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Schizophrenia: Putting context in context

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Abstract

Although context-processing deficits may be core features of schizophrenia, 'context' remains a poorly defined concept. To test Philips and Silverstein's model, we need to operationalize context more precisely. We offer several useful ways of framing context and discuss enhancing or facilitating schizophrenic patients' performance under different contextual situations. Furthermore, creativity may be a byproduct of cognitive uncoordination.

Current neurobiological theories of schizophrenia mirror the dominant, localizationistic trends in neuroscience. Yet after decades of lobe-trotting under intense scrutiny, no single region has emerged as the clear culprit. Similarly, psychological models tend to favor omnipotent single mechanisms (e.g. context processing, working memory, inhibitory control, sensory gating etc) to explain a bewildering range of symptoms that characterize schizophrenia. Alas, the glass slipper does not fit.

Reasonable theories of schizophrenia must address multiple cortical and subcortical interactions that can explain a wide range of symptoms under different conditions. Philips and Silverstein's hypothesis that the disorganized syndrome is the clinical manifestation of deficits in cognitive coordination caused by NMDA hypoactivity is a great leap forward in demystifying the heterogeneity of schizophrenia. One major contribution of the target article is a stimulating and thoughtful discussion of the concept of 'context'. Although context-processing deficit has been proposed to be a core feature of schizophrenia (Cohen and Servan-Schreiber, 1992), it is not entirely clear what is included or excluded in this 'context'. Extending the definitions of context presented in the target article, we will discuss several ways of framing context (See figure 1) and examine the hypothesis that context processing is impaired in schizophrenia.

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Insert Figure 1 about here

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Perceptual context

Focusing on the role of the attended vs. unattended features (or stimuli) against the background is helpful in understanding the relationship between the selected target (or feature) and the background (or context). Context can, but does not necessarily, influence target processing.

1. **Context represented within the target stimulus**: A stimulus consists of multiple dimensions and features. If the task is to process one feature of the target (e.g. color), other unattended features provide the contextual environment (e.g. location, identity, size, speed etc). The same is true with auditory stimuli.

2. **Context surrounding the target stimulus**: The layout (whether visual or auditory) around the target provides contextual information and may influence the processing of the target. (e.g. perceptual grouping). Context can also influence the target processing across modalities.

3. **Temporal relationship between the target event and the contextual background**: The interval between the target onset and the contextual element may determine the extent of interaction. For example, lexical disambiguation depends on the temporal proximity between the target and the context. In associative conditioning, temporal contiguity is crucial.

Cognitive Context

1. **Long-term memory, skills, and habits provide the context**: There is an "influence of stored memories of regularities of previous input on current perception" (Gray et al., 1991). The contextual influence can be direct, explicit and aware or indirect, implicit and subconscious. For example, in a semantic priming task, experiences and associations play a key role in determining the speed of lexical decision. The Kamin blocking effect and latent inhibition also depend on the context.

2. **Task-relevant information in working memory is identified as providing context** (Cohen and Servan-Schreiber, 1992). For example, in a CPT-AX task, subjects must respond to an X only if it follows an A. In the Stroop task, the correct response depends on the inhibition of over-learned relationship in context.

Socio-affective Context

A more global context is set by the affective state of the individual. The target article is focused on cognitive coordination, but affect is likely to influence all levels of perceptual and cognitive processing. Moreover, NMDA hypoactivity or PCP psychosis is
accompanied by changes in affect. Positive affect alters a wide range of cognitive processes via moderately increasing dopaminergic action (Ashby et al., 1999). Different affective states can either facilitate or reduce prefrontal functions (Gray et al., 2002).

Do schizophrenia patients have deficits in context processing?

Deficits in context-processing are central to major theories of schizophrenia but data from our laboratory suggest that context processing may depend on the context.

**Perceptual context:** We found that schizophrenia patients are sensitive to the context represented within the target stimulus in a spatial working memory (SWM) task. About 80% of schizophrenia patients show profound deficits in SWM. We were able to facilitate SWM by manipulating the target type without changing the task itself. On 80% of the trials, we presented a black circle as the target. On remaining trials, we presented unusual stimuli (e.g. Korean letters or faces) and found that accuracy of schizophrenia patients on SWM was increased on these trials. Thus, schizophrenia subjects benefited from the contextual information embedded within the target (Park et al., 2000; Lee & Park, 2002). Schizophrenic subjects are also sensitive to the perceptual context surrounding the target. We asked subjects to remember a random configuration of spatial locations, one of which was probed with a cue after a short delay. Performance on this task is best when the global spatial configuration of the display is preserved from the encoding to retrieval stages. Schizophrenic subjects were just as sensitive to global spatial configurations as controls. These results indicate that at least in SWM tasks, schizophrenics may exhibit intact perceptual grouping and normal contextual processing (Lee et al., 2003).

**Cognitive Context:** We found that by manipulating the salience of the target to maximize the role of stimulus-driven attention at the encoding stage, we could improve CPT-AX performance in schizophrenic patients. The working memory component within the CPT-AX was manipulated by varying the interstimulus interval (ISI). Salient cue (e.g. red A) improved the performance of schizophrenia patients in CPT-AX with long ISI, relative to normal controls, but not in CPT-AX with short ISI. In other words, strengthening the context without changing the meaning of the target improved CPT-AX performance in schizophrenia. (Lee and Park, 2002).

**Socio-affective Context:** Our data show that SWM deficits in schizophrenic subjects can be ameliorated by manipulating socio-affective input. For example, giving positive feedback in a social context improved SWM in schizophrenic patients. SWM was also
facilitated by introducing direct social interaction context prior to the memory task. (Park, et al., 2000)

When Context is 'Uncoordinated'

While coordination allows a conventional cognitive trajectory, lack of it may be the key to creative output. Thought disorder, which is the hallmark of disorganized syndrome, may be viewed as a creative, unconventional way of using language; however there is little empirical evidence for the speculative relationship between creativity and madness (Prentky, 1979). The concept of cognitive coordination gives us a framework for deriving concrete methodology and for explaining the relationship. Unconventional solutions may occur when coordination is fragmented or randomized, or during periods of intuition when the initial context has been temporally and semantically removed from the stimulus event (Bowers et al., 1990). The facilitation of creativity in 'pathological' states may result from an inherent loosening or associative elimination of contextual relationships. Here lies a potential empirical link between madness and creativity.

In sum, we laud the target article for bringing the concepts of cognitive coordination and context into a sharp focus and thereby generating specific, testable hypotheses. Once one delves into multiple levels of context, it is possible to find pockets of intact context processing in schizophrenia. The challenge is in coordinating these performance profiles across multiple levels of context to derive a coherent model of the disorder.

References


