inner world," of not feeling himself, or even having no consciousness at all (Møller & Husby 2000, pp. 221–23, 228).

Normal ipseity (and the normal tacit-explicit structuring of experience this implies) is a condition for the experience of appetite, vital energy, and point of orientation: It is what grounds human motivation and organizes our experiential world in accordance with needs and wishes, thereby giving objects their *affordances* – their significance for us as obstacles, tools, objects of desire, and the like. In the absence of this vital self-affection and the lines of orientation it establishes, there can no longer be clear differentiation of means from goal; no reason for certain objects to show up in the focus of awareness while others recede; no reason for attention to be directed outward rather than inward toward one's own body or processes of thinking (i.e., "hyperreflexivity"; Sass 2000).

Most attempts to explain the disturbances of schizophrenic cognition have assumed they are rooted in purely cognitive and often rather modular dysfunctions, such as associational disturbance, failures of attention or working memory, or an incapacity for the planning or monitoring of discourse or thought. Such functions may indeed be abnormal. It is possible, however, that these disturbances are secondary to a more fundamental distortion of psychological processes that are relevant for adopting a practical, goal-oriented stance toward the world, and for constituting a lived point of orientation and the correlated pattern of meanings that make for a coherent and significant world. We believe that P&S's view of schizophrenia as an "impairment in cognitive coordination" may be relevant for identification of such a fundamental distortion of psychological processes in schizophrenia. However, future research would benefit from incorporating phenomenological approaches to examine relationships between disorders of cognition and self-experience.

Cortical connectivity in high-frequency beta-rhythm in schizophrenics with positive and negative symptoms

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Abstract: In chronic schizophrenic patients with both positive and negative symptoms (see Table 1), interhemispheric connections at the high frequency beta2-rhythm are absent during cognitive tasks, in contrast to normal controls, who have many interhemispheric connections at this frequency in the same situation. Connectivity is a fundamental brain feature, evidently greatly promoted by the NMDA system. It is a more reliable measure of brain function than the spectral power of this rhythm.

Recently we have studied several EEG measures revealing some abnormalities in schizophrenia (Burgess et al., submitted; Strelets et al., under review). In our work aimed at the study of different brain rhythms' spectral power and connectivity, it was revealed that, in schizophrenic patients with positive and negative symptoms, the spectral power of all brain rhythms except the beta2-rhythm was decreased in comparison with normal controls (Strelets et al. 2002). We refer to this rhythm, consisting of oscillations with a frequency of 20–40 Hz, more precisely as 38 Hz. Therefore, the spectral power of this rhythm in schizophrenic patients does not differ significantly from that of the normal controls, though the literature on this point is controversial. The interhemispheric connections at this rhythm, studied by the coherence method, in contrast to those in normal controls, were absent, while at other rhythms we can observe in patients normal connections or even hyperconnectivity. One can propose that the high frequency rhythms aren't well organized enough to form necessary connections during cognitive tasks in schizophrenic patients. The glutamatergic ionotropic NMDA system and other neurotransmitters evidently play a great role in this disorganization of connectivity at the beta2-rhythm in schizophrenic patients.

The EEG was recorded from ten derivations using the standard scheme in the rest condition (eyes closed) and during task performance – silently counting the hours on an imaginary clock dial.

EEG traces of 100 seconds were recorded. Subsequent analysis of each EEG segment consisted of selection of 10 to 20 five-second EEG fragments, free from artifacts. These fragments underwent Fast Fourier Transform, the results of this procedure being used for subsequent analysis.

The study of connectivity was carried out using two methods: (1) Coherence, the most commonly used method – measure of synchronization, based on the evaluation of functional integration between the brain areas at the frequency, averaged across frequency domain for each subject; and (2) the method of typical connections analysis, developed by our group (Strelets et al. 2002), based on the analysis of the peaks, precisely coinciding in frequency in individual power spectra of different derivations for each frequency domain. The most typical connections for the group were selected by their probabilities, and their significance was tested by a Monte-Carlo method. Therefore, this method enables us to detect the real (not averaged) frequency at which the connections between cortical areas are established.

Coherence study. In the rest condition in the beta2-range (20–40 Hz), in normal subjects there were two interhemispheric connections. During the task performance, the number of connections at this rhythm increased to eight in comparison with the rest condition. The connections were revealed mostly in the anterior cortical areas.

In patients with positive symptoms, in the beta2-range interhemspheric connections were absent, and the number of intrahemispheric connections was significantly more, the latter including the temporal areas. During task performance, a paradoxical reaction was observed in this group: opposite to the norm, the number of connections decreased compared to the rest condition.

In comparison with the norm, in both experimental situations patients with negative symptoms had no interhemispheric con-

Table 1 (Strelets). *Demographic characteristics of three subject groups*

	Group		
	Normals	Patients with "positive" symptoms	Patients with "negative" symptoms
Age (years)	20–50 (32.56±8.67)	25–47 (33.21±7.94)	20–53 (34.94±9.18)
Education (years)	10–15 (12.56±2.25)	8–15 (11.25±2.40)	7–15 (10.20±62.52)
The age of first onset (years)	—	17–39 (26.57±5.80)	19–53 (28.10±10.95)
Chronicity:			
since the last admission (years)	—	0–9 (1.42±1.31)	0–4 (1.05±0.93)
since the first admission (years)	—	0–23 (6.43±6.01)	0–29 (6.68±6.16)
Number of admissions	—	1–24 (5.34±5.11)	1–9 (3.47±2.34)

nections in the beta2-range, revealing pathological rigidity. During task performance, the differences in coherence patterns between these two groups were insignificant.

As we see from the above, the results obtained in the coherence study showed dramatic results: the absence of interhemispheric connections in both patient groups in comparison with the norm at the frequency 20–40 Hz (beta2) in all conditions. At the same time there were no significant differences between the two patient groups.

Typical connections study. In the normal group in rest condition, there were two interhemispheric and three intrahemispheric connections at the frequency 38 Hz. During the task, the number of connections at this frequency increased to four interhemispheric and five intrahemispheric ones, with the predominant inclusion of areas of the left hemisphere. In patients with positive symptoms in the rest condition, in the beta2-range interhemispheric connections were absent. In comparison with the norm, in this group there were significantly more connections of temporal areas with other ones. During task performance in patients with positive symptoms, typical interhemispheric connections in the beta2-range were also absent.

In patients with negative symptoms, in the beta2-range (20–40 Hz) typical connections were revealed only in the left hemisphere. The interhemispheric connections were absent in both situations.

The comparison between the patients with positive and negative symptoms during task performance revealed in the beta2-range (20–40 Hz) a sort of "parity" in the number of significant differences between these groups, but patients with negative symptoms had more connections in medial areas, including interhemispheric ones, and patients with positive symptoms had more connections in the temporal areas.

The greatest departure of schizophrenics from the norm was revealed at the frequency 35–40 Hz: In the norm there were many typical interhemispheric connections, while in schizophrenics there were no interhemispheric connections at this frequency. Instead, a new pathological system seems to have evolved in patients – the system of connections at a frequency (29 Hz) significantly lower than normal.

Conclusions. 1. In both groups of schizophrenic patients there is phase shift instability, revealed by the coherence method. This instability causes functional disconnections between the hemispheres in the beta2-rhythm, this rhythm being important for cognitive functions and consciousness.

2. In both groups of patients, the number of typical connections was decreased in comparison with the norm. In patients with negative symptoms, this number was greater than in the other patient group, but on account of lower frequency connections.

3. All the abovementioned deficiencies observed in schizophrenic patients may be at least partly connected with NMDA-hypofunction.

Synchronous dynamics for cognitive coordination: But how?

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Abstract: Although interesting, the hypotheses proposed by Phillips & Silverstein lack unifying structure both in specific mechanisms and in cited evidence. They provide little to support the notion that low-level sensory processing and high-level cognitive coordination share dynamic grouping by synchrony as a common processing mechanism. We suggest that more realistic large-scale modeling at multiple levels is needed to address these issues.

The main hypothesis advanced by Phillips & Silverstein (P&S) is that synchrony of fast rhythms (e.g., gamma or beta rhythms) can explain "cognitive coordination" throughout the cortex at multiple levels of processing, and that schizophrenia results from a breakdown of this coordination. These dynamics, in turn, are hypothesized to be regulated by NMDA-receptor activity, which is thought to be reduced in schizophrenia. The evidence presented by P&S mainly derives from studies of context in perceptual processing, and P&S suggest that the principles at this level can be extended to higher level cognitive processing throughout the cortex. They hypothesize that synchrony of high-frequency rhythms across cell assemblies is sufficient as an explanatory mechanism for a dynamic grouping that underlies cognitive coordination at multiple levels. But is this consistent with the evidence? Furthermore, while the P&S hypothesis is appealing in its parsimony, it is not clear that synchrony is necessary to explain the phenomena described. In the debate on the role of rhythms in the cortex, it has been argued, including by one of the authors (Phillips & Singer 1997a), that no rhythmic patterns are necessary for synchronization to occur (Roy et al. 2001).

How appropriate is it to assume a unified process across multiple levels, such as low-level perception and cognitive coordination of high-level processes? In general, there is little explanation in the target article of specific mechanisms that make use of synchrony that might support the authors' view. Rather, supporting evidence is drawn for each of the parts of the argument, but little is done to induce a "Gestalt": How, exactly, do all the pieces fit together? Does "coordination" of perceiving the parts of an object as a whole equate with selecting an appropriate answer to a simple perceptual matching task, and does the latter require the same type of coordination that is needed for playing chess or for daydreaming? If so, then which components of each task are bound by the dynamic grouping, and in what order? Synchronous gamma band activity has been proposed to serve a role in binding components of a percept into a unified whole, and most of the evidence cited by P&S draws on this literature. This, in itself, is not coordination, in the more common sense of the word. Coordination implies sequences of actions in some useful order in time, and certainly, higher-order cognitive processes require coordination in this sense. No satisfactory definition is given to the term "coordination," and no explanation is given here of how the proposed synchronous mechanisms could mediate the necessary transitions between states for coordination to occur.

A large part of the authors' argument revolves around the role of NMDA both in mediating the synchronous behavior across multiple levels, and in the lack of this coordination in schizophrenia. Yet it is widely believed that dopamine plays a significant role in control of processing in the frontal cortex, but not in early sensory and association regions of the cortex. This fact already suggests potentially different basic mechanisms. With respect to schizophrenia, virtually all antipsychotics have dopamine receptor binding action. Although the evidence for NMDA-receptor involvement in schizophrenia is compelling (Holcomb et al. 2001; Medoff et al. 2001; Tamminga 1998), it is not clear that it alone can explain the disease, since NMDA partial agonists seem to be most effective in treating negative symptoms (van Berckel et al. 1996), and mainly in conjunction with other, more standard antipsychotics. Recent theories of schizophrenia have rather emphasized the likely role of multiple interacting receptor systems in this disease. One theory that might involve the type of dynamics proposed by P&S is in studies of the regulation of dopamine by NMDA-receptor activity. Specifically, there is evidence that NMDA-receptor-based mechanisms may regulate the flow of dopamine from the ventral tegmental area (VTA) to the prefrontal cortex (PFC) in a reciprocal interaction which depends on a temporal pattern of activity in the VTA (Svensson 2000).

A bursting pattern of activity at 5 Hz (near the alpha-rhythm) in the VTA caused dopamine release to the PFC, while nonbursting spiking at the same mean rate did not. This dynamic behavior was found to depend on NMDA-receptor activation by afferents