that patients reason well. The second protocol at the start of the chapter is a piece of virtuoso reasoning: an obsessive patient constructs a long chain of inferences implying that she may have contracted the HIV virus. She realizes her conclusion is unlikely, yet, typically for such patients, she cannot reject it. Observations of this sort led us to wonder whether poor reasoning is the cause of mental illnesses. But, if it is not the cause, then what is?

The hyper-emotion theory

An answer to the preceding question comes from the hyper-emotion theory: emotions cause psychological illnesses (Johnson-Laird et al., 2006). The emotions are appropriate to the situation but inappropriate in their intensity. This account depends on a theory of emotions and a theory of reasoning, which we now outline, and it yields testable predictions including an account of the different reasoning strategies in psychopathology.

The theory of emotions postulates that cognitive evaluations of situations trigger emotions, which in turn predispose individuals to certain courses of thought and action (Oatley & Johnson-Laird, 1987; 1996). Innate mechanisms yield *basic* emotions, which are universal to all cultures, and of which the paradigm cases are happiness, sadness, anger, anxiety, and disgust. Individuals can experience most basic emotions without knowing their causes, which can be primitive evaluations that make no use of working memory and that occur outside awareness. Basic emotions in turn underlie *complex* emotions, which concern the mental models that individuals have of themselves and of others. They cannot experience complex emotions, such as guilt, jealousy, or remorse, without being aware of the cognitive evaluations that caused them. They feel, say, guilt, which depends on disgust with themselves as a result of a self-evaluation in relation to their idealized model of themselves.

Basic emotions underlie psychopathology. An electrician enters an elevator, for example, and experiences a momentary anxiety—a rational reaction, because he knows that people have been stuck for hours in elevators. Some individuals, however, are predisposed to overreact, as a result of innate dispositions or recent stresses (Ingram & Price, 2001). Their emotion is out of proportion to the situation. It is a *hyper*-emotion. They react—the electrician leaves the elevator at once, fearing a panic attack. He is aware of what caused the emotion, but not of what caused its intensity. It's akin to listening to

music: a listener knows that the music caused an emotion, but not what in the music is the cause (Johnson-Laird & Oatley, 2008). The phobic electrician likewise says: "I don't know why I am so frightened in elevators, other than the fear of losing control of myself." The theory follows Lashley (1958) in postulating that individuals are not aware of any mental processes, but only of their results. They may be aware of the cause of an emotion, but they cannot be aware of the process that makes the transition to the emotion itself. This transition is unconscious, but underlies the construction of the contents of consciousness (see Helmholtz, [1866] 1962). Hyper-emotions in turn concentrate the mind: individuals reason about their predicament. Their reasoning amplifies their emotions and enlarges the circumstances that trigger the unconscious transitions to them. Such emotions occur at the onset of an illness, but they continue to occur and to maintain the illness. Individuals have no voluntary control over them. All they can do is to adopt some method to decrease the emotions, such as avoiding whatever is their cause.

The theory of reasoning underlying our account is based on mental models. It postulates that reasoning depends, not on formal rules of inference (e.g., Rips, 1994), but on mental models of the possibilities to which propositions refer, and on drawing conclusions that hold in these models (Johnson-Laird, 2006). A common error in reasoning is to overlook a possibility. You know that the fault is in the printer or in the cable from the computer. The cable *is* defective, and so you infer that you've solved the problem. But, you've overlooked a possibility: the fault could be in both the cable and the printer. Any factor that diminishes such oversights improves reasoning, and one such factor is an emotion concerning the topic of inference. When individuals experience this emotion, they are motivated to reason about its cause and to examine possibilities more closely than otherwise.

Characteristic reasoning strategies in psychological illnesses

Basic emotions arise from the important events in the lives of human beings (and other social mammals). Different psychological illnesses arise from different hyper-emotions: anxiety causes phobias, sadness causes depression, disgust causes obsessive-compulsive disorder, and anger causes oppositional defiant disorder. In daily life, individuals make inferences in order to achieve goals (Lee et al., 2008), to avoid dangers (de Jong, Mayer, & van den Hout, 1997; de Jong, Haenen, Schmidt, & Mayer, 1998), and to prevent catastrophic mistakes (Friedrich, 1993; Trope & Liberman, 1996). They also make inferences to establish reasons for decisions (Tversky & Shafir, 1992). And different sorts of problem elicit different strategies in reasoning (Van der Henst, Yang, & Johnson-Laird, 2002). The different emotions in psychological illnesses should also lead to different strategies (Johnson-Laird et al., 2006; Mancini, Gangemi, & Johnson-Laird, 2007), and we illustrate three of them.

The first protocol at the start of the chapter illustrates the characteristic steps in the reasoning strategy of hypochondriacs:

- 1 They focus on a danger, such as bodily symptoms, which causes an unconscious transition to intense anxiety that they have a serious illness.
- 2 They seek confirming evidence, such as an analogy with a friend or relative.
- 3 They infer that if they consult a doctor and are not ill, no harm is done. But, if they fail to consult a doctor and are ill, then the consequences are catastrophic. On a simple cost-benefit analysis, these pay-offs focus them on the worst case.
- 4 If the doctor says nothing is wrong with them, and yet they still have bodily symptoms, they infer that the doctor may be wrong and that a further consultation is sensible.

They may loop around these four steps repeatedly.

Step 3 is similar to Pascal's wager about belief in God. If you believe in God and God exists, then you have eternal bliss, and if God doesn't exist, no harm befalls you. If you don't believe in God and God exists, then you are damned, and if God doesn't exist, no harm befalls you. So, you'd better believe and be safe than disbelieve and be sorry. Hypochondriacs make an analogous cost-benefit analysis and infer that they'd better see the doctor again (de Jong et al., 1998; Smeets et al., 2000).

Pascal's wager does not persuade everyone to believe in God, and one reason is that the same argument can be advanced for belief in Allah. Likewise, a cost-benefit analysis does not lead everyone to doubt a doctor's diagnosis. The difference is that mentally healthy individuals do not over-react to every bodily sign of illness.

The second of the opening protocols illustrates one side of the dialectical character of reasoning in obsessional-compulsive patients:

- 1 They focus on a dangerous action that they have carried out. They make an unconscious transition to intense anxiety about contagious contamination, and so they overestimate the risk (Butler & Mathews, 1983).
- 2 Some of them make a further transition to the complex emotion of guilt, because they carried out an unnecessary action that was wrong in that it might harm them and others.
- 3 On the one hand, they try to infer that no feasible cause puts them at risk, and they search for counterexamples to the danger.
- 4 On the other hand, in trying to exclude the danger, they necessarily think about causes that could put them at risk. They may oscillate between this step and the previous one.
- 5 Even if they can infer a small risk of contamination, step 4 amplifies their anxiety. They infer that they have to act to minimize the risk. If they don't, they and others are at risk.

Their aim of showing that nothing endangers them has a paradoxical effect. It suggests possible mechanisms. So, they search still harder to show that no risk exists, with the aim of reducing culpability (Mancini, 2005; Mancini & Gangemi,

2004). This sort of dialectical reasoning leads obsessive patients to accept the danger as real. What distinguishes it from the reasoning of healthy individuals is the intensity of the patient's emotion and its consequent focus on the risk of contamination and the compulsive need for actions to assuage their guilt (cf. Niler & Beck, 1989; Rachman, 1993; Salkovskis & Forrester, 2002; Van Oppen & Arntz, 1994). Those who are free from abnormal anxiety make a more measured assessment of risk.

The third of the protocols at the start of this chapter illustrates the characteristic strategy of reasoning in depression:

- 1 Depressed individuals focus on what they have lost. They make an unconscious transition to intense sadness.
- 2 They infer that the loss may never be made good. The possibility leads them to focus still more on the loss.
- 3 They try to think of a possible substitute. But the intensity of their emotion reflects the value of the individual or entity they have lost, and the more they focus on this loss, the higher their standards for an acceptable substitute (Scott & Cervone, 2002).
- 4 The loss is therefore irreplaceable. They loop round these steps repeatedly.

When healthy individuals suffer a profound loss, such as the death of someone they love, they too mourn the departed person. They miss the life together with their partner, and perhaps reproach themselves for any friction between them. Their mourning, however, has a natural terminus, and they recover within a year or so. They take up their social relationships again, they enjoy life, and their loss recedes into the past—they can think about the missing person without grief. What occasions their recovery is the disappearance of the transition to intense sadness. But, this waning does not occur in depressed individuals. The transition to a hyper-emotion is too strong to dissipate. As a result, they become expert at reasoning about the cause of their depression. It helps them to reduce the risk that they waste cognitive resources in thinking about other less important matters (Mancini & Gangemi, in press). Of course, the focus on one hypothesis, and the inability to examine alternatives are not in themselves pathological. As Wason's (1960) studies implied, it is characteristic of healthy individuals testing hypotheses.

The experimental evidence for the theory

The hyper-emotion theory makes four principal predictions. First, basic emotions of aberrant intensity cause and maintain psychological illnesses. Second, when inferences elicit an emotion, all reasoners are more motivated and more likely to consider possibilities that they would otherwise neglect. Contrary to the Platonic doctrine, they should therefore reason better than when inferences elicit no emotion. Third, as a consequence, those with psychological illnesses should reason better about their illnesses than about other topics. Contrary to cognitive therapy, they should therefore reason better than mentally healthy individuals do. Fourth,

different psychological illnesses should lead to different strategies in reasoning. We now summarize our experimental investigations designed to test these four predictions.

Emotions in psychological illnesses

Most theories of psychological illnesses postulate that they concern emotions (e.g., Freud, [1916–1917] 1973; Beck, 1976). The hyper-emotion theory, however, predicts that the emotions are basic rather than complex, and that they both cause and maintain the illnesses. Evidence for the role of basic emotions comes from studies using imaging, such as functional magnetic resonance imaging (for a review, see Johnson-Laird et al., 2006). It is harder to pin down the nature of the emotions at the onset of psychological illnesses. However, we carried out a small-scale epidemiological study in which 24 Italian psychiatrists, who were not familiar with the prediction, answered a questionnaire about their recent patients (Johnson-Laird et al., 2006). The 15 questions required them to consult their notes, and one question called for them to check a list of emotions and to report which of them the patient reported at the onset of illness. Of the 101 patients who recalled their initial emotions, 83 reported a basic emotion at the onset of their illnesses: sadness for depressives, and anxiety or fear for agoraphobics and hypochondriacs. The most frequent complex emotion was guilt (12 patients), and it typically occurred—as did anxiety and disgust in other patients—at the onset of an obsessive-compulsive disorder. A separate question concerned emotions during the illness, and the pattern of results was very similar. Overall, these findings corroborated the prediction that basic emotions rather than complex ones occur during the onset and maintenance of psychological illnesses. The one exception of guilt in obsessives is not a decisive counterexample, because it may reflect the indirect nature of our methodology.

The effects of emotions on reasoning

In studies of emotions and reasoning, a crucial distinction is whether the emotion arises from the reasoning itself or from some other cause (Johnson-Laird, 2006, Chapter 6). To refer to these two contrasting cases, we use the terms *integral* and *incidental* emotions (from Blanchette and Richards, 2010). When emotions are incidental, e.g., a movie induces them; they burden the system and lead to poorer performance (Blanchette, 2006; Blanchette & Richards, 2004; Derakshan & Eysenck, 1998; Melton, 1995; Oaksford, Morris, Grainger, & Williams, 1996; Palfai & Salovey, 1993). In contrast, as the theory predicts, when emotions are integral, arising from the topic of reasoning, they enhance reasoning. Blanchette and her colleagues have shown such effects, e.g., British war veterans with post-traumatic stress disorder evaluated syllogisms better when the conclusions referred to war than to neutral topics (Blanchette & Campbell, 2005). Analogous effects occurred in the evaluation of syllogisms after the terrorist attacks in London in July 2005 (Blanchette, Richards, Melnyk, & Lavda, 2007). The closer

the geographical proximity of the participants to the attacks, the greater the proportion of them who correctly evaluated syllogisms concerning terrorism: those in London were more accurate than those in Manchester, UK, who in turn were more accurate than those in London, in Ontario. The difference between the Mancunians and Canadians disappeared six months later, but the Londoners still reasoned more accurately about terrorism than the other two groups. The effect depended on emotion, because the three groups differed in the reported intensity of their emotions.

In an early but unpublished study, we manipulated whether or not mentally healthy participants were in an emotional state, and whether or not the contents of a reasoning problem were relevant to this state. We used the emotion of guilt, because for non-clinical participants it is associated with a narrower range of circumstances than other basic emotions such as sadness or anger. The emotion tends to be ephemeral, and so we used a simple task: the participants inferred what was possible and what was impossible according to a given proposition. One group of participants wrote an account of an episode in their lives in which they had felt guilty. They had to write about it as vividly as possible, and to include the details of their thoughts and feelings. Another group acted as controls and wrote no such account. The manipulation worked: when the experiment was over, the experimental group's ratings of their feelings of guilt were reliably higher than those of the control group. On each trial in the experiment, the participants read a brief vignette that ended with a particular proposition, such as: *The alarm rings or I feel tired, or both*. They then listed what was possible and what was impossible according to this proposition. In this case, there are three distinct possibilities: (1) the alarm rings; (2) I feel tired; and (3) the alarm rings and I feel tired; and there is one impossibility: (4) the alarm doesn't ring and I don't feel tired. Each of the groups of participants was further subdivided into two. In one case, the participants had to list possibilities for assertions in vignettes designed to elicit guilt, such as:

Suppose I am at my house with some friends. We decide to join some other friends in a bar. We leave the house joking amongst ourselves, but I forget to close the bathroom window. The burglar alarm rings or I feel guilty, or both.

They listed possibilities for the final proposition. In the other case, the participants listed possibilities for neutral vignettes, which ended with a proposition, such as: *The burglar alarm rings or I feel tired, or both*, for which they listed possibilities. All the participants carried out the task four times with different contents, and two of the vignettes had a test proposition based on "and" and two of the vignettes had a test proposition based on "or." The participants who were feeling guilty performed more accurately with the contents concerning guilt than their counterparts who were not feeling guilty, but the difference between the groups disappeared with the neutral vignettes. A corollary in daily life is that individuals feeling guilty should tend to reason about such matters in a more

expert way, thinking of possibilities that might otherwise elude them. The effect is to increase motivation and to improve reasoning, perhaps because emotions enable individuals, whether they are psychologically ill or in a temporary emotional state, to think of possibilities that they would otherwise not envisage. One potential mechanism is the emotion activates semantically congruent memories (e.g., Bower, 2003).

Reasoning and psychological illnesses

The hyper-emotion theory predicts that just as integral emotions in healthy individuals improve their reasoning, so too the emotions underlying psychological illnesses should improve reasoning about these illnesses. As a result, patients should reason more accurately than control participants, but this advantage should disappear with neutral topics. We have carried out several experiments to test this prediction.

In our initial experiments, we examined the reasoning of participants with obsessive-compulsive tendencies and those with depressive tendencies (Johnson-Laird et al., 2006). As our epidemiological study showed, both these groups are prone to anxiety, and so we examined guilt in the obsessive participants and anxiety in the depressed participants. We used the same procedure as in the previous study with healthy individuals. On each trial, the participants read a vignette that ended in a particular proposition, such as: *The alarm rings or I feel tired, or both*, for which they listed what was possible and what was impossible. The first experiment compared the 5% who scored highest on a valid test of obsessive-compulsive tendencies with the 5% who scored lowest on the test from a sample of 290 students. One subgroup in both groups worked with vignettes designed to elicit guilt, and another subgroup worked with vignettes irrelevant to obsessiveness, i.e., either neutral vignettes or those relevant to depression. All the participants carried out the task four times with different contents, two of the descriptions had a test proposition based on “and” and two of the descriptions had a test proposition based on “or.” The obsessive-compulsive participants listed many more correct complete possibilities for propositions about guilt (63%) than the control participants did (23%), but no reliable difference occurred between the two groups for neutral or depressing propositions.

The second experiment was identical except that the participants were at risk for depression: from 370 students, we selected the 5% most at risk according to the Beck depression inventory, and the 5% least at risk. Those at risk of depression listed many more correct complete possibilities for propositions about being depressed (66%) than the control participants did (27%), but no reliable difference occurred between the two groups for neutral propositions or those about guilt. What both studies showed is that participants with propensities towards mental illness reason about topics relevant to their illness better than about other topics, and better than control participants do.

We followed up these studies with experiments in which the participants drew their own conclusions from syllogistic premises (Gangemi, Mancini, & Johnson-Laird, 2013). A well-known phenomenon in such reasoning is a bias

to accept believable conclusions and to reject unbelievable conclusions (Evans, Barston, & Pollard, 1983). This so-called “belief bias” is greater for invalid inferences than for valid inferences, and it occurs even when individuals formulate their own conclusions (Oakhill & Johnson-Laird, 1985). A study of individuals with a phobia for spiders showed that their evaluations reflected the belief bias, but it was bigger for neutral assertions than for those about spiders (de Jong et al., 1997). This result is consistent with the hyper-emotion theory, which predicts that individuals with psychological illnesses should tend to reason better from premises pertinent to their illness and be susceptible to the effects of beliefs only in reasoning about other topics. Hence, our studies of syllogistic reasoning aimed to contrast the theory’s prediction with belief bias.

Our first study examined depressed patients under treatment but not on antidepressants and control participants of a similar age and educational level. Previous studies of syllogisms enabled us to predict the conclusions that individuals were likely to draw to ten forms of syllogistic premises (Bucciarelli & Johnson-Laird, 1999): four with valid conclusions and six with no valid conclusions about definite relations between the terms that occur in only one of the two premises. We knew the conclusion, valid or invalid, that each of the ten forms was likely to elicit. From these premises, for instance:

Sometimes when I think of my future, I feel sad.

Every time I feel sad, I’m very pessimistic.

Participants should tend to draw the conclusion:

Therefore, sometimes when I think of my future, I’m very pessimistic.

A preliminary study with participants from the same populations established the relative believability of putative conclusions with different sorts of contents. It showed that the conclusion above was more believable for depressed patients than for control participants. In contrast, from the neutral premises:

Sometimes when I look back at my life, I find myself smiling. Every time I find myself smiling, I feel very satisfied with myself.

Participants should tend to infer this conclusion:

Therefore, sometimes when I look back at my life, I feel very satisfied with myself.

This conclusion was more believable for control participants than for depressed patients. A crucial point, however, is that the patients and the controls both tended to believe the neutral conclusions to a greater degree than the depressing conclusions.

In the experiment, all the participants stated in their own words what followed, if anything, from 20 pairs of syllogistic premises presented in a different random order to each of them: one set of the ten forms of premises had putative conclusions that were depressing, and the other set of the same ten forms had putative conclusions that were neutral. Overall, the depressed patients were more accurate in their reasoning (42% correct responses) than the control participants (26% correct responses). The mean level of performance was comparable, or even slightly better, than performance in the literature for syllogisms of the ten forms. If both groups were equally susceptible to belief bias, they should have tended to draw the neutral valid conclusions more often than they drew the depressing valid conclusions, because their relative believability was the same for both groups. That did not happen with the depressed patients: they drew more depressing conclusions (77%) than neutral conclusions (37%). But it did happen with the controls: they drew more neutral conclusions (43%) than depressing conclusions (33%). The outlier is clearly the patients' performance with depressing conclusions. For syllogisms with no valid conclusions, belief bias predicts that both groups should respond, "nothing follows," more often for depressing conclusions than for neutral conclusions. That held for the control participants (28% versus 7% correct rejections), but not for the depressed patients (8% versus 56% correct rejections). The outlier in this case is the patients' performance with neutral conclusions. In sum, belief bias accounted for the reasoning of the controls, but not for the reasoning of the patients, who were better reasoners than the controls.

Our second study compared the reasoning of students who were at high risk of panic attacks with controls who were not. The experiment was identical to the previous study apart from the different participants and contents. A preliminary study of the believability of the putative conclusions showed that highly anxious individuals tended to believe the anxiety-provoking conclusions more than they believed the neutral conclusions, but control participants believed the neutral conclusions more than the anxiety-provoking conclusions. The results of the reasoning experiment had a remarkably similar pattern to the previous experiment. Anxious participants (38% correct responses) outperformed control participants (22% correct responses). For the premises with valid conclusions, the anxious participants drew more anxiety-provoking conclusions (75%) than neutral conclusions (38%), whereas the control participants drew the same percentages of neutral conclusions (33%) and anxiety-provoking conclusions (33%). The outlier is clearly the anxious participants' performance with anxiety-provoking conclusions. For syllogisms with no valid conclusions, belief bias predicts that both groups should respond that "nothing follows" when a putative conclusion is unbelievable than when it is believable. That held for the control participants: 22% correct responses when the putative conclusions were unbelievable (anxiety-provoking) versus only 6% correct responses when the putative conclusions were believable (neutral). It also held for the anxious participants: 42% correct responses when the putative conclusions were unbelievable (neutral) versus 8% correct responses when the putative conclusions were believable (anxiety-provoking). The outlier in this case, as in the previous experiment, is the patients' more accurate performance with neutral conclusions.

Overall, these two studies refute the hypothesis that psychological illnesses impair reasoning: both the depressed and anxious participants outperformed control participants of the same age and educational achievement. The controls showed the effects of belief bias: they tended to draw conclusions that they believed, and not to draw conclusions that they did not believe, especially for syllogisms that had no valid conclusions. The depressed and anxious participants were unlike the control participants: they tended to draw conclusions pertinent to their illnesses, and to be susceptible to belief bias only in not drawing conclusions about other topics. As a consequence, they drew more valid conclusions and fewer invalid conclusions than the controls (see Goel & Vartanian, 2012, for similar effects of emotions on the evaluation of syllogisms).

The theory implies that psychological illnesses lead patients to explore more possibilities in reasoning about their symptoms. This account does not hold universally for the syllogistic results: if the patients had explored more possibilities, then they should have refrained from drawing invalid conclusions about their symptoms. A more nuanced account of their reasoning is that they were more motivated to draw conclusions about their symptoms, and less motivated to draw conclusions about other matters, than were controls. This interpretation accords with the general principle that individuals think more carefully about what is important to them than about what is unimportant (Blanchette & Richards, 2010; Tanner & Medin, 2004). As a consequence, mentally ill individuals are not impaired in reasoning, and can reason better than those who are mentally healthy (see also Smeets and de Jong, 2005; Vroling & de Jong, 2009).

Reasoning strategies in psychological illnesses

When human beings repeatedly reason from similar sorts of premise, they spontaneously develop strategies, i.e., systematic sequences of elementary mental steps that they follow in making these inferences (Van der Henst et al., 2002). We are far from a theory of the reasoning strategies that occur in different psychological illnesses. But some of these proposed strategies are clear enough that they can be embodied in verbal protocols of reasoning regardless of topic. It is therefore possible to test whether individuals can identify these strategies.

Earlier, we outlined the dialectical strategy of obsessive-compulsive individuals in which they consider the hypothesis that they are at risk and its denial, and the confirmatory strategy of hypochondriacs in which they consider only the hypothesis that they have a serious illness. Our first study examined the ability of psychiatrists to distinguish between these two strategies. Because the ruminations of obsessive-compulsives and hypochondriacs differ in content, a crucial precaution in the experiment was to rotate topics over the different strategies, so that topics could play no role in the identification of strategies. In the study, 34 Italian psychiatrists read a series of six pairs of protocols in which the members of each pair had the same topic but embodied two different reasoning strategies (see Johnson-Laird et al., 2006). As an example, consider the following protocol:

I'm afraid of the little pain I'm feeling in my abdomen on the same side as my liver. It could be a symptom of cancer, a liver cancer. I remember an uncle of mine who died from liver cancer after suffering a lot. But he was in his 80s, and I'm 30, and a liver cancer at my age is rare. On the other hand, it's not impossible. Moreover, it seems to me that I look unhealthy; my tongue is dirty; sometimes my mouth tastes bitter. I seem to be pale, and I could have anemia. Of course, these are common symptoms, and they can be trivial. I have had them many other times. But they are there, and they are not incompatible with cancer. Moreover, they don't exclude it. My doctor prescribed several tests for me, and the results were all negative. But the results could be those for another person—sometimes laboratories mix up test tubes, or the secretary makes a mistake in writing the patient's name, or she puts the results for one person in the folder for another patient. A mistake can always occur. The laboratory may be very professional, but there cannot be a 100% guarantee that it didn't make a mistake. Moreover, I am the main person responsible for my own health. You can imagine how I would feel if I really had cancer and had left it too late. The best I can do is to go back to my doctor.

The protocol has a hypochondriac's worries, but it embodies the characteristic dialectical strategy of an obsessive-compulsive reasoner. The first of the protocols at the start of the chapter shows the original protocol of the hypochondriacal patient: the italicized sentences above are identical in the two protocols, but those in the roman font above introduce the contrasting dialectic—the case for and against the liver cancer—that replace a focus on the worst case in the original protocol.

The psychiatrists evaluated six pairs of such matching protocols. They had the typical topics of six psychological illnesses: obsessive-compulsive disorder (in two varieties, one concerning contamination and the other a compulsion to check), hypochondria, generalized anxiety, specific phobia, and paranoia. One member of each pair embodied the dialectical strategy of obsessive-compulsive reasoning, and the other member embodied the strategy of the illness that provided the topic. The psychiatrists were given the list of the six illnesses, and they had to answer the question: What diagnosis would you make for each of the two patients? They diagnosed dialectical protocols, regardless of their contents, as characteristic of obsessive individuals on 83% of trials, and confirmatory protocols, regardless of their contents, as characteristic of hypochondriacs on 97% of trials. Their diagnoses were rapid and intuitive, which was striking because Italian psychiatrists receive no training in psychotherapy.

A second study examined whether patients themselves recognize their characteristic reasoning strategies. We used the same design as the previous study in order to ensure that the topics of the protocols could not be used to identify the strategies. Hence, the same six pairs of protocols were given to two groups of patients: obsessive patients and patients affected by other anxiety disorders (e.g., general anxiety disorder, panic attack, social phobia). Obsessive patients

identified the dialectical protocols as more similar to their way of reasoning, than did the other group of participants. But these other patients suffering from anxiety disorders recognized the corroboratory protocols as more similar to their way of reasoning than did the obsessive group. These results establish that obsessive patients and those suffering from anxiety disorders adopt different reasoning strategies, which psychiatrists and they themselves can identify, regardless of topic. A task for the future is to determine whether the difference in strategies is specific to psychological illnesses or can be elicited by the basic emotions associated with them.

Conclusion

This chapter began with Plato's view that to be in the grip of an emotion is a form of madness. This view has come down to us in two variants. The first variant is that strong emotions can elicit psychopathology, and it is embodied in the hyper-emotion theory of psychological illnesses: they are a result of appropriate emotions of an inappropriate intensity. The second variant is that faulty reasoning causes and maintains these illnesses (e.g., Beck, 1976). However, the last 40 years of experimental investigations of reasoning have shown that everyone, even the healthiest of individuals, is prone to err. Faulty reasoning is not exclusive to the mentally ill.

Patients suffering from mental illness experience intense emotions. They may know the object or cause of their emotion, but they do not know what creates its intensity. Psychoanalysts fill this theoretical vacuum with unconscious conflicts. Defence mechanisms prevent these conflicts from becoming conscious, and so patients cannot explain why something frightens them, nor can they control their fear. Following Beck (1976), cognitive therapists are skeptical about the role of unconscious conflicts. They say that a close questioning of patients yields the thoughts causing the emotions, and reveals that the source of illnesses is faulty reasoning. The correction of these inferential errors would contribute to preventing the aberrant emotions. In contrast, when the first two authors practice cognitive therapy, they notice that close questioning does not always help patients to identify the thoughts causing their emotions, nor does it reveal faulty reasoning. The hyper-emotion theory offers a different explanation. It postulates that individuals make cognitive evaluations, possibly unconscious, that yield a transition to a basic emotion. Sometimes these cognitive evaluations are primitive—individuals are not aware of their content. As listeners sometimes say, they feel sad after listening to some music, but they do not know what it is about the music that elicits their emotion: "It just sounds sad." Likewise, as patients sometimes say, they feel over-anxious about a situation, but they do not know what elicits the emotion's aberrant intensity: "It just makes me frightened that I'll lose control." Because transitions to emotions are unconscious, patients have no control over them, even if they realize that their aberrant intensity is inappropriate. Emotions direct attention, interpretation, and reasoning about their potential causes (Johnson-Laird et al., 2006). This view has its antecedents in Beck's theory of

schemata in memory that bias anxious individuals to process information relevant to anxiety, and bias depressed individuals to process information relevant to depression (e.g., Beck, Emery, & Greenberg, 1986). Our view, however, is that this role is played by emotions (see Bower, 2003), whether they are induced by an experimental task or by a psychological disorder. They lead individuals to be more likely to envisage possibilities that they might otherwise neglect. Outside tests of reasoning, their increased accuracy is counterproductive, because it depends on exploring more possibilities in a deeper way. This process in turn leads to further emotions that sustain the illness (e.g., Harvey et al., 2004).

The experimental evidence has corroborated the hyper-emotion theory. Patients reported that they experience emotions at the onset of their psychological illnesses, and most of these emotions are basic rather than complex. When healthy individuals are in an emotional state and the contents of their inferences are related to the emotion, they enumerate possibilities more thoroughly than when the contents are not relevant to their emotion or they are not in an emotional state. Plato's doctrine that emotions impair reasoning seems like common sense, but it has matters the wrong way round: integral emotions improve reasoning.

Psychological illnesses are characterized by certain emotions, and so those who suffer from them, or who are at risk, are more motivated to reason accurately about their illnesses than other individuals. Their reasoning is focused on such contents, and so they tend to draw more valid conclusions from them than control participants do, and they draw fewer invalid conclusions from other sorts of premises than control participants do. The nature of the eliciting event in a pathological emotional reaction governs the likely strategy in reasoning. Hypochondriacs worry about serious illnesses, and their anxiety leads them to adopt a characteristic strategy in which they focus on the danger, and infer that they should be safe rather than sorry. Obsessive individuals worry about possible contamination and feel guilty about putting themselves at risk. Their strategy weighs the evidence on either side in a dialectical way. Still other strategies may be adopted in other psychological illnesses.

We began with the two mysteries of psychopathology: what causes psychological illnesses, and what maintains them in the face of evidence to the contrary? The answer on our account is aberrant emotions, which are likely to reflect both innate and environmental factors such as stress. They cause psychopathology. And reasoning focused on the circumstances in which they occur maintains, and even worsens, the resulting illnesses, because it can enlarge the circumstances that trigger the unconscious transitions to these emotions. In the ordinary course of events, the over-reaction may dissipate and the individual recover. Otherwise, the primary therapeutic goal should be to dissipate the over-reaction—to inhibit the unconscious transitions to pathologically intense emotions. It is not easy to control one's emotions as opposed to their expression. However, various therapeutic techniques seem to be effective, including exposure therapy for anxiety, and cognitive therapy for depression and other disorders. Good reasoning, however, is not a cure for those suffering from psychological illnesses, and bad reasoning was not the cause of their ills.

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