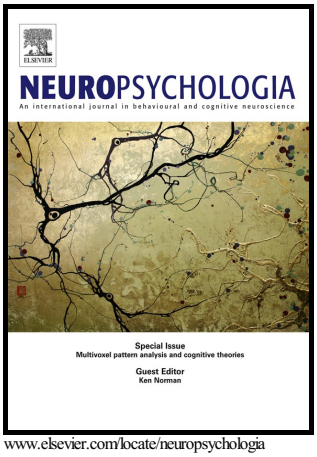


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# Schizophrenia: The Micro-Movements Perspective

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**Abstract**
Traditionally conceived of and studied as a disorder of cognitive and emotional functioning, schizophrenia (SZ) is also characterized by alterations in bodily sensations. These have included subjective reports based on self-evaluations and/or clinical observations describing motor, as well as sensory-based corporeal anomalies. There has been, however, a paucity of objective methods to capture and characterize bodily issues in SZ. Here we present a new research method and statistical platform that enables precise evaluation of peripheral activity and its putative contributions to the cognitive control of visuomotor actions. Specifically, we introduce new methods that facilitate the individualized characterization of the function of sensory-motor systems so as to detect if subjects perform outside of normal limits. In this paper, we report data from a cohort of patients with a clinical diagnosis of SZ. First, we characterize neurotypical subjects performing a visually guided pointing task that requires visuomotor transformations, multi-joint coordination, and the proper balance between different degrees of intent, among other factors. Then we measure SZ patients against the normative statistical ranges empirically determined. To this end, we examine the stochastic signatures of minute fluctuations in motor performance (micro-movements) of various velocity- and geometric-transformation-dependent trajectory parameters from the hand motions. These include the motions en-route to the target as well as spontaneous (without instructions) hand-retractions to rest. The comparisons reveal fundamental differences between SZ patients and controls. Specifically, velocity-dependent signatures show that SZ patients move significantly slower than controls with more noise and randomness in their moment-by-moment hand micro-motions. Furthermore, the normative geometric-dependent signatures of deliberateness are absent from the goal-directed reaches in SZ, but present within normative ranges in their spontaneous hand retractions to rest. Given that the continuous flow of micro-motions contributes to internally sensed feedback from self-produced movements, it is highly probable that sensory-motor integration with externally perceived inputs is impaired. Such impairments in this SZ cohort seem to specifically alter the balance between deliberate and spontaneous control of actions. We interpret these results as potential indexes of avolition and lack of agency and action ownership. We frame our results in the broad context of Precision Psychiatry initiatives and discuss possible implications on the putative contributions of the peripheral nervous system to the internal models for the cognitive control of self-produced actions in the individual with a clinical diagnosis of SZ.

**Keywords**