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EDITORIAL

Why We Should Take a Closer Look at Gestures

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Gesture is an integral feature of nonverbal communication that serves as an outward manifestation of several interacting fundamental processes including motor behavior, language, and sensory integration. Likewise, gesturing has been linked to semantic retrieval, learning, and communicative ability. Indeed, processing of gesture performance and perception involves cerebral networks of multimodal integration, action planning and semantic association. Despite the fact that gesture has been a central topic in areas of cognitive-developmental psychology, and that psychoses are characterized by deficits in several of these fundamental processes, the scientific community's interest in gesture in schizophrenia spectrum disorders is only just evolving. Gesture abnormalities are found across all stages of the disorders, including individuals with prodromal syndromes,[1,2] unmedicated recent-onset patients, and chronic psychosis populations.[3–5]

Gestures may be investigated in 3 principle paradigms: gesture "perception" (ie, processes involved with perceiving information conveyed from gestures), "interpretation" of gesture content (ie, assigning appropriate meaning to gestures), or gesture "performance" (ie, affectively conveying gestures with coordinated hand and finger movements that accompany sematic material in speech). Primary targets include movements that substitute speech, or movements that accompany speech such as iconic (eg, literal gestures such as forming a dogs mouth shape with a hand while discussing a dog), metaphoric (eg, abstract gestures such as making a cup with a hand while discussing a concept such as love), and beat (timing gestures that involve small movements that mark pauses) gestures. Gesture paradigms can either be applied in experimental settings using novel techniques such as virtual reality, kinematic based motion energy analysis, or in ecological settings such as video rated real life interactions. Finally, the neural correlates of gesture processing can be investigated combining the experimental paradigms with multimodal neuroimaging and psychophysiology techniques. Gesture paradigms are somewhat similar to paradigms of action, including observation, planning, execution, and monitoring of motor acts. However, gesture does not purely reflect the motor domain as it is specifically used in communication and may convey meaning beyond the simple motor act. Thus, at the interplay of thought and action, gesture is particularly relevant to psychoses. Moreover, thought disorder and motor abnormalities are frequent throughout the course of schizophrenia spectrum disorders.

Impaired or aberrant nonverbal behaviors including gesture perception, interpretation, and performance may contribute to poor social interaction in psychosis. Indeed, communication with individuals with schizophrenia spectrum disorders is further hampered by incongruent use of gesture and verbal content.[1] In addition, both individuals with prodromal syndromes as well as schizophrenia use hand gestures less frequently than healthy subjects.[2,6] In ecological interactions, patients' reduced gesturing impacts their impression on others, eg, leading to increased gesturing in communication partners.[6] Finally, 60% of schizophrenia patients have deficits performing gestures on verbal command correctly, and 33% perform poorly on demonstration.[3,4] A behavioral study indicated generalized gesture impairments, as deficits in gesture perception and performance are so tightly coupled in many psychosis patients.[3]

Gesture also appears closely tied to core symptoms and cognitive deficits. In one study, both performance and perception deficits were linked to 2 factors: one included positive symptoms and impaired working memory and the other consisted of motor abnormalities and frontal lobe dysfunction.[3] The motor abnormalities hampering gesture include catatonia, Parkinsonisms, neurological soft signs, as well as impaired fine motor skills.[3,5] In addition, defective gesture performance has been associated

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with negative symptoms.[6,7] Likewise, the biased interpretation of gesture content in schizophrenia has been attributed to delusional experiences or formal thought disorders.

The neural underpinnings of gesture in healthy subjects have received attention, pointing to partially distinct brain activity during performance, perception, and interpretation of gestures. Interestingly, some of the critical brain regions have frequently been implicated in the pathophysiology of psychosis. For example, gesture performance requires knowledge of skilled actions and is critically linked to action planning and execution. In healthy subjects planning gestures typically endorses the left inferior frontal gyrus (IFG), inferior and superior parietal lobules (IPL, SPL) as well as premotor cortices. Execution of gestures instead activates primary motor cortex (M1) and supplemental motor area (SMA). Furthermore, performance of socially relevant communicative gestures activates orbitofrontal cortex and superior frontal gyrus, areas implicated in mentalizing processes. Likewise, the use of co-speech gestures has been linked to brain structures; eg, beat gestures have been tied to regional cerebellar volumes and metaphoric gestures to the left superior temporal gyrus (STG) and IPL.[8]

Perception of gestures basically involves the same brain areas as performance of gestures, ie, IPL, IFG and (pre)motor areas "including the mirror neuron system." In addition, language related areas in the temporal lobe and IFG are engaged whenever communicative gestures are observed. Parallel brain scans of gesturer's and gesture observer's brains indicated that the temporal course of brain activity during gesture processing is tightly coupled. The neural basis of gesture interpretation relies on both motor and language related fronto-temporal brain areas. For example, the semantic content of gestures is processed within the left IFG, temporal pole, middle temporal gyrus (MTG), and M1.

Despite these advances, the neurocorrelates of gesture processes in psychosis are relatively unknown. However, recent studies have begun to examine domains of gesture functioning in innovative neuroimaging paradigms. One good example is in the area of gesture interpretation. Specifically, investigators observed that decoding of abstract meaning is particularly challenging to schizophrenia patients and during the processing of metaphoric gestures schizophrenia patients demonstrate reduced activation of language areas and aberrant functional connectivity between IFG and superior temporal sulcus.[9] While this sheds some light on one domain, the neural correlates of impaired gesture perception and performance in psychoses are yet to be discovered.

There are several compelling reasons why gesture is a promising target for psychosis research. As gesture behavior is well understood in healthy populations across developmental time points, it can serve as an anchor point in efforts for mapping this behavior in populations where we enjoy considerably less understanding. Certainly, findings that indicate that different gestures are linked to different neural networks speak to considerable potential for biomarker development in this regard. Further, as gesture is closely related to social cognition, deficits may serve as a sensitive "outcome" marker of "social functioning," calling for longitudinal studies. "In a related point, while gesture and facial expressions are both distinct domains of nonverbal communication, one very interesting and potentially informative line of inquiry relates to when they are perceived or employed in tandem, or, how neural processes governing this underlying coordination can become dysregulated." Finally, gesturing may be improved by specialized training, or noninvasive brain stimulation "targeting the mirror neuron system." "Because of the close cross-sectional association between gesture perception and performance[3] we may speculate for generalization effects when targeting one end of the problem."

Aberrant gesture behavior is linked to fundamental cognitive processes and clinical signs in psychosis. It provides insight into relevant aspects of social interaction including the underlying neurobiology. As the field is searching for readily observable biomarkers as well as supplementary treatment strategies, gesture, which can be quantified with simplistic and sophisticated methods remains a low-hanging target. Further development of research programs in psychosis as well as new development in other candidate disorders such as bipolar disorder is sorely needed. In short, it is time to take a closer look on gestures!

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