

How do individuals with different cognitive performance levels differ in their self-reported limitations after SARS-CoV-2 infection, their well-being, and their resting state neural activity?

Cognition is essential for everyday functioning. Cognition refers to a range of mental processes related to the acquisition, storage, manipulation, and retrieval of information. It underpins many daily activities, in health and disease, across the age span. Cognition can be separated into multiple distinct functions, dependent on particular brain circuits and neuromodulators. The ability to test, measure and monitor cognitive performance across the lifespan opens up the chance for patients to be identified earlier, access treatments faster, and stay healthy for longer, improving quality of life and reducing costs.

Cognition is defined as “the mental action or process of acquiring knowledge and understanding through thought, experience, and the senses.” The modern word “cognition” actually has its roots back to Latin, the word “cognoscere” which is to “get to know”.

Cognitive functioning is therefore critical for day-to-day life, governing our thoughts and actions. Need cognition to help us understand information about the world around us and interact safely with our environment, as the sensory information we receive is vast and complicated: cognition is needed to distill all this information down to its essentials.

Cognitive assessment refers to the objective measurement of distinct cognitive abilities, such as working memory, inhibition, cognitive flexibility, psychomotor speed and sustained attention. Cognition can be measured using a variety of methods, each varying in their level of objectivity and sensitivity.

Relation between objective measure of cognition and subjective perception of cognitive functioning reported by ...

Patients with ... experience a broad range of cognitive impairments affecting domains such as...

(Bland et al. 2024):

Given that subjective and objective cognitive function may be driven by different underlying mechanisms, it is important to explore factors which contribute to objective impairments

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and subjective feelings of “brain fog” in order to design targeted interventions for individuals living with Post-COVID.

Taken together, understanding the relationship between subjective and objective cognitive impairment and the driving factors underlying these is crucial for the development of tailored rehabilitation programs aimed at improving cognitive function and facilitating recovery in Post-COVID patients. In line with previous literature in other patient groups, we hypothesised that subjective cognitive dysfunction would be associated with increased fatigue and stress whereas objective cognitive function would be most dominantly linked to clinical features of COVID-19.

Theoretical background

Post-Covid Syndrome

(O’Mahoney et al., 2023)

(Chen et al., 2022)

Cognitive deficits related to Post-Covid Syndrome

Subjective and objective cognitive functions are two distinct measures of cognition.

(McWhirter, Ritchie, Stone & Carson, 2020): Cognitive symptoms are common: according to this Review they are present in around a third of the population with no clear relation to age.

Subjective

Theoretical background

1. Cognitive Performance as a Key Variable: Introduce cognitive performance as a central factor in your research. Explain its relevance in understanding individual differences in behavior, health, and psychological outcome. Cognitive performance as a key variable that influences many aspects of life, such as well-being, self-reported limitations, and brain function. Cognitive abilities vary across individuals.

Introduction to Cognitive Performance Variability

- Overview of individual differences in cognitive abilities
- Importance of studying cognitive performance clusters

Cluster Analysis in Cognitive Research

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Commented [JH4]: Cognitive Performance as a Key Variable

Cognitive performance refers to an individual’s ability to carry out mental processes such as attention, memory, executive function, and problem-solving. It plays a crucial role in determining how individuals navigate daily life, affecting everything from decision-making to managing complex tasks. Cognitive performance is not a uniform trait but varies significantly between individuals, influenced by factors like age, education, lifestyle, and health conditions. Understanding these variations is essential in psychological and health research because they are often linked to broader outcomes like well-being, self-reported limitations, and brain activity.

Higher levels of cognitive performance have been associated with better problem-solving skills, greater emotional regulation, and improved mental and physical health outcomes. Conversely, individuals with lower cognitive performance may experience difficulties in these areas, leading to reduced well-being and higher levels of self-reported limitations. Therefore, cognitive performance is a key variable when investigating individual differences in how people experience and report limitations in their daily lives, their well-being, and their underlying neural activity.

Cluster Analysis for Grouping Based on Cognition

Given the variability in cognitive performance across individuals, it is important to group people in ways that reflect meaningful differences in their cognitive abilities. One effective method for achieving this is **cluster analysis**, a statistical technique used to classify individuals into groups (or clusters) based on shared characteristics. In this study, cluster analysis will be used to group participants solely based on their cognitive performance scores. This method allows us to objectively identify subgroups of individuals w...

Commented [JH5]: Cognitive Performance and Variability

•**Understanding Cognitive Performance:** Define cognitive performance and its components (e.g., memory, attention, executive functioning). Provide an overview of how cognitive performance can vary across individuals due to factors like age, education, or health.

•**Measuring Cognitive Performance:** Describe how cognitive performance is typically assessed in research, including the tools and tests used (e.g., neuropsychological assessments).

•**Cognitive Variability in Populations:** Review studies that show cognitive variability in the general population and ...

Commented [JH6]: Cluster Analysis in Cognitive Research

•**Overview of Cluster Analysis:** Introduce the concept of cluster analysis as a statistical method for grouping individuals based on similarities in cognitive performance. Briefly explain how this method works and why it is suitable for your study.

•**Using Cognitive Data for Clustering:** Discuss examples of previous research that have used cluster analysis to form groups based on cognitive data, such as working memory, attention, or processing speed.

•**Rationale for Grouping Based on Cognition:** Explain why creating two groups based on cognition (high and low ...

- Brief explanation of cluster analysis methodology
- Applications in cognitive psychology and neuroscience
- Advantages of using cluster analysis to group individuals based on cognitive performance

📌 Cognitive Domains and Assessment

- Overview of key cognitive domains (e.g., memory, executive function, processing speed)
- Common neuropsychological tests used to assess these domains
- Factors influencing cognitive performance (e.g., age, education, health status)

📌 Self-Reported Limitations and Cognitive Performance

- Relationship between objective cognitive measures and subjective experiences
- Importance of self-reported outcomes in understanding daily functioning
- Potential discrepancies between objective performance and subjective reports

📌 Well-being and Cognitive Function

- Definitions and measures of well-being
- Bidirectional relationship between cognitive abilities and psychological well-being
- Impact of cognitive performance on quality of life

📌 Resting State Neural Activity

- Explanation of resting state neural activity and its significance
- Relationship between cognitive performance and resting state brain function
- Neuroimaging techniques used to study resting state activity (e.g., fMRI, EEG)

📌 Integrating Cognitive Performance Clusters with Self-Report, Well-being, and Neural Activity

- Theoretical models linking these aspects
- Previous studies examining relationships between these factors
- Gaps in current understanding and rationale for your study

📌 Relevance and Implications

- Clinical implications of identifying cognitive performance clusters
- Potential for personalized interventions based on cognitive profiles
- Broader implications for understanding brain-behavior relationships

📌 SARS-CoV-2 Context (if relevant)

- Brief mention of how this research might apply to post-COVID cognitive issues
- Potential for understanding variability in cognitive outcomes after infection

📌 Conclusion

- Summary of key points
- Transition to your specific research question and hypotheses

Commented [JH7]: Self-reported Limitations and Cognitive Performance

- **Link Between Cognition and Self-reported Limitations:** Explore how cognitive performance levels might relate to how individuals perceive and report limitations in their daily lives (e.g., physical, mental, or emotional limitations). Hypothesize that individuals with lower cognitive performance might be more prone to report limitations or, conversely, less aware of them.
- **Cognitive Performance as a Predictor of Self-reports:** Discuss research showing that cognitive performance can affect self-awareness and self-reporting behavior. Explain why this might lead to differences in the way people with high vs. low cognitive performance report limitations.

Commented [JH8]: Cognitive Performance and Well-being

- **Impact of Cognition on Well-being:** Define well-being in this context (e.g., emotional, mental health, life satisfaction) and explore how cognitive performance can influence well-being. People with higher cognitive performance might have better problem-solving skills, which could buffer them from stress and promote well-being.
- **Cognitive Impairment and Reduced Well-being:** Discuss studies showing that lower cognitive performance is often associated with reduced well-being, higher levels of distress, or mental health challenges.
- **Cognition as a Protective Factor:** Alternatively, higher cognitive functioning may serve as a protective factor in maintaining well-being. Hypothesize how the two cognitive groups formed through cluster analysis might differ in their overall well-being.

Commented [JH9]: Resting State Neural Activity as a Cognitive Indicator

- **Cognitive Indicator:** Explain the role of resting state neural activity (such as default mode network or other brain networks) in reflecting cognitive function. Provide a brief overview of how neural activity in a resting state can provide insights into cognitive processing efficiency and flexibility.
- **Differences in Resting State Activity by Cognitive Level:** Review existing studies that have found differences in resting state neural activity between individuals with varying cognitive performance levels. Discuss how resting state activity can serve as a biological marker of cognitive differences.
- **Hypothesized Neural Differences:** Suggest how the two cognitive groups (high vs. low) might show different patterns of neural activity during rest, supporting the idea that cognition is linked to neural functioning.

📖 Introduction to Cognitive Performance Variability

- Overview of individual differences in cognitive abilities
- Importance of studying cognitive performance clusters

📖 Cluster Analysis in Cognitive Research

- Explanation of cluster analysis methodology
- Applications in cognitive psychology and neuroscience
- Advantages of using cluster analysis to group individuals based on cognitive performance

📖 Cognitive Domains and Assessment

- Overview of key cognitive domains (e.g., memory, executive function, processing speed)
- Common neuropsychological tests used to assess these domains
- Factors influencing cognitive performance

📖 Post-COVID Syndrome (PCS) and Cognitive Complaints

- Definition and prevalence of PCS
- Common cognitive complaints in PCS
- Challenges in objectively measuring PCS-related cognitive issues

📖 Self-Reported Limitations and Objective Cognitive Performance

- Relationship between objective cognitive measures and subjective experiences
- Importance of self-reported outcomes in understanding daily functioning
- Potential discrepancies between objective performance and subjective reports
- Specific focus on self-reported PCS groups and their characteristics

📖 Well-being and Cognitive Function

- Definitions and measures of well-being
- Relationship between cognitive abilities and psychological well-being
- Impact of perceived cognitive decline on quality of life

📖 Resting State Neural Activity

- Explanation of resting state neural activity and its significance
- Relationship between cognitive performance and resting state brain function
- Potential neural correlates of PCS and cognitive complaints

📖 Integrating Cognitive Performance Clusters, Self-Reported PCS, and Neurophysiological Measures

- Theoretical models linking these aspects
- Previous studies examining relationships between objective cognitive performance and self-reported symptoms
- Gaps in current understanding and rationale for your study

📄 Methodological Considerations

- Advantages and limitations of cluster analysis vs. self-reported grouping
- Importance of combining objective and subjective measures
- Challenges in aligning neuropsychological data with self-report

📄 Clinical and Research Implications

- Potential for improving diagnosis and characterization of PCS
- Implications for tailoring interventions based on cognitive profiles and self-reported symptoms
- Broader implications for understanding brain-behavior relationships in health and disease

📄 Conclusion

- Summary of key points
- Transition to your specific research question and hypotheses