Description of Significance and Potential Contribution

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Goal-directed behavior is demonstrated by the ability to orient and interact accordingly with the environment. Integral to this ability is the expression of cognitive flexibility: the modification of behavior to receive a desired consequence from the environment. Despite the relevance of cognitive flexibility and its deficiency in several psychological disorders such as obsessive-compulsive disorder, addiction, and schizophrenia, little is known about its neural underpinnings. Cognitive flexibility requires engaging the execution of motor responses to stimuli in the environment that satisfy internal goals or external task demands. For example, consider the steps underlying changing lanes in a vehicle. In this context, a motor movement is selected and prepared for moving the steering wheel. However, if you were to notice a car in the neighboring lane just prior to the execution of this movement, then it would be essential to inhibit that now unwanted movement, update the goal, and flexibly switch tasks to remain in the original lane. Ever present in this example is the use of visual working memory. Visual working memory is characterized as the capacity to hold relevant information in mind so that it may then be used to interact with the environment accordingly. Appropriately carrying out even the most elementary of activities (e.g. drinking a cup of coffee) calls for systems of action and visual working memory to interact in real-time. The utilization of information held in visual working memory is therefore critical to the organization of behavior and research has shown it to be predictive of several positive life outcomes.

. While visual working memory and motor systems closely coordinate to produce goal-directed behavior, one aspect that has not been extensively studied is how engaging the motor system influences memory encoding and recall of the stimuli being acted upon. To address this

question, I will measure neural activity while participants execute or withhold motor responses and the subsequent recall of these items in memory. Using this methodology, I can directly measure the strength of engagement of motor cortex and whether activation in this region influences memory areas and performance. In this way, the current study aims to delineate parts of the brain specific to the neural architecture of visual working memory and motor systems by utilizing functional magnetic resonance imaging (fMRI). These findings could promote directions of new ideas about these neural networks grounded in an embodied account of behavior. That is, elucidating the complexity of motor and visual working memory networks could provide significant insight into the functional nature of goal-directed behavior. In turn, understanding the motor processes which underlie goal-directed behavior, via information in visual working memory, could inform future intervention efforts aimed at human cognitive development and quality of life outcomes. Taken together, this study offers an account of visual working memory unique to the field and outlines its interaction with the motor system as crucial to the subsequent expression of goal-directed behavior.