Pergamon

Clinical Psychology Review, Vol. 16, No. 7, pp. 641–654, 1996

0272-7358/96 $15.00 + .00

PII S0272-7358(96)00039-6

DOES THE BIOLOGY GO AROUND THE SYMPTOMS? A COPERNICAN SHIFT IN SCHIZOPHRENIA PARADIGMS

Chris E. Harrop, Peter Trower, and Ian J. Mitchell

Department of Psychology, University of Birmingham, England, UK

ABSTRACT. *It is often assumed that if physical differences exist between the brains of people with schizophrenia and normal people then those biological differences will have caused the psychological abnormalities to occur. In this article, we challenge this view. First, we argue that the reverse case is also plausible, namely, that it is possible for the physiological differences associated with the condition to be the result of the condition and not the cause. Less contentiously, we propose that the relationship between the psychological problems and the physiology should be viewed not as a simple billiard-ball style cause-and-effect relationship but more as a reciprocal and iterative relationship where psychological effects can affect the physiology that can in turn affect the psychology. The evidence for the various physiological differences between people with schizophrenia and normals is assessed and it is concluded that these differences exist but that there is little evidence to demonstrate that all (or indeed even any), of them precede the onset of schizophrenic symptoms. Similarly, current information-processing theories can also be considered as descriptive of a psychotic state rather than causal to it. Similarities between traumatic shock and schizophrenia are discussed and it is argued that phenomena associated with trauma might need to be considered as an integral part of the psychotic's experience. It is also concluded that no psychological theory can deny the importance of the physiological level in schizophrenia.* Copyright © 1996 Elsevier Science Ltd

THE PREVAILING paradigm within biological psychiatry is that the symptoms of schizophrenia are caused by physiological abnormalities — a view apparently so substantially underpinned by evidence that it may seem self-evident (Murray, 1994). However, in the critical scientific spirit of Copernicus,[1] we make the case that the

Correspondence should be addressed to C. E. Harrop, Department of Psychology, University of Birmingham, England, United Kingdom. E-mail: c.e.harrop@bham.ac.uk

[1]Copernicus is credited with being one of the first people to claim that the Earth went around the sun, a view considered heretical at the time. Kuhn (1970) demonstrated how this Copernican revolution symbolizes the essential process of postulating alternative theories to counter established paradigms.

opposite view is equally compelling — that is, that a psychosocial model of cause, whereby the physiological differences would be caused by psychological mechanisms. Our aim is not to attempt to prove that either biological or psychological factors cause schizophrenia (which would be to return to the nature–nurture argument) but rather we seek to reconcile the two camps: both must be considered to provide an adequate explanation of psychotic symptoms. After considering ways in which biology and symptoms may be linked, we then review the biology-causes-symptoms argument and the symptoms-causes-biology argument. Finally, we develop an integration of the two.

HOW IS THE RELATIONSHIP BETWEEN BIOLOGICAL ABNORMALITY AND SCHIZOPHRENIA CHARACTERIZED?

Jackson (1990) produced an excellent list of how the relationship might be characterized between "central-nervous-system" (CNS) anomalies thought to be implicated in Schizophrenia (e.g., excess dopamine, hemispheric integration anomalies, frontal lobe damage) and the observed symptoms of schizophrenia (see Figure 1).

To briefly explain, there are several possibilities as to how a CNS abnormality and schizophrenic symptomatology are associated: As shown in Figure 1, (1) Is that there is no association; (2) Refers to a direct relationship between the CNS abnormality and the symptoms, e.g., fluctuations in the symptom would mirror fluctuations in the underlying pathology; (3) Is the more traditional stance of Bleuler (Bleuler, 1911), that demands the action of another factor (biological or physical) for the symptom's occurrence. This item can also illustrate vulnerability/stress models such as those of Nuechterlein (1987). Here there would be an interaction between the extent of the CNS abnormality and the amount of stress endured to produce symptoms. A small biological abnormality and a large amount of stress may produce symptoms or a large biological loading and a small amount of stress. (4) CNS abnormalities are coincidental to the symptomatology and may result from another factor (e.g., treatment strategies or inactivity).

Items 5 and 6 of Figure 1 are our suggestions. They are novel in that they go against the intuition that problems with the brain cause mental problems. In the mind/brain Cartesian dichotomy, it can seem like only the brain is particularly scientific (Rose, Kamin, & Lewontin, 1984); however, this kind of reductionism has long been too prevalent in this field and we would like to reverse this.

The first alternative that we propose (Item 5 in Figure 1) is that *many (or perhaps most or even all) of the CNS abnormalities seen in the brains of people suffering from schizophrenia are produced by the schizophrenic symptoms.* Thus, CNS abnormalities would be the physiological response to or implementation of a psychotic mental state. This changes direction of causality around, so that the symptoms of schizophrenia can be viewed as on par with the physiology in determining the cause of the condition. At its most basic, this is stating that the psychological side has been seen as a "junior partner" to the physiology, as if the psychological is an epiphenomenon of the physiological (Rose, 1984).

Recent neurobiological evidence lends support to the alternative view by showing that long-term changes in the structural make-up of the brain can be produced in the absence of pharmacological or physiological interventions. Our own work, for example, has demonstrated that modest but sustained alterations in the external environment that result in unusual sensory stimuli being relayed to the brain are sufficient to induce the death of restricted neuronal populations in adult mammals (Mitchell, Cooper, Brown, & Waters, 1995). Thus, neural representations of unusual psycholog-

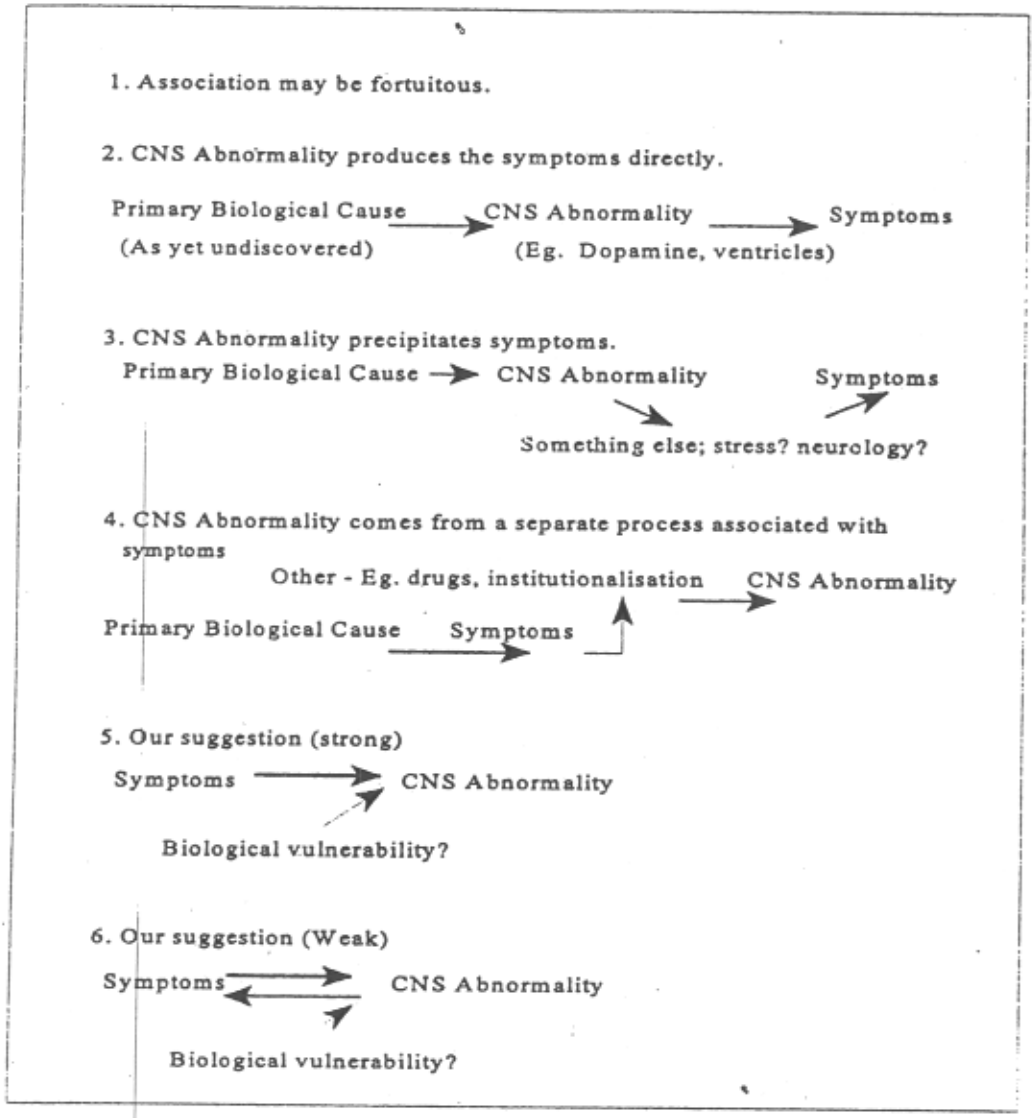

FIGURE 1. Characterisations of The Relationship Between Biological and Psychological Levels. Adapted from Jackson (in "Reconstructing Schizophrenia," Routledge, 1990).

ical and environmental stimuli alone are sufficient to induce drastic and permanent changes in brain structure.

Once the conceptual shift toward the psychological has been made, another perhaps more satisfactory proposal is as follows (Item 6 in Figure 1): *The physiological and psychological work in a reciprocal and iterative fashion.* This would involve changing the straightforward billiard-ball view of causation to a more sophisticated one. Philosophers of science have taken a dislike to the over-use of such strict Hume-ean causality in scientific models (Harré & Second, 1972). Asking "What causes Schizophrenia?" has been hindered by not considering that there are different ways in which "causes" can be linked to "effects." It might be that more useful metaphors could be found from disciplines other than mechanics, for example, quantum physics, connectionist modelling, or meteorology. In the present context, we suggest

that it could mean the symptoms produce changes in the brain and that these in turn shape the form of the symptoms. These would not be discrete actions but ongoing and reciprocal interchanges. Perhaps the psychological and biological differences are emergent properties of a myriad of small psychological and biological changes each affecting the other.

The next step in our argument is to examine the evidence for a biological abnormality and assess what sort of differences have been reliably found and what evidence has been put forward to claim that they come before the symptoms.

THE BIOLOGY-CAUSES-SYMPTOMS CASE

Why is it assumed that schizophrenia is a biologically-caused condition probably due to some lesion or defect as yet undiscovered? There are only so many ways to research the brain of a person suffering from schizophrenia; it is argued that the abnormalities found are closely linked with the techniques used; in many cases, it is a case of methodology dictating theory. Historically, animal work has tended to focus on studying behavior following a lesion rather than manipulating the environment and observing the effects on the brain. It is a small step from there to having a multitude of theories all of which only postulate that damage to particular parts of the brain causes schizophrenia. Other main physiological or structural ways to investigate biological factors are postmortem, brain scanning experiments (PET, CT, MRI) and Input/Output experiments (drugs). A critical question that must be addressed by researchers adopting any of these physiological or structural approaches is whether they can tell us anything about whether the biological change came before the symptoms.

Ventricular Enlargement: Origin or Consequence?

The importance of this issue of whether biological change comes before the symptoms are seen by considering the case of ventricular enlargement in schizophrenia. Ventricular enlargement has been studied at postmortem and more recently using *in vivo* scanning. Few reliable structural differences in the brains of people with a psychosis have been seen at postmortem. This failure may, however, reflect the fact that postmortem studies are difficult to conduct because of the difficulty in getting material (at least in Britain). Clients often die in old age or else when young from some accident (frequently self-inflicted), such as might cause damage to the brain. The studies that have been done can tell us little about whether or not the structural change came before the symptoms because in every case they use the brains of clients who have suffered from schizophrenia for a long time, and who have quite possibly been on medication for decades.

As technology improved, scanning experiments have superceded postmortem studies. They have shown that there is enlargement of the lateral ventricles, especially of the inferior horn, which is indicative of a reduction in the size of the temporal lobe. This abnormality is lateralized, the largest effect usually seen on the left (e.g., Johnstone, Crow, Frith, Husband, & Kreel, 1976; Shelton & Weinberger, 1986). This is a generally accepted finding (although some studies have failed to replicate it (e.g., Jernigan, Zatz, Moses, & Cardellins, 1982), and even a sympathetic review estimates that only 20%–30% of schizophrenics are afflicted with such pathology (Seidman, 1984). However, it still falls short of saying that the pathology involved in producing enlarged ventricles produces the symptoms.

Three lines of argument have been followed to claim pathology (i.e., increased ventricular size and decreased temporal lobe size) produces symptoms:

1. Several studies have tried to investigate at the very onset of psychosis (to demonstrate that the relevant parts of the lateral ventricles were enlarged at the very start of psychosis and therefore predate the symptoms). For instance Weinberger, DeLisi, Perman, Targum, & Wyatt (1982) found that 20% of schizophrenics who were within 2 weeks of their first admission for psychiatric illness showed ventricles larger than expected for their age. This is interpreted as strongly suggesting that pathology predates the symptoms. However, all such studies involved subjects being scanned no earlier than their first admission for treatment (e.g., Weinberger et al., 1982; Nyback, Wiesel, Berggren, & Hindmarsh, 1982; Schultz et al., 1983). It has been well documented that there is usually a large delay between the first psychotic symptoms and the time when an individual accesses treatment. The mean treatment lag is approximately 1 year, with some variability (Beiser, Erickson, Fleing, & Iacono, 1993; Loebel et al., 1992).
2. The reduced size of the temporal lobes in the brains of schizophrenics is generally assumed to arise from a developmental problem very early in life rather than a degenerative condition which occurs after onset of schizophrenic symptoms. This view has found acceptance as until recently it has been assumed that neuronal death on a scale sufficient to result in decreased size of the temporal lobe could be readily detectable if it occurred in the adult. For example, large scale neuronal death is usually accompanied by activation of microglia, that can readily be seen in postmortem material. Failure to observe gliosis (i.e., the results of the action of microglia) in the brains of people with schizophrenia at postmortem (Roberts & Bruton, 1990) has thus led to the assumption that the small size of the temporal lobe reflects a failure of this brain area to develop correctly. Recent advances in understanding the process of apoptosis has led to the realization that large numbers of cells can die in a manner that is so nondisruptive that it is difficult to detect by traditional means. It is thus entirely conceivable for the reduced size of the temporal lobe to result from the death of neurons by apoptosis in response to changes in neural transmission (Mitchell et al., 1994; Mitchell et al., 1995). It is conceivable, therefore, that reduction in the size of the temporal lobe seen in schizophrenic brains results from an apoptotic process, which is induced by changes in neural transmission. Accordingly, it is possible that such morphological difference may result as a consequence of the condition, as opposed to being the cause of it. Note that this possibility negates the need to look solely for events very early in life (e.g., mothers having had influenza during pregnancy or obstetric complications), to account for the reduced temporal lobe size. Interestingly, this area of research has been heavily criticized on methodological grounds (Crow, 1994).
3. Researchers have argued that ventricular enlargement cannot be the result of the condition or the medication because there are generally no correlations between the extent to which the ventricle is enlarged and the time for which they have suffered the condition or been taking neuroleptics (although some studies have reported otherwise, e.g., Nyback et al., 1982). Whereas if there was such a correlation it would be valid to assume that ventricle size is due to institutionalization or drugs, absence of a correlation does not prove that ventricle enlargement is not due to institutionalization or neuroleptics. It is dangerous to argue from a negative, and this line of thinking also seems to assume a simplistic relationship between the factor and the ventricular size. There could easily be a ceiling effect at a threshold specific to individuals or a more convoluted function than an obvious correlation. Researchers here appear to be assuming

a pathological deterioration akin to that seen in Alzheimer's disease or Parkinson's disease. But schizophrenia is much more variable in outcome then either of these: severity varies with time fairly unpredictably. For example, Ciompi (1981), on analyzing the life courses of 228 schizophrenics, concluded that 27% achieved complete remission, 22% "minor residuals," 24% intermediate outcome, and 28% severe outcome (9% indifferent).

As a concluding point, it is worth reiterating that any comparison of symptomatic individuals with nonsymptomatic ones cannot provide evidence that biological factors are primary. Such evidence would have to be obtained from prospective studies in which potential biological differences were assessed prior to onset of psychiatric symptoms.

Other Conditions With Psychotic Symptoms

Several neurological conditions have been characterized, of which a form of psychosis is a part (Davison & Bagley, 1969). Huntington's disease (a disease whose origins have been traced to a genetically controlled loss of specific sets of cells in the striatum) often begins with a change in beliefs akin to a form of psychosis (Garron, 1973). Neurosyphilis also has a psychosis associated with it (Davison, 1983), as have certain forms of temporal lobe epilepsy (Slater & Beard, 1963).

Although these examples are interesting and certainly show that some brain lesions cause a kind of psychosis, it would not be logically sound to say that all psychoses are caused by brain lesions. On a separate note, it is important to research how similar these organic psychoses are to schizophrenia. For example, Cutting (1987) compared psychotic individuals with a known organic basis with those without, and concluded that there were several differences in the content of the symptoms. For example, only organic psychotics displayed a theme of "imminent misadventure to others or bizarre happenings in the immediate vicinity."

Dopaminergic Drugs and Schizophrenia

Drugs that act on the dopamine system can be effective in reducing positive symptomatology. More specifically, the ability of a drug to reduce positive symptoms tends to be related to the strength with which it can block dopamine receptors (Seeman, Lee, Chau-Wong, & Wong, 1976). However, this does not mean that a neurotransmitter imbalance causes psychosis. As Kandel, Schwartz, and Jessel (1991) said, "It is difficult, in principle, to extrapolate from the mechanisms of action of a therapeutic agent to the causal mechanisms of a disease." Headaches are not caused by aspirin deficiency. Rose (1984) gave an account of occasions where a drug's efficacy has been used to hypothesize about the nature of a psychiatric condition. For example, depressives who respond to a drug are considered to have a socially caused depression, whereas those who do not respond are thought to have a biologically-based depression.

Theories on the role of dopaminergic transmission in schizophrenia have been refined as our physiological knowledge is refined. However, the exact nature of the dopamine imbalance in schizophrenia remains unknown. There are also issues about the extent to which drugs completely alleviate symptoms and of the percentage of clients that will respond to treatment.

Genetic Contribution

That there is a genetic contribution to schizophrenia is close to being widely accepted. However, there are extremely cogent critical reviews of this well-established area

of research particularly with regard to the methodologies used (see Pam, 1990; Rose et al., 1984; Marshall, 1990). The best conclusion to draw seems to be that, whereas there undoubtedly is a genetic component, it may be substantially smaller than many studies have estimated. Space prevents a detailed review of the methodological faults here, but among other things, researchers have been accused of "extrapolating" interviews with dead relatives to judge them for schizophrenia, with such "interviews" even being contradictory to up to 4 interviews conducted while the relative was alive. Other methodological criticisms of this work include fluctuating diagnostic categories such as "inadequate personality," and far-reaching conclusions about the nature of schizophrenia being drawn from samples where only one or two actual schizophrenics were found (Rose et al., 1984). A smaller rather than larger genetic component would be consistent with the idea that social and environmental stimuli may go further in eliciting psychosis in some people than in others.

Vulnerability

It was just argued that the reasoning which originally prompted researchers to look for biological complications during pregnancy or birth no longer holds. That is, it is now realized that the reduced number of cells in the temporal lobe of the brains of people suffering from schizophrenia could be accounted for by a nondisruptive cell death mechanism operating in the adult as opposed to a developmental defect. Nevertheless, some promising developmental neurobiological work has recently been done in this area that does seem to indicate some anomalous brain development during pregnancy (e.g., Akbarian et al., 1993; Akbarian et al., 1995), though it is too early to examine the full impact of this work.

In summary, all evidence for biological factors only shows, at best, that there are physiological differences between schizophrenic brains and normal ones. The shift in the paradigms is in saying that *at least some, many, or even all of these differences follow behind the psychological characteristics of psychosis.*

THE PSYCHOLOGY-CAUSES-BIOLOGY CASE

It might seem like a radical idea at first, but the idea of psychology influencing physiology is not remotely new. It is well established that environmental conditions can influence neurotransmission in a specific manner. For example, stress has been shown to increase dopamine-mediated transmission in the prefrontal cortex and, to a lesser extent, in the nucleus accumbens (Thierry, Tassin, Blanc, & Glowinski, 1976; see Iversen 1995, for a review). Furthermore, it is now known that the circulating level of corticosteroids, stress hormones released by the adrenal glands, in part determines whether neurons within the temporal lobe of the adult rat undergo apoptosis (Uno et al., 1994; Sloviter et al., 1990; Sapolsky, Uno, Rebert, & Finch, 1990).

In fact, a moments thought will bring to mind any number of occasions where physiological change follows a cognitive one:

- Sexual arousal (e.g., following an erotic thought or image),
- Pupil dilation as a response to something pleasing,
- Hyperventilation and panic attacks due to catastrophic thinking, (one of the most successful applications of Cognitive Therapy; Clarke, Salkovskis, & Chalkley 1985),
- Fear response, where increased heart rate and readiness for action is shown in response to being frightened by something,

- Psychiatric outpatients showing an electrodermal response when a high-EE (Expressed Emotion) relative enters the room (Tarrier et al., 1988),
- Stomach ulcers arising from long-term exposure to psychological stress,
- Placebo effects, where the expectation that a person is receiving help leads to physical improvement.

Psychological theories can have the opposite flaw, in that many psychological theorists would deny the existence of any primary lesion. For them, psychosis is primarily psychological in origin. But it would be a mistake to take up the more extreme position that the physiological level is not useful or that there are no physiological differences in schizophrenic brains because (as just reviewed), there plainly are and the physiological level has much to contribute. There can be physical differences without these implying a lesion. All "normal" mental processes or responses have some sort of physiological implementation and the form of the mental process is dictated by physiological constraints. For example, in the blushing mechanism, when a person feels embarrassed (a cognitive judgement and affect); there is a physiological response of a blush whereby blood rushes to the cheeks. There is no *a priori* logical reason why the physiological response should be the one that it is. It might just as well be steam coming out of the ears and an involuntary hooting sound coming from the mouth. It would probably serve the same evolutionary purpose. Nor is there any *a priori* reason why the symptoms of schizophrenia should be along themes of hallucinations or an inability to concentrate, yet people in very disparate parts of the world are presenting with remarkably similar symptoms independently of each other. It seems that physiological constraints are dictating the form of the symptoms to at least some extent. In schizophrenia, people are operating in such a different way to normals that it would be surprising if there was not some sort of difference in their brains.

Whatever the origin of the schizophrenia, be it primarily physiological or psychological, the best way to treat it does not have to be of the same form. Some physical illnesses (e.g., stomach ulcers) can be treated well by either medication or psychological treatments (e.g., stress reduction). So, a psychological condition may be treated with drugs or psychological interventions.

INFORMATION-PROCESSING THEORIES: ESSENTIALLY BIOLOGICAL?

The new perspective we are suggesting can also lead to a useful re-examination of the information-processing models of schizophrenia that have been put forward. Several theorists have tried to spot an information-processing deficit from which all the other schizophrenia symptoms could plausibly derive. Such theories carefully choose a definition of the information-processing deficit and describe how all the symptoms could be explained from it. For example, there might be an unusual perceptual anomaly (by implication produced due to a CNS abnormality) which the person then strives to come to terms with in much the same way as a "normal" person might. This normal cognitive interpretation of anomalous percepts leads to psychological symptoms (Maher, 1974). Paramount in these theories is a lesion, as yet undiscovered, which produces a problem in function at a specific place in the processing model.

The most widely known information-processing theories are those of Hemsley (1987)/Gray et al. (1991) and Frith (1979, 1992). Some of these theories are discussed next from the perspective of hypothesizing what might cause the "primary deficit" itself. Accuracy of the theories themselves is not discussed and it is assumed they are useful characterizations of psychosis.

Hemsley (1987) reviewed several opinions as to what the nature of the cognitive impairment in schizophrenia was and from these hypothesized that the primary problem was "a weakening of the influence of stored memories of regularities of previous input on current perceptions." (This is known as *Hemsley's deficit.*)

The Hemsley model accounts nicely for the positive symptoms of schizophrenia. For example, because people suffering from schizophrenia are less able to interpret incoming perceptual data properly using stored memories, there is heightened awareness of irrelevant stimuli which lead to bizarre perceptual experiences, that is, hallucinations. Delusions arise from memory having less influence in inferring causal relationships between events. Causal relationships are therefore inferred from single occurences (Hemsley, 1987). Gray (1993) interpreted this information-processing model as problems at a neural level resulting in problems at a cognitive level, resulting in problems at a symptom level.

However, it is not the case that Hemsley's deficit could only be produced by neural level dysfunction. It is possible to explain Hemsley's deficit from social factors, though this has rarely been attempted. One could possibly interpret the deficit as a weakening of the influence of constructs in the Kelly or Kantian sense. Thus, individuals need to impose order on the world in a way that makes sense to them and according to their own needs. These constructs are the basic results of their assimilating the world. Implicit in Hemsley's deficit is the idea that "healthy" people do not vary too much in the degree to which they can relate new experiences to their old ones. However, competence at this skill varies depending on the time of day and the emotional state. An even bigger difference is seen between different individuals.

To help clarify this idea that people vary in the extent to which they can assimilate material cogently, consider Gilbert's work on social hierarchies (Gilbert, 1993). He proposed that ways of behaving in dominance/subordination hierarchies are driven by evolutionary mechanisms and as such are ingrained and involuntary. Social factors trigger off the behaviors characteristic of these hierarchies. A person at the bottom of the social hierarchy will be least likely to get resources. As part of the subordinate's role (as a hard-wired way of behaving), a lowly individual has to attend to superiors in case he/she incurs the displeasure of their betters. It is likely that there is great deal of anxiety, attentiveness, and loss of control involved in the subordinate's role (Trower & Gilbert, 1989), plus much willingness to adjust to someone else's whims and desires. At a cognitive level, persons at the bottom are less able to have the time and space to do things as they want to make the world meet their needs, or come to terms with it (construe it properly). Those individuals will have to be more adept at only meeting the demands of others. In sum, they will be less able to integrate experiences in the way Hemsley suggests and are more likely to get overwhelmed by everything.

To approach from another angle, sensory/emotional overload is central to Hemsley's theory. He sees such overload as coming about because of the basic deficit (caused by brain pathology), thereby producing an overload of perceptual data and hallucinations associated with that. It is equally possible to posit sensory and emotional overload coming about for social reasons. Such overload could show itself as Hemsley's deficit and the symptoms such as hallucinations and delusions could result from that. The difficulty in integrating everyday interactions within a bizarre, intensely personal framework may be why clients find interactions so difficult and spend time avoiding them.

It has, therefore, been argued that even if the cognitive information-processing deficit described by Hemsley is accurate (even in most of its anatomical splendor; Gray et al. (1991), it does not necessarily mean there is a lesion. A difference in

cognitive processing could just as easily be brought about by social and psychological pressures.

Frith's (1992) account of the origins of schizophrenic symptoms are enhanced by considering social factors just as Hemsley's can. For Frith, the primary deficit is due to a fault in "meta-representing." The meaning of meta-representing can be loosely summarized as being able to attribute ownerships to thoughts and intentions. People with schizophrenia, for example, instead of realizing that they themselves thought "I know that my car is faulty," experience that idea as the thought "my car is faulty" being inserted into their consciousness. They are, thus, not able to label it as having originated from themselves. In this manner, the theory can account for the range of schizophrenic symptoms. Frith's theory gives no reason for why the problem in "meta-representing" arises. It could be argued that his primary aim was more descriptive. However, the theory does seem to implicitly assume that the first factor is an organic deficit.

There is plainly a systematic bias toward very emotionally significant ideas in the examples used by Frith (1992), although this bias is not really drawn out by him. This bias is also seen in hallucinations and delusions in general, and it is remarkable that a deficit in attributing ownership and responsibility to thoughts should be dealing so predominantly with material with very negative emotional tones. It is not assuming too much to say that problems in meta-representing and filtering in Frith's paradigm could be emotionally motivated. Hingley (1992) suggested that psychological defense mechanisms are seen as filters of sorts. Any account of hallucinations and delusions that does not account for the very emotional nature of most of them is sadly deficient. Recent developments in cognitive therapy and allied treatments (Chadwick, Birchwood, & Trower, 1996; Chadwick & Birchwood, 1994) have shown that taking into account the emotional nature of voices and delusions, the functions they serve for the client and the context in which they arose can be very effective in theory and practice.

To summarize, it has been argued that although there are information-processing differences between normals and schizophrenics, it does not necessarily mean that they are caused by a lesion as yet undiscovered. The information-processing differences may actually point to a psychological mechanism as the primary cause of the symptomatology.

EXAMPLES OF PSYCHOLOGICAL FACTORS CAUSING ALTERED PERCEPTIONS IN THE SHORT TERM IN ABSENCE OF KNOWN CNS DAMAGE

The following examples add credence to the thesis that strange psychological states can arise without any preceding CNS abnormality. The examples illustrate how psychological, social, or environmental contingencies lead to altered perceptions in the short term.

(A) The Fear or Panic response demonstrates a distinctive physiological and psychological response to a psychological event. If a man were to come into the room where you are reading this article with an axe and a certain look of purpose about him, there would immediately be an enormous response physiologically. This is a physiological mechanism that has evolved, giving enormously useful benefits such as the capacity for immediate fight/flight. In getting these benefits, however, some of the abilities of the normal state have been lost. For example, it would be difficult to concentrate on this article with the axeman standing behind you. There would have been a trade off between things that were important and things that could be sacrificed. Almost certainly, the sacrifices would be made because of physiological con-

straints. It would not be physiologically possible to have both capacity for fight/flight and capacity for intellectual thought, otherwise we would retain these. Therefore, in this situation, there are major differences in cognition resulting from psychological factors independent of any CNS abnormality.

(B) The purely psychological event of bereavement can produce very distinctive psychological effects in the absence of physiological abnormality. During a period of grieving, a person may not be able to concentrate on everyday tasks and may be overwhelmed with certain thoughts. The experience can be so intense that it is almost experienced as physiological changes. For example, after his wife's death, C.S. Lewis wrote "No one ever told me that grief felt so much like fear...the same fluttering in the stomach, the same restlessness, the yawning. I kept swallowing." (Lewis, 1966)

(C) The trauma or shock response such as occurs directly after an accident or disaster and has recently been the focus of much research interest in Post Traumatic Stress Disorder (PTSD) also demonstrates a distinctive psychological effect. In trauma, there can be an actual physical shaking, the muscles rich in resources for action. Psychologically, there is often a feeling of things not being real, an inability to concentrate or take things in, and a brooding "shatteredness." Completely spurious and odd connections between ideas arrive that later seem totally ridiculous but at the time seem real enough. For example, a policeman at the Hillsborough disaster in Britain in 1989 where 96 people died at a football game due to police mismanagement said, "At one point it was like I was going in and out of reality. I felt as if I were seeing things and then drifting off into not noticing things even though they were happening — I just couldn't register them. I can only remember in patches. The daft thoughts that go through your head. They're not thoughts from you. I don't know how they get there" (Taylor, Ward, & Newburn, 1995).

It has been proposed that people may suffer PTSD as a result of an experience of being psychotic (McGorry, 1995; McGorry et al., 1991). For example, individuals experiencing a forced hospitalization on their first episode of psychosis may show symptoms associated with PTSD because of this. We suggest that some symptoms of psychosis itself may best be understood as either PSTD-type experiences or experiences to do with an individual currently experiencing trauma. For example, for many people with a psychosis, their daily interaction with their family can be traumatic. Many people with schizophrenia are also having many experiences that involve extreme fear, often religious absolutes like God and the Devil, and it would be surprising if this were not traumatic. Thought disorder, for example, can be seen as a natural adaptive response similar to the loss of concentration seen in trauma. A similar way of looking at thought disorder is a kind of natural antidepressant. To stop themselves experiencing all sorts of damning thoughts/voices, they "numb-out," with the unfortunate consequence that they can not concentrate on or feel anything. Haddock, Wolfenden, Lowens, Tarrier, and Bentall (1995) showed that thought disordered clients' difficulties become much more severe when they are asked to focus on emotionally meaningful material. It was mentioned earlier that Maher (1974) put forward the idea that delusions are formed by clients interpreting bizarre perceptions using normal reasoning. It may be that one of the only abnormal experiences that clients need to explain to themselves are those characteristics of the trauma state (sense of unreality, spurious connections, etc.).

In trauma, there is a psychological event producing an unusual psychological state. It might be possible to conjecture about whether there was any change in brain chemistry concomitant with these psychological events. For example, if it were possible to examine the brain chemistry of a person in traumatic shock, one might find that

there was a dopamine imbalance there. In this case, one might want to conclude that neuroleptic medication could be used to help clear the minds of people in psychological shock and free them of the worst mental problems. If this indeed was a valid parallel to people with schizophrenia, one might be justified in taking the (perhaps extreme) view that this characterizes anti-psychotic drugs as "acting on the bruise but not the primary hurt."

CONCLUSIONS

Biological approaches to understanding the origins of schizophrenic symptoms have focused on trying to find biological differences between brains from people with schizophrenia and normal people. Such approaches have emphasized possible differences in dopaminergic transmission within the forebrain and regarding the size of the temporal lobe and it has been assumed that these biological differences lead to the symptoms of schizophrenia. We have argued that the direction of this causal relationship has not been satisfactorily demonstrated and we raise the possibility that the biological changes may actually result from the symptoms of the disorder. Similarly, the information-processing differences between those suffering from schizophrenia and normals may arise as a consequence of the condition rather than any biological abnormality. This reversal of causality between biological difference and psychological state would parallel the reversal Copernicus championed when he argued that the earth revolved around the sun and not the sun around the earth. Given the plasticity in the brain's response to psychological events, including stress, it seems likely that the descent into schizophrenia would involve a constant interplay between psychology and physiology. We postulate existence of a reiterative loop whereby a particular set of circumstances would elicit psychological responses that would induce specific physiological events that would affect the perception and psychological reaction to the next situation and so on. If the psychology and physiology are as tightly interwoven as suggested here, it perhaps becomes less important to try and isolate which particular factor acts as the initial cause of the condition.

REFERENCES

Akbarian, S., Kim, J. J., Potkin, S. G., Hagman, J. O., Tafazzoli, A., Bunney, W. E., & Jones, E. G. (1995). Gene expression for glutamic acid decarboxylase is reduced without loss of neurons in prefrontal cortex of schizophrenics. *Archives of General Psychiatry, 52,* 258–266.

Akbarian, S., Vinuela, A., Kim, J. J., Potkin, S. G., Bunney, W. E., & Jones, E. G. (1993). Distorted distribution of nicotinamide-adenine dinucleotide phosphate-diphorase neurons in temporal lobe of schizophrenics implies anomalous cortical development. *Archives of General Psychiatry, 50,* 178–187.

Beiser, M., Erickson, D., Fleing, J. A. E., & Iacono, W. G. (1993). Establishing the onset of psychotic illness. *American Journal of Psychiatry, 150,* 1237–1243.

Bleuler, E. (1911). *Dementia praecox or the group of schizophrenias* (translated 1950). New York: International University Press.

Chadwick, P., & Birchwood, M. (1994). The omnipotence of voices: A cognitive approach to auditory hallucinations. *British Journal of Psychiatry, 164,* 190–201.

Chadwick, P. J., Birchwood, M., & Trower, P. (1996). *Cognitive therapy for delusions, voices and paranoia.* Chichester: Wiley.

Ciompi, L. (1981). The social outcome of schizophrenia. In J. K. Wing, P. Kielholtz, and W. M. Zinn (eds.), Rehabilitation of patients with schizophrenia and depression. Bern: Hans Huber.

Clarke, D. M., Salkovskis, P. M., & Chalkley, A. J. (1985). Respiratory control treatment for panic attacks. *Journal of Behavior Therapy and Experimental Psychiatry, 16,* 23–30.

Crow, T. J. (1994). Prenatal exposure to influenza as a cause of schizophrenia: There are inconsistencies and contradictions in the evidence. *British Journal of Psychiatry, 164,* 588–592.

Cutting, J. (1987). The phenomenology of acute organic psychosis: Comparison with acute schizophrenia. *British Journal of Psychiatry 151,* 324–332.

Davison, K. (1983). Schizophrenia-like psychoses associated with organic cerebral disorders: A review. *Psychitr. Dev. 1*, 1–34.

Davison, K., & Bagley, C. R. (1969). Schizophrenia-like psychoses associated with organic disorders of the central nervous system: A review of the literature. In R. N. Herrington (ed.), *Current problems in neuropsychiatry: Schizophrenia, epilepsy and the temporal lobe.* British Journal of Psychiatry special publication no. 4.

Frith, C. D. (1979). Consciousness, information-processing and schizophrenia. *British Journal of Psychiatry, 134*, 225–235.

Frith, C. D. (1992). *The cognitive neuropsychology of schizophrenia.* Hillsdale, NJ: Erlbaum.

Garron, D. C. (1973). Huntingdon's chorea and schizophrenia. In A. Barbeau, T. N. Chase, & O. Paulson (eds.) *Advances in neurology* (pp. 729–734). New York: Raven Press.

Gilbert, P. (1993). Defense and safety: Their role in social behaviour and psychopathology. *British Journal of Clinical Psychology, 32*, 131–153.

Gray, J. A., Feldon, J., Rawlins, J. N. P., Hemsley, D. R., & Smith, A. D. (1991). The neuropsychology of schizophrenia. *Behavioural Brain Sciences, 14*, 1–20.

Gray, J. A. (1993). Consciousness, schizophrenia and scientific theory. In *Experimental and theoretical studies of consciousness.* Wiley, Chichester (Ciba foundation symposium 174), 263–281.

Haddock, G., Wolfenden, M., Lowens, I., Tarrier, N., & Bentall, R. P. (1995). Effect of emotional salience on thought-disorder in patients with schizophrenia. *British Journal Of Psychiatry, 167*, 618–620.

Harré, R., & Second, P. F. (1972). *The explanation of social behaviour.* Oxford, UK: Blackwells.

Hemsley, D. R. (1987). An experimental psychological model for schizophrenia. In H. Hafner, W. F. Gattaz, & W. Janzarik (Eds.), *Schizophrenia, concepts, vulnerability and intervention.* Heidelberg: Springer.

Hingley, S. M. (1992). Psychological theories of delusional thinking: In search of integration. *British Journal of Medical Psychology, 65*, 347–356.

Iversen, S. D. (1995). Interactions between excitatory amino acids and dopamine systems in the forebrain: Implications for schizophrenia and parkinson's disease. *Behavioural Pharmacology, 6*, 478–491.

Jackson, H. F. (1990). Are there biological markers for schizophrenia? In R. Bentall (Ed.), *Reconstructing Schizophrenia.* London: Routledge.

Jernigan, T. I., Zatz, I. M., Moses, J. A., & Cardellins, J. P. (1982). Computed tomography in schizophrenics and normal volunteers: I. Fluid Volume. *Archives of General Psychiatry, 39*, 771–773.

Johnstone, E. C., Crow, T. J., Frith, C. D., Husband, J., & Kreel, L. (1976). Cerebral ventricle size and cognitive impairment in schizophrenia. *Lancet, ii*, 924–926.

Kandel, E. R., Schwartz, J. H., & Jessel, T. M. (1991). *Principles of neural science (3rd ed.).* New York: Elsevier.

Kuhn, T. S. (1970). *The structure of scientific revolutions (2nd ed.).* Chicago, London: University of Chicago Press.

Lewis, C. S. (1966). *A grief observed.* London: Faber & Faber.

Loebel, A. D., Lieberman, J. A., Alvir, J. M. J., Mayerhoff, D. I., Geisler, S. H., & Szmanski, S. R. (1992). Duration of psychosis and outcome in first episode schizophrenia. *American Journal of Psychiatry, 149*, 1183–1188.

Maher, B. A. (1974). Delusional thinking and perceptual disorder. *Journal of Individual Psychology, 30*, 98–113.

Marshall, R. (1990). The genetics of schizophrenia: Axiom or hypothesis? In R. Bentall (Ed.), *Reconstructing Schizophrenia.* London: Routledge.

McGorry, P. D. (1995). The clinical boundaries of post-traumatic-stress-disorder. *Australian and New Zealand Journal of Psychiatry, 29*, 385–393.

McGorry, P. D., Chanen, A., McCarthy, E., Vanriel, R., McKenzie, D., & Singh, B. H. (1991). Post-traumatic stress disorder following recent onset psychosis: An unrecognised postpsychotic syndrome. *Journal of Nervous and Mental Disease, 179*, 253–258.

Mitchell, I. J., Lawson, S., Moser, B., Laidlaw, S. M., Cooper, A. J., Walkinshaw, G., & Waters, C. M. (1994). Glutanate-induced apoptosis results in a loss of striatal neurons in the Parkinsonian rat. *Neuroscience, 63*, 1–5.

Mitchell, I. J., Cooper, A. J., Brown, G. D. A., & Waters, C. M. (1995). Apoptosis of neurons in the vestibular nuclei of adult mice results from prolonged change in the external environment. *Neuroscience Letters, 198*, 153–156.

Murray, R. M. (1994). Neurodevelopmental schizophrenia: The rediscovery of Dementia Preacox. *British Journal of Psychiatry, 165*(Supp. 25), 6–12.

Nuechterlein, K. H. (1987). Vulnerability models for schizophrenia: State of the art. In H. Hafner, W. F. Gattaz, & W. Janarzik (Eds.), *Search for the causes of schizophrenia.* Berlin, Heidelberg: Springer.

Nyback, H., Wiesel, F. A., Berggren, B. M., & Hindmarsh, T. (1982). Computed tomography of the brain in patients with acute psychosis and in healthy volunteers. *Acta Psychiatrica Scandinavia, 65*, 403–411.

Pam, A. (1990). A critique of the scientific status of biological psychiatry. *Acta Psychiatrica Scandinavia, 82*, 1–36.

Roberts, G. W., & Bruton, C. J. (1990). Notes from the graveyard: Schizophrenia and neuropathology. *Neuropathology and Applied Neurobiology, 16,* 3–16.

Rose, S. (1984). Disordered molecules and diseased minds. *Journal of Psychiatric Research, 18,* 351–359.

Rose, S., Kamin, L. T., & Lewontin, R. C. (1984). *Not in our genes.* London: Penguin.

Sapolsky, R. M., UNo, H., Rebert, C. S., & Finch, C. E. (1990). Hippocampal damage associated with prolonged glucocorticoid exposure in primates. *Journal of Neuroscience, 10,* 2897–2902.

Schultz, S. C., Koller, M. M., Kishore, P. R., Hamer, R. M., Gehl, J. J., & Friedel, R. O. (1983). Ventricular enlargement in teenage patients with schizophrenia spectrum disorder. *American Journal of Psychiatry, 140,* 1592–1596.

Seeman, P., Lee, T., Chau-Wong, T., & Wong, K. (1976). Antipsychotic drug doses and neuroleptic/dopamine receptors. *Nature, 261,* 717–718.

Seidman, L. J. (1984). Schizophrenia and brain dysfunction: An integration of recent neurological findings. *Psychological Bulletin, 94,* 195–238.

Shelton, R. C., & Weinberger, D. R. (1986). X-ray computerised tomography studies in schizophrenia: A review and synthesis. In H. A. Nasrallah & D. R. Weinberger (Eds.), *The neurology of schizophrenia* (pp. 207–250). Amsterdam: Elsevier.

Slater, E., & Beard, A. W. The schizophrenia-like psychoses of epilepsy: (v) Discussion and conclusions. *British Journal of Psychiatry, 109,* 143–150.

Sloviter, R. J., Valiquette, G., Abrams, G. M., Ronk, E. C., Sollas, A. I., Paul, L. A., & Neubort, S. L. (1989). Selective loss of hippocampal granule cells in the mature rat brain after adrenalectomy. *Science, 243,* 535–538.

Tarrier, N., Barrowclough, C., & Porceddu, K. (1988). The psychophysiological reactivity to the expressed emotion of the relatives of schizophrenic patients. *British Journal of Psychiatry, 152,* 618–624.

Taylor, R., Ward, A., & Newburn, T. (1995). *The day of the Hillsborough disaster: A narrative account.* Liverpool: Liverpool University Press.

Thierry, A. M., Tassin, J. P, Blanc, G., & Glowinski, J. (1976). Selective activation of the mesocortical DA system by stress. *Nature 263,* 242–244.

Trower, P., & Gilbert, P. (1989). New theoretical conceptions of social anxiety and social phobia. *Clinical Psychology Review, 9,* 19–35.

Uno, H., Eisele, S., Sakai, A., Shelton, S., Baker, E., DeJesus, O., & Holden, J. (1994). Neurotoxicity of glucocorticoids in the primate brain. *Hormones and Behaviour, 28,* 336–348.

Weinberger, D. R., DeLisi, L. E., Perman, G. P., Targum, S., & Wyatt, R. J. (1982). Computed tomography in schizophreniform disorder and other acute psychiatric disorders. *Archives of General Psychiatry, 39,* 778–783.