

The Schizophrenic Experience: Taken Out of Context?

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A currently favored cognitive model of the abnormal behaviors and experiences characteristic of schizophrenia suggests that they may be linked to a disturbance in the effects of context. The present article reviews some of the relevant literature, noting the wide range of experimental paradigms that have been employed. This range of paradigms is both a strength and a potential weakness of the literature because it raises complex issues of definition and the need to distinguish the various ways that context may influence behaviors. This influence may be crucially dependent on specific task parameters. Despite this, a number of phenomena can be plausibly related to changes in the way that context operates: delusions, disorganization, hallucinations, and the loss of a sense of personal identity. Potential links with the neural bases of the disorder are indicated.

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The search continues for the “core” cognitive disturbance linking the clinical phenomena of schizophrenia to their biological bases. Such a disturbance should both explain the wide-ranging cognitive deficits associated with this condition and provide a plausible account of the emergence of psychotic symptoms. The research strategy remains as Oltmanns and Neale wrote in 1978: “First, the single empirical measure which has been assessed is assumed to index a more general construct.... Second, it is then postulated that the construct which is implicated in the deficit is causally related to schizophrenia and can account for a variety of schizophrenic behaviours. In other words it is held to be a primary symptom of schizophrenia” (p. 198).

A currently favored formulation proposes that a weakening of contextual influences is central to the condition (e.g., Cohen and Servan-Schreiber 1992). As may be seen from table 1, the suggestion has a considerable history. The quotations derive from both clinical observations and the specification of performance deficits, from which is inferred a change in the operation of context. As

with the earlier selective attention hypothesis (cf, McGhie and Chapman 1961), it is this convergence that is particularly appealing.

Advantages claimed by this approach’s proponents include the following: (1) there are plausible links to a range of symptoms; and (2) two crucial cognitive processes thought to be impaired in schizophrenia, namely working memory (WM) (e.g., Park and Holzman 1992) and inhibitory processing (e.g., Braff et al. 1999), might be seen to reflect the operation of a single underlying mechanism, the context module (Cohen and Servan-Schreiber 1992). Although context information is relevant to the performance of almost all cognitive tasks—subjects must at least keep a set of instructions in mind—it is more important to some tasks than others. If there is response competition and a strong response tendency must be overcome for appropriate behavior, the context module plays an inhibitory role. However, when there is a delay between the relevant stimulus and the response, the context module plays a WM role. The role of context might therefore be particularly crucial when it is necessary to maintain information over time and to use this information to inhibit a habitual response.

It has also frequently been argued (e.g., Frith 1992) that specification of the nature of the cognitive disturbance may provide links to underlying brain mechanisms. As will be indicated below, “context” is a term with widespread use within studies of animal learning and behavior; hence, development of animal models of certain aspects of the disorder is possible. Ways in which the idea of contextual disturbance may be employed to understand the biological bases of schizophrenia are well illustrated in a recent article by Phillips and Silverstein (2003). They argue that certain aspects of schizophrenia, in particular disorganization, may be linked both to an alteration in the operation of context and to N-methyl-D-aspartate hypofunction.

The claim is not that contextual disturbance is the primary cause of schizophrenic symptoms but that a range of genetic and environmental influences contributing to the disorder may operate through a “final common pathway” of failure to integrate contextually appropriate stored material with current sensory input and ongoing motor programs (e.g., Hemsley 1993).

The aim of this article is to review some research that emphasizes such a disturbance and to indicate the problems that arise from the various ways in which

Table I. Examples of use of the term "context" in schizophrenia research

“When the perceptual context is disturbed, individual objects acquire different properties from those which they have when the normal context prevails” (Matussek 1952, p. 292).

Schizophrenia patients show deficits on tasks that require “subjects to use contextual variables in determining the appropriate responses” (Hemsley and Richardson 1980, p. 141).

Perceptions “are not placed in a context of background knowledge” (Anscombe 1987, p. 256).

“Failure to integrate current contextual information with stored information relevant to such contexts will weaken moment by moment associations between the elements of the stream of discourse” (Gray et al. 1991, p. 3).

“Studying tasks that involve the processes by which context determines relevance will enable us to understand the symptoms of schizophrenia” (Frith 1991, p. 29).

There is in schizophrenia “a disturbance in the internal representation of contextual information”; this may be simulated by “reducing the gain of units in the context module” (Cohen and Servan-Schreiber 1992, p. 62).

“Contextual information, both spatial and temporal, controls the activation of appropriate stored material” (Hemsley 1994, p. 164), and “a failure to activate contextually appropriate schemata could lead to some of the perceptual distortions and disruption of activities characteristic of the disorder” (Hemsley 1998, p. 116).

“Hallucinators fail to make use of contextual information which controls the activation of appropriate material” (Levitan 1996, p. 253).

“Schizophrenic patients are also impaired in their ability to alter perceptual organization of ambiguous stimuli based on current context” and are “characterized by reduced contextual influences in functions such as memory, attention and language processing.” “Acute schizophrenia is characterised by a general failure to flexibly adapt distributed processes on the basis of external context” (Silverstein and Schenkel 1997, p. 696).

“Both P300 and N400 abnormalities appear to index failure to utilize preceding context, either semantic or probabilistic, to modulate stimulus processing” (Nestor and O’Donnell 1998, p. 542).

“The ‘sense of self’ in part results from the consistent manner in which contextually appropriate stored material operates on sensory input.... If in schizophrenia there is a disruption in the moment by moment integration of these sources of information, then a disturbance in the ‘sense of self’ is implicit in the model” (Hemsley 1998, p. 115).

context has been both defined and considered to exert its influence. There are intriguing parallels with the research literature of the 1960s and 1970s that claimed a disturbance of selective attention as basic to the schizophrenic condition. Indeed, some studies can be used to support both formulations. However, it will be concluded that there are important advantages in the more recent hypothesis, in terms of the consistency of findings, the range

of experimental paradigms employed, and the number of symptoms with which context might plausibly be linked.

Definitions

“Context” is derived from the Latin “contexere”—to weave together—and can mean both “the connection of the parts of a discourse” and, more concretely, “the parts which immediately precede or follow any particular passage or text and determine its meaning” (*Shorter Oxford English Dictionary*). In view of the term’s derivation, it is of interest that recent models have emphasized the role of context in lending continuity to conscious experience (Hemsley 1998; Epstein 2000) and that a change in its operation may be linked to the discontinuities that can characterize psychosis. It is clear that the above definitions relate specifically to language and that the paradigms that have been employed to study contextual influences in schizophrenia are not restricted to this domain.

In general terms, context may be seen to influence the processing of a target stimulus by drawing on patterns of stored predictive relationships. As Phillips and Singer (1997) write in a major review of the operation of context, “the contextual input is used to selectively enhance the transmission of that information in the processor’s receptive field that is coherently related to the context”; they also note that the probability that “information is transmitted about any feature at any moment is increased if that feature is predicted by the context and decreased if it is incompatible with that prediction” (p. 659). This is similar but not identical to the operation of Broadbent’s (1971) “pigeonholing” mechanism, which acts to bias category state thresholds; a disturbance of this process in schizophrenia was proposed many years ago (e.g., Hemsley 1975), and the idea continues to receive some experimental support (e.g., Harris et al. 1990). A system of this kind has “the ability to go beyond the information given in an appropriate way” (Phillips and Singer 1997, p. 661), for example, by making it more salient, or less ambiguous, and by grouping it with other relevant signals. It should be noted that the authors do not consider in detail the issue of whether, and under what circumstances, contextual influences may mislead the processor. It is emphasized by Phillips (personal communication to J. Gray, 1997) that “for us, context is not equivalent to background signals, to unattended signals, or to signals concerning time and space.... Effects of stimuli other than what is called the target does not imply that those effects must involve contextual modulation of the transmission of information about the target.”

For Cohen and Servan-Schreiber (1992), context can be “a set of task instructions, a specific prior stimulus, or the result of processing a sequence of prior stimuli” (p. 46). This very general statement acknowledges that context information can be used in a variety of ways

to support task-relevant processing. A number of distinctions may be important and relevant to schizophrenic dysfunction:

1. Both temporal and spatial context can clearly influence performance. Although primarily concerned with the latter, Phillips and Singer (1997) acknowledge the importance of both temporal and spatial structure, and suggest that “the ways in which the two constraints can be used together merit further study” (p. 709). Temporal and spatial context may influence the processing of target stimuli in different ways, and in many experimental situations the effects may be difficult to disentangle. The situation may be further complicated by abnormalities of visual scan paths in schizophrenia, which are now well documented (e.g., Green et al. 2000). The literature to be considered below is consistent with a disturbance in both aspects of contextual influence in schizophrenia.
2. The parameters of the relationship, either temporal or spatial, may crucially affect the nature of the influence observed. This is well documented in such procedures as semantic priming. Thus, Strandburg et al. (1997) argue that schizophrenia patients’ failure to take full advantage of contextual information in determining the meaning of target words “is most apparent when the contextual cues and target stimuli are separated in time” (p. 597). Phillips and Singer (1997) stress the importance of studying “how the modulatory effects of context depend upon the precise temporal relationships between target and context” (p. 680). There is also the possibility that in addition to generally weakened contextual influences, schizophrenia may sometimes be characterized by inappropriately distant contextual stimuli influencing performance (e.g., de Silva and Hemsley 1977).
3. Context can clearly have both facilitatory and inhibitory effects. As Cohen et al. (1996) write, “Under conditions of response competition ...the context module can be seen to play an inhibitory role.... In contrast, the context module can be seen to play a role in memory by actively maintaining that information over time” (p. 1517). Phillips and Singer (1997) also argue that contextual inputs both increase the probability of outputs that are coherently related to that context and decrease the probability of opposing outputs. Abnormalities in both inhibitory (cf, Hemsley 1994; Braff et al. 1999) and facilitatory (cf, Spitzer 1997) processes have been documented, although findings on the former, employing a variety of paradigms, appear better established.
4. Linked to (2) is the issue of “tonic” versus “phasic” context. Lubow (1989) goes so far as to define context as “all of those environmental stimuli relatively constant during the course of a procedure” (p. 74). Depending on one’s definition of “procedure,” this

definition could exclude many findings that have been considered relevant to contextual disturbance in schizophrenia. The tonic-phasic distinction overlaps with that made between “global” and “local” context. In arguing for the importance of the former, Tononi and Edelman (1997) propose that “there is no alternative but to consider, both theoretically and experimentally, the context provided by the entire brain and its history” (p. 70). While this may be true, it clearly could present problems for those developing models of schizophrenia based on a weakening of contextual influences.

5. Mayes et al. (1985) distinguished between “interactive” and “independent” context. The former “directly affects the semantic (conceptual) identification of the target ...the latter is associated spatiotemporally but not conceptually with the target information” (Pickering 1993, p. 205). From the perspective of Phillips and Singer (1997), contextual effects are those that modulate the transmission of information about something else. As noted previously, context is not considered equivalent to background signals, although these may also convey useful information. These researchers’ focus is therefore on what Mayes et al. (1985) would term “interactive context.” Hemsley et al. (1993) accepted the potential utility of the distinction between interactive and independent context in the development of models of schizophrenic disturbance but expressed doubts as to whether in most experimental situations a confident prediction could be made as to which was likely to operate. Phillips and Singer (1997) indicate ways in which network models could clarify this issue. One intriguing possibility is that in schizophrenia there could be a confusion between interactive and independent context, leading to either inappropriate influences on the processing of a target or an absence of appropriate influences. Such a disturbance could produce a range of abnormal behaviors and experiences.
6. In addition to the above distinctions, the nature of the material may affect the extent of the contextual disturbance. The most obvious would be possible differences between verbal and nonverbal stimuli.

Perceptual and Cognitive Abnormalities Considered to Reflect a Disruption of Contextual Influences

Cohen and Servan-Schreiber (1992) interpret a wide range of schizophrenic deficits in terms of a disturbance in the processing of context. Their model is the most clearly elaborated and linked to plausible brain mechanisms. It builds upon an extensive body of research on cognitive disturbance in schizophrenia.

Among the earliest experimental studies were those involving memory for passages of varying contextual constraint (e.g., Levy and Maxwell 1968). Although the

interpretation was sometimes problematic because of variations in task difficulty (cf, Chapman and Chapman 1973), recent research (Manschrek et al. 1997) confirms that schizophrenia patients are indeed less able to benefit from context. A deficit is also apparent when schizophrenia patients are required to use context when shadowing passages of prose (Hemsley and Richardson 1980; Harris et al. 1990) and to generate words deleted from passages of text—the “reverse Cloze” procedure (e.g., Newby 1998). On variants of this latter task, normal subjects show greater accuracy with increasing amounts of context; this is clearly dependent on subjects’ ability to accurately use the varying predictive power of words increasingly separated from the target. On average, the farther a cue is removed from a target word, the less its contribution to the determination of the word in question. Chronic schizophrenia patients, in contrast, showed stable inferior performance, and acute patients even demonstrated worsening performance as context increased (de Silva and Hemsley 1977). For this latter group, the inability to assess the relative importance of contextual cues may have led to the deterioration in performance. Assigning equal weight to all cues would disrupt performance, the more so with increasing numbers of cues.

Research by the Chapmans and their colleagues (e.g., Chapman et al. 1964) has indicated a tendency for schizophrenia patients, especially more chronic patients, to rely less on contextual cues when interpreting an ambiguous word (Williams et al. 1976). A related report by Bullen and Hemsley (1987) also supported Frith’s (1979) prediction that schizophrenia patients would “fail to inhibit alternative [i.e., those inappropriate to a given context] meanings of ambiguous words” (p. 231). A study by Kuperberg et al. (1998) suggests that impaired sensitivity to linguistic context may be particularly linked to schizophrenic thought disorder. Noteworthy was their finding that patients showing marked variation of such disorder over testing sessions were least sensitive to context when most disordered. Bazin et al. (2000) support the strength of this association and, taking their earlier work into account as well, conclude that the deficit is specific to “interactive context.”

The above studies are therefore broadly consistent with a failure of linguistic expectations to disambiguate verbal material. They receive strong support from research that has monitored event-related potentials during linguistic processing by schizophrenia patients (e.g., Nestor et al. 1997; Niznikiewicz et al. 1997; Strandburg et al. 1997). There appears to be general agreement that the findings are probably related to a failure to maintain and to use semantic context.

Findings from the A-X variant of the Continuous Performance Test have also supported Cohen and Servan-Schreiber’s (1992) emphasis on a “context processing deficit” as basic to the schizophrenic disturbance (Servan-Schreiber et al. 1996; Stratta et al. 2000). The

task is notable for its prediction of minimal schizophrenic deficit in the A-Y condition precisely because normals do make use of the, here misleading, context. Such a differential pattern of performance is less likely to be attributable to the well-documented “generalized deficit.” The search for such patterns has long been advocated (cf, Knight 1984). The findings are consistent with both Hemsley’s (1987) model and Patterson’s (1987) suggestion of “a failure in the automaticity with which prior experience may be recreated in parallel with current stimulus input ... (with concomitant failures in future orientation or contextually generated expectancy)” (p. 555). Both “disorganization” and “poverty” symptoms have been shown to relate to performance on the A-X task (e.g., Barch et al. 2003).

While most of the above has been concerned with temporal context, there is also evidence for a weakening of the effects of spatial context. Thus, Jones et al. (1991) employed a choice reaction time task in which subjects were presented with either of two letters (e.g., A or B), each requiring a different response. These were regularly displayed with two flanking letters (e.g., X, Y in the form XAX, YBY) but occasionally interchanged (YAY, XBX); normal subjects were slowed by this change of context, but acute schizophrenia patients were unaffected. In a number of studies, schizophrenia patients’ deficits in perceptual organization (e.g., Silverstein et al. 2000) have also been interpreted as “one manifestation of a broader deficit in the co-ordination of contextually related stimuli” (p. 18).

To emphasize the breadth of research findings that can be subsumed under the context deficit model, it should be noted that this concept has been invoked to explain schizophrenia patients’ performance on latent inhibition (LI), negative priming (NP), and prepulse inhibition (PPI) paradigms. Whether this is a strength or a weakness is an issue that will repeatedly arise in this article. For example, Hemsley (1994) argued that LI, NP, and PPI all represent the operation of contextually elicited inhibitory mechanisms. While it was acknowledged that they appear to be very different psychological processes, all depend heavily on the integration of previously presented material with current sensory input. Although schizophrenic deficits in PPI and NP appear well established (cf, Braff et al. 1999; Peters et al. 2000) and indicate a weakening of the effect of the immediately preceding stimulus (i.e., temporal context), the literature on LI is less consistent (cf, Gray et al. 1992; Swerdlow et al. 1996). However, the most recent report appears to confirm the earlier findings of disrupted LI in the acute phases of the disorder (Raschle et al. 2001). The authors indicate methodological differences that may account for the discrepant results. It is well established that LI is attenuated by a context shift between preexposure and conditioning (e.g., Westbrook et al. 2000), and Gray et al. (1991) argued that a failure to link the stimulus–no consequence association to its

context would have the same consequences as a context shift (i.e., abolition of LI).

Although a reduction in contextual influences has been most frequently related to thought disorder (e.g., Knight and Silverstein 1998; Kuperberg et al. 1998), others have pointed to a possible link to hallucinations. For example, in a study by Ward et al. (1999), current hallucinators displayed a pattern of event-related potentials suggestive of reduced sensitivity to contextual influences during processing of linguistic information. Hallucinations have also been linked to the impairment in source monitoring that has been demonstrated in schizophrenia (e.g., Vinogradov et al. 1997). This in turn is viewed as resulting from a failure to identify and maintain in memory the spatial and temporal context in which events occur (Brebion et al. 1998).

In many studies, however, contextual deficits have been examined in relation to the diagnostic category of schizophrenia. As noted above, few have considered particular aspects of symptomatology, and this clearly merits further investigation. It could usefully be combined with an attempt to categorize contextual tasks by using the distinctions outlined in the preceding section. A related classification scheme has recently been proposed by Park et al. (2003). They distinguish “perceptual context”—largely concerned with spatial aspects of the stimulus array—from “cognitive context.” The latter includes both long-term memory, skills, and habits and, as a separate subcategory, task-relevant information in WM.

Such distinctions are clearly crucial because, although the above studies make a convincing case for the utility of context disturbance as an explanatory concept, a study by Elvevag et al. (2000) employing a variety of tasks did not suggest a simple unitary context deficit.

This is perhaps not surprising given the complex issues of definition considered above. Even within the field of animal learning theory, at least four different roles for context have been proposed (Hemsley et al. 1993). First, context can itself be directly associated with the outcome to be predicted (the unconditioned stimulus [US] in typical animal learning experiments). In this role, context would summate with any other, conventional conditioned stimuli (CSs) that predict the same US. Second, context can enter into stimulus-stimulus associations with an explicit CS and thereby acquire secondary conditioned properties. This might also lead to contextual facilitation of some aspects of the conditioned response to simultaneously presented CSs that predict the same US. Third, context can form a configural cue in combination with the CS and thereby participate in predicting the US if and only if the appropriate compounded CS is simultaneously presented. In this case, neither context alone nor the CS alone would elicit a maximal response and context would not facilitate responses to other CSs that predict the same US. Fourth, context may be able to act as an occasion-setting stimulus that specifies when

a particular CS-US association will be in force. In this role, context’s effects would be specific to a particular CS-US combination. This complexity was noted by Winocur (1997), who in discussing the effects of hippocampal (HPC) lesions wrote that “the results indicate that while HPC lesions alter the animal’s response to context, the expression of that change varies with the task and relates to the various ways that contextual cues are used” (p. 228).

Models of Schizophrenic Symptoms That Emphasize a Disturbance in the Role of Context

The utility of a model of schizophrenia based on “contextual disturbance” relies not only on the extent to which it can explain a range of performance abnormalities but also on its plausibility as the basis for the emergence of psychotic symptoms. The earlier “selective attention” formulation was frequently criticized for failing to specify the pathway from cognitive deficit to clinical phenomena. Although on many experimental tasks the two models make similar predictions, this is not always the case (e.g., Jones et al. 1991).

Delusions. Matussek (1952) was one of the first to argue that there is a link between a disturbance in the operation of context and the emergence of schizophrenic symptoms. In particular, he noted that a weakening of contextual influences could correspond to a breakdown of gestalt perception. He describes a patient who was aware of a “lack of continuity of his perceptions both in space and over time. He saw the environment only in fragments. There was no appreciation of the whole. He saw only details against a meaningless background” (p. 92). In such circumstances, individual objects may acquire properties different from those that exist when the normal contextual influences are operative; in particular, they may take on altered significance or implications for action. Under normal conditions, contextual information controls the activation of appropriate stored material and results in “expectancies” or “response biases” (cf, Broadbent 1971). However, in schizophrenia, “perceptions are not placed in a context of background knowledge” (Anscombe 1987, p. 256), and attention may be captured by incidental details of the environment that would not normally reach awareness. Their registration may, however, prompt a search for reasons for their occurrence, a process that Frith (1979) saw as contributing to the formation of delusional beliefs.

An abnormal view of relationships between events is among the most prominent features of delusional thinking. Schneider (1930) noted that meaningful connections may be created between temporarily coincident external impressions. Similarly, Arieti (1974) observed that “patients see non-fortuitous coincidences everywhere” (p. 231). More recently, Emrich (1992) has emphasized

that there are “abnormal assumptions about causal relationships” (p. 375). The failure of context to activate appropriate stored material not only may result in the intrusion of redundant material into awareness but also may affect assessment of the covariation between two events X and Y, by reducing the influence of instances of X in the absence of Y and Y in the absence of X (i.e., past regularities). Hence, abnormal causal relationships may be inferred on the basis of a single co-occurrence.

The above formulation comes close to suggesting that it is a failure of context to activate appropriate schema to guide processing that is crucial to the emergence of some forms of delusional beliefs. As Norman and Bobrow (1976) wrote, “past experience has created a vast repertoire of structural frames or schemata that can be used to characterize the propositional knowledge of any experience. The problem for the perceptual processes is to determine the appropriate schema and to match the present occurrence with the frame provided for them” (p. 119). A breakdown in such a system in which entirely inappropriate frames of reference are applied to sensory input could correspond to “primary delusions.” Recently demonstrated abnormalities in schizophrenia patients’ social context processing (Penn et al. 2002) may not only relate to abnormalities in social functioning but contribute to the development of abnormal beliefs about others.

Disorganization. The most straightforward theoretical link between contextual disturbance and schizophrenic symptoms is that concerning language behavior. Both language perception and language production are clearly heavily dependent on context. As Dennett (1991) notes, “speech perception ... would be beyond the physical limits of the brain’s machinery if it didn’t use ingenious anticipatory strategies that feed on redundancies in the input” (p. 144).

However, thought disorder is but one instance of the disorganized behavior that may characterize psychosis. Jensterle et al. (2000) argue that there are “two sources of constraint on our behaviour which increase its long term coherence and organization” (p. 116). First, there is contextual priming of certain routine sequences, roughly equivalent to Shallice’s (1988) “contention scheduling system.” Second, there is a “top-down” process, dependent on goals and plans, that overrides routine responses; this is one of the functions of Shallice’s “supervisory attentional system.” Failure of either may lead to disorganized behavior, but it is apparent that at times the latter has also been viewed as a “contextual disturbance.” This is most apparent when “context” is taken to include task instructions, such as on the Stroop test (cf, Cohen and Servan-Schreiber 1992). It well illustrates the problems of definition highlighted earlier.

Hallucinations. Perhaps most problematic for “context” theories are hallucinatory experiences. A potential

link is provided by Hoffman and McGlashan’s (1997) computer simulation of a speech perception network. During the course of training, the network acquired the ability to use linguistic expectations based on temporal context. These corresponded to activation patterns resonating between the hidden and temporary storage layers of the network. With degraded phonetic input, elimination of the majority of these connections resulted in output layer activation patterns corresponding to words even in the absence of inputs—“hallucinations.” These activation patterns had arisen from “misapplied sequential expectations derived from working memory” (p. 1687).

The necessity for the phonetic input to be degraded if it is to model “hallucinations” is of interest because the extent of hallucinatory experiences in chronic hallucinators is related to the lack of structure in sensory input (Margo et al. 1981). It is also clear that in normal subjects the unstructured input of perceptual deprivation experiments may result in abnormal experiences that Leff (1968) suggested “overlap considerably with those of mentally ill patients” (p. 1507). Conditions of total perceptual deprivation are, by definition, those in which context can generate no valid expectancies. George and Neufeld (1985) have referred to “an interaction between the spontaneous retrieval of information stored in long term memory (LTM) and sensory processing, the latter having an inhibitory effect on the former” (p. 268). A weakening of the effect of context could increase the ambiguity of sensory input and hence fail to inhibit the emergence of material from LTM. As Hartmann (1975) wrote, “possibly something in the ability to pattern sensory input may be involved in the inhibitory factor [for hallucinatory experiences]” (p. 73).

Loss of Sense of Personal Identity. The idea that there is a fundamental disturbance in the “sense of self” in schizophrenia has played a significant role in the development of theories of the disorder (e.g., Bleuler 1911; Jaspers 1963). It continues to receive attention (cf, Spitzer 1988), and indeed Fabrega (1989) proposed that “the basic phenomenological correlate of schizophrenic episode or end state, then, is an impairment of self functioning, involving self awareness, definition and regulation” (p. 278). However, Levin (1992) has argued that studies of the self-concept involving conscious reflection fail to address key issues concerning the sense of personal identity that is normally concomitant with every idea and lends continuity to conscious experience. Gallagher and Marcel (1999) also noted the limitations of this approach and raised the issue of “whether it is possible to capture a sense of self that is more embedded in contextualized actions” (p. 4). It is a disturbance in this “nonreflective” self that may be linked to contextual dysfunction.

I previously proposed (Hemsley 1975, 1995) that schizophrenia patients fail to establish contextually appropriate response biases or “unconscious expectancies”

and hence do not use temporal and spatial redundancy to reduce information processing demands. It was further suggested that such redundancy is involved in giving consciousness the distinctive “streamlike” attributes emphasized by James (1890). The influence of context may correspond to the “transitive” parts of conscious experience that link “substantive” parts together. In a similar vein, Epstein (2000) suggests that one component of James’s “stream of thought” consists of “a fringe of dimly sensed contextual information” that controls the entry of information into awareness (p. 550). A breakdown in this system could correspond to “thought block.” Hemsley (1998) argued that the sense of self in normal subjects arises in part from the consistent manner in which context activates stored material to integrate with sensory input; a disturbance in this system is emphasized in the model of schizophrenia put forward by Gray, Hemsley, and their colleagues (e.g., Gray et al. 1991; Hemsley 1993). It was further proposed that a consideration of action identification theory (Vallacher and Wegner 1987) permits further links to be made to the disruption of the sense of self because higher level action identities are viewed as being practically synonymous with self-defining significance. Vallacher and Wegner (1987) emphasized the way in which an appropriate use of context often imparts a relatively high level of identification to actions.

Neuropsychological Speculations

The prevalent view of the biological basis of schizophrenia is that it corresponds to a disruption of particular neural circuits. A number of variants have been put forward (e.g., Gray et al. 1991; Bogerts 1997; Andreasen et al. 1998). Particularly influential is the suggestion (e.g., Friston 1998) that there is a failure of functional integration within the brain and, in particular, abnormal interaction between the frontal and temporal regions.

Numerous magnetic resonance imaging studies have documented abnormalities in temporal lobe structures in schizophrenia. It is well established that there are reductions in gray matter volume (e.g., Hirayasu et al. 1998), and there are also suggestions of a progressive process in areas of the dominant temporal cortex subserving auditory perception and language processing (Kasai et al. 2003). Although prefrontal structural changes have been less consistent (McCarley et al. 1999), recent research does indicate significant frontal gray matter volume reduction (Hirayasu et al. 2001). Gray matter deficits in both frontal and temporal regions were also reported by Sigmundsson et al. (2001). Particularly interesting was the co-occurrence of white matter deficits in left hemisphere tracts known to incorporate axonal connections between the regions of gray matter deficits. They claim that anatomical abnormalities are distributed in a network of neocortical and limbic regions and intercon-

necting white matter tracts, these data being compatible with supraregional models for the pathology of schizophrenia. Consistent with such reports are findings indicative of abnormal functional connections between such regions. For example, positron emission tomography (PET) studies of information processing in schizophrenia (e.g., Jennings et al. 1998; Fletcher et al. 1999) have been suggestive of abnormal frontotemporal interaction.

McCarley et al. (1999) argue that temporal lobe structures such as the hippocampus, the parahippocampal gyrus, and the superior temporal gyrus form part of a neural network that is functionally important for associative links in memory. The extensively documented impaired verbal memory in patients with schizophrenia includes a decreased ability to identify the temporal and spatial context in which words are learned (e.g., Danion et al. 1999) and has been interpreted as evidence for impaired frontotemporal integration in schizophrenia (Dolan et al. 1999). Consistent with this, and with earlier reports of abnormalities of frontotemporal cerebral blood flow during schizophrenia patients’ performance on memory tasks (Ragland et al. 1998), a PET study by Weiss et al. (2003) indicated impaired hippocampal recruitment during normal modulation of memory performance in schizophrenia. Weiss et al. (2003) raise the possibility that the greater hippocampal activation in controls may be linked to conscious recollection that incorporates contextual details.

Functional magnetic resonance imaging techniques (cf, Bullmore and Suckling 2000) have recently been applied to the A-X continuous performance task discussed above, where schizophrenia patients’ performance has been indicative of a “context” deficit (Cohen and Servan-Schreiber 1992). Three studies have been reported (Haworth 2003; MacDonald and Carter 2003; Perlstein et al. 2003). While the experimental designs have varied, all report abnormal patterns of brain activation in schizophrenia patients during task performance.

How might such research on frontotemporal abnormalities, and their important role in schizophrenia patients’ deficits in information storage and retrieval, relate to models that emphasize a disruption of contextual influences? Several authors have put forward ideas on how this might be achieved. Thus Spitzer (1997), in discussing linguistic abnormalities, suggests that the frontal cortex may provide contextual information that controls the activation of a semantic network possibly residing in the temporal lobe. A reduction in connections between frontal and temporal regions could result in a weakening of the linguistic constraints normally generated by context. A related formulation is put forward by Cohen et al. (1996): “Semantically rich ...representations in posterior neocortex are not only required to encode the statistical structure of the environment ...but also serve as the basis for developing an appropriate set of representations in prefrontal cortex (PFC).” Because these latter

in turn “enable the flexible biasing of representations in posterior neocortex” (p. 1524), a vicious circle may develop. As representations in PFC become more distorted, this may lead to increasingly inappropriate biasing of representations in posterior regions.

A recent paper by Friston (2002) may enable us to specify the nature of such interactions in more detail. He has indicated the ways in which “constraints from higher levels of a cortical hierarchy provide contextual guidance to lower levels of processing” (p. 222). The detailed model developed suggests that higher level systems provide a prediction of inputs to lower level regions (cf, Gray et al. 1991) and higher level representations can in turn be modified if a mismatch occurs.

Animal studies have for some time emphasized the role of the hippocampal formation in exerting contextual influences. Thus, Winocur (1997) notes, “Unable to form the associations that define an event within its context... HPC damaged animals or humans cannot meaningfully represent an experience” (p. 228). In a similar vein, Holland et al. (1999) suggest that hippocampal lesions “particularly interfere with inhibitory learning about both explicit and contextual cues” (p. 143). The emphasis on inhibitory learning is important in the light of claimed disruption of such processes in schizophrenia (cf, Hemsley 1994). However, O’Reilly and Rudy (2001), while accepting the important role of the hippocampus in “encoding conjunctions between context and stimulus elements” (p. 316), argue that this system must operate in parallel with a contextual system that “integrates over multiple experiences to extract generalities” (p. 311). These could be seen as the “representations” emphasized by Cohen et al. (1996), and both sets of authors stress the bidirectional influences operating. Thus, O’Reilly and Rudy (2001) note that “the development of cortical representations can affect the trajectory of hippocampal learning and vice versa” (p. 322). The circuit crucial to the development of schizophrenic systems may involve frontal and temporal regions, both of which play a role in these differing operations of context. It was suggested above that context plays an important role in the continuity of conscious experience, as emphasized by James (1890). It is therefore of interest that Epstein (2000) concludes that the “fringe” of contextual information, constituting the transitive aspects of conscious experience, corresponds to a “set of mechanisms in the frontal and medial temporal lobes” (p. 550).

The operation of context is also explicit in the circuits seen as crucial to schizophrenic dysfunction by Gray and Hemsley (e.g., Gray et al. 1991; Hemsley 1993, 1994), in two ways. First, the immediate temporal context, in normal subjects, is seen as activating appropriate stored material (e.g., stimulus-stimulus regularities) to integrate with subsequent sensory input. The hippocampus and related brain structures are seen as particularly crucial for this process. Indeed, Gray (1995) has gone so far as to

equate the outputs of this system with the contents of consciousness—a view that has been challenged (see commentaries above). A second aspect of contextual influence operates in the form of information about ongoing motor programs; these are also considered to activate stored response-stimulus regularities because motor activity is to some extent predictive of subsequent sensory input. The model views the cingulate and prefrontal cortices as crucial to this process. Together, these two forms of contextual information generate a frame of reference that influences access to conscious experience, significance assessment, and implications for action. An abnormality in the effects of context could therefore result from a disturbance at one or more points in these circuits. According to this model, the final common pathway to psychotic symptoms is the failure to relate current sensory input to contextually appropriate stored material.

Conclusions

There is convincing evidence for an alteration in the way that context exerts its influence in schizophrenia. A wide range of cognitive abnormalities may be linked to such a disturbance, and Barch et al. (2003) raise the possibility that context-processing deficits may even represent a stable or mediating vulnerability factor for schizophrenia. The contextual disturbance model may also be plausibly linked to a number of the abnormal behaviors and experiences characteristic of the disorder; it has the strength of addressing some of the more subtle experiential, perceptual, and cognitive phenomena more convincingly than alternative cognitive formulations. Finally, it is also appealing in its potential for links with animal models of schizophrenia. As noted in this article, the role of context in animal learning and behavior has been extensively investigated. The brain regions implicated in its operation include those, such as the hippocampus, that are of considerable interest in schizophrenia research.

The convergence of these three lines of inquiry is intriguing, but the varying uses of the term “context” make it unlikely that we are dealing with a unitary dysfunction. It is clearly necessary to begin to clarify its various modes of operation and whether these are related to particular patterns of symptomatology.

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