Minerva Team Cognition Study Measures

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# Demographic Information: Questionnaire

What is your gender? \_\_\_\_\_\_\_\_\_\_\_\_\_\_

What is your race or ethnicity?

(1) African-American / Black (2) Asian-American / Pacific-Islander (3) Caucasian / White

(4) Hispanic (5) Latine/Latinx (6) Other (please specify) \_\_\_\_\_\_\_\_\_\_

What is your class standing?

(1) Freshman (2) Sophomore (3) Junior (4) Senior

(5) Other (please specify) \_\_\_\_\_\_\_\_

What is(are) your academic major(s)? If you have more than one, please indicate all of them in the space provided: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

# Individual

## NASA Cognition Test Battery

**The APPLICATION DESCRIPTION below is FOR IRB to understand measure, this text is NOT SHOWN TO PARTICIPANTS.**

According to the Joggle Research (2018) website, their mobile application “offers a core set of eight tasks covering a range of cognitive domains.” This includes the following tasks: Motor Praxis Task, Visual Object Learning Task, NBACK, Abstract Matching, Line Orientation Test, Digital Symbol Substitution Task, and Balloon Analog Risk Task. The entire stimuli set cannot be provided due to copyright law but video demos for the tasks are provided by Joggle on the following webpage:

* <https://admin.joggleresearch.com/Home/Tasks> **(THESE DEMOS SHOW WHAT PARTICIPANTS WILL SEE)**

The experimental tasks in this mobile application are drawn from measures developed in and widely-validated across studies of their respective cognitive domains (e.g., working memory, sensory motor skills, spatial orientation, etc.; Joggle Research, 2018; Moore et al., 2015, 2017). Furthermore, the assessments draw from a large collection of stimuli to mitigate practice effects and can be completed in less than 14 minutes. Participants will be scored based on their response accuracy, test duration, response time, errors or lapses, depending on the particulars of the task. Additional information about the individual cognitive assessments, including scoring, is provided below.  Participants will complete this assessment once after providing informed consent and before the experimental task. Administration and scoring information is based on Joggle Research (2018) and Moore et al. (2015, 2017).

**Cognitive Task Descriptions and Data** (task name is *italicized*)

*Motor Praxis Task (MPT)*

* Cognitive Domain: **sensory motor speed**
* Participants are to quickly touch ever-shrinking boxes. Each time a new box appears in a different location on the screen. Performance is assessed by the speed with which participants click each square.
* Type of data collected and used for analysis:
  + Mean and standard deviation (SD) of accuracy
  + Mean and SD of test duration

*Visual Object Learning Task (VOLT)*

* Cognitive Domain: **visual learning and spatial working memory**
* Participants first memorize a set of 3-dimensional Euclidean shapes. During recall, participants are to distinguish between the initial shapes mixed with ten distractor shapes.
* Type of data collected and used for analysis:
  + Mean and SD of accuracy
  + Mean and SD of test duration

*NBACK*

* Cognitive Domain: **working memory**
* Participants are shown images one at a time and are to identify images that occurred “n” trials ago. This non-verbal variant of the n-back task uses images of fractals. Participants have to respond when the current stimulus matches the stimulus displayed n figures ago.
* Type of data collected and used for analysis:
  + Mean and SD of accuracy
  + Mean and SD of reaction time

*Abstract Matching (AM)*

* Cognitive Domain: **abstraction**
* Participants select pairs of shapes that fit with another shape. The test paradigm presents participants with two pairs of objects at the bottom left and right of the screen, varied on perceptual dimensions (e.g., color and shape).
* Type of data collected and used for analysis:
  + Mean and SD of accuracy
  + Mean and SD of test duration

*Line Orientation Task (LOT)*

* Cognitive Domain: **spatial orientation**
* Participants are shown two lines at different angles and are to rotate one line incrementally until it is parallel to the other. Difficulty is determined by the length of the rotating line, its distance from the stationary line, and number of degrees that the line rotates with each click.
* Type of data collected and used for analysis:
  + Mean and SD of test duration
  + Mean and SD of accuracy

*Digital Symbol Substitution Task (DSST)*

* Cognitive Domain: **complex scanning and visual tracking**
* Participants touch the number paired to the symbol that matches the current target symbol. The DSST requires the participant to refer to a displayed legend relating each of the digits to specific symbols. One of the symbols appears on the screen and the participant must select the corresponding number as quickly as possible. The test duration is fixed, and the legend key is randomly re-assigned with each administration.
* Type of data collected and used for analysis:
  + Mean and SD of throughput
  + Mean and SD of errors

*Balloon Analog Risk Task (BART)*

* Cognitive Domain: **risk decision making**
* Participants inflate balloons of unknown popping probability to obtain the highest reward. Each pump increases the potential reward. The potential reward is lost if the balloon pops. The BART requires participants to either inflate an animated balloon or collect a reward. Participants are rewarded in proportion to the final size of each balloon, but a balloon will pop after a hidden number of pumps, which changes from trial to trial. The average tendency of balloons to pop is systematically varied between test administrations. This requires participants to adjust the level of risk they take based on the behavior of the balloons.
* Type of data collected and used for analysis:
  + Mean and SD of test duration
  + Mean and SD of risk propensity

Psychomotor Vigilance Test (PVT)

* Cognitive Domain: **vigilance, attention**
* Participants are to quickly respond to the sudden appearance of stimuli inside a box and avoid responding prematurely. Participants are instructed to monitor a box on the screen and respond once a millisecond counter appears in the box and starts incrementing. Subjects are instructed to be as fast as possible without responding without a stimulus (i.e., false starts or errors of commission).
* Type of data collected and used for analysis:
  + Mean and SD of response speed
  + Mean and SD of lapses

**References**

Joggle Research: Cognitive Tasks. (2018). Retrieved from https://admin.joggleresearch.com/Home/Tasks.

Moore, T. M., Reise, S. P., Gur, R. E., Hakonarson, H., & Gur, R. C. (2015). Psychometric properties of the Penn Computerized Neurocognitive Battery. *Neuropsychology, 29*(2), 235–246.

Moore, T. M., Basner, M., Nasrini, J., Hermosillo, E., Kabadi, S., Roalf, D. R., … Gur, R. C. (2017). Validation of the Cognition Test Battery for Spaceflight in a Sample of Highly Educated Adults. *Aerospace Medicine and Human Performance, 88*(10), 937–946.

## Sociable Dominance Scale

Kalma, A. P., Visser, L., & Peeters, A. (1993). Sociable and aggressive dominance: Personality differences in leadership style?. *The Leadership Quarterly, 4*(1), 45-64.

Instructions: Please rate yourself on a scale from 1 to 6 with respect to the following statements:

1. I have no problems talking in front of a group.

2. At school I found it easy to talk in front of the class.

3. No doubt I’ll make a good leader.

4. I certainly have self-confidence.

5. For me it is not hard to start a conversation in a group.

6. I am not shy with strangers.

7. I like taking responsibility.

8. People turn to me for decisions.

9. I can look everybody in the eye, and lie with a straight face.

10. I can lie without anybody noticing it.

11. I find it important to get my way.

12. I find it important to get my way, even if this causes a row.

13. I quickly feel aggressive with people.

14. I make smart, sarcastic remarks if people deserve it.

15. I’d rather be disliked (for being unkind) and that people look down on me (for not achieving my aims).

Response scale: 1 (strongly disagree) to 6 (strongly agree).

## Psychological Collectivism Scale

Jackson, C. L., Colquitt, J. A., Wesson, M. J., & Zapata-Phelan, C. P. (2006). Psychological collectivism: A measurement validation and linkage to group member performance. *Journal of Applied Psychology, 91*(4), 884.

Instructions: Think about the work groups to which you currently belong and have belonged to in the past. The items below ask about your relationship with, and thoughts about, those particular groups. Respond to the following questions, as honestly as possible, using the response scales provided. (1 = Strongly Disagree to 5 = Strongly Agree).

1. I preferred to work in those groups rather than working alone.

2. Working in those groups was better than working alone.

3. I wanted to work with those groups as opposed to working alone.

4. I felt comfortable counting on group members to do their part.

5. I was not bothered by the need to rely on group members.

6. I felt comfortable trusting group members to handle their tasks.

7. The health of those groups was important to me.

8. I cared about the well-being of those groups.

9. I was concerned about the needs of those groups.

10. I followed the norms of those groups.

11. I followed the procedures used by those groups.

12. I accepted the rules of those groups.

13. I cared more about the goals of those groups than my own goals.

14. I emphasized the goals of those groups more than my individual goals.

15. Group goals were more important to me than my personal goals.

## Ten Item Personality Inventory (TIPI)

Here are some personality traits that may or may not describe you. Please mark the degree to which you agree or disagree that the statement describes you. You should rate how much the pair of traits applies to you, even if one characteristic applies more strongly than the other.

1. Extraverted, enthusiastic.

2. Critical, quarrelsome.

3. Dependable, self-disciplined.

4. Anxious, easily upset.

5. Open to new experiences, complex.

6. Reserved, quiet.

7. Sympathetic, warm.

8. Disorganized, careless.

9. Calm, emotionally stable.

10. Conventional, uncreative.

Response scale:

1 Disagree strongly

2 Disagree moderately

3 Disagree a little

4 Neither agree nor disagree

5 Agree a little

6 Agree moderately

7 Agree strongly

## Stress and Workload

STRESS: Overall, how would you rate your current level of stress?

Response scale: 1=No stress at all, 2=Very little stress, 3=Some stress, 4=A lot of stress, 5=A great deal of stress

Reference: Booth, B. M., Vrzakova, H., Mattingly, S. M., Martinez, G. J., Faust, L., & D’Mello, S. K. (2022). Toward Robust Stress Prediction in the Age of Wearables: Modeling Perceived Stress in a Longitudinal Study With Information Workers. IEEE Transactions on Affective Computing, 13(4), 2201–2217. <https://doi.org/10.1109/TAFFC.2022.3188006>

WORKLOAD: Using the scale below, please answer the following question. How easy or difficult was it to complete the task?

Response scale: 1 very easy – 2 – 3 – 4 – 5 – 6 – 7 very difficulty

Reference: Fiore, S. M., Warta, S. F., Best, A., Newton, O., & LaViola, J. J. (2017). Developing a theoretical framework of task complexity for research on visualization in support of decision making under uncertainty. Proceedings of the Human Factors and Ergonomics Society Annual Meeting, 61(1), 1193–1197. <https://doi.org/10.1177/1541931213601781>

# Team Process

## Measures of Action*,* Transition*,* Interpersonal Process

Mathieu, J. E., Luciano, M. M., D’Innocenzo, L., Klock, E. A., & LePine, J. A. (2020). The development and construct validity of a team processes survey measure. Organizational Research Methods, 23(3), 399–431. <https://doi.org/10.1177/1094428119840801>

**Transition Processes**

To what extent does our team actively work to ...

***Mission Analysis***

1. Identify our main tasks?

\*2. Identify the key challenges that we expect to face?

3. Determine the resources that we need to be successful?

4. Develop a shared understanding of our purpose or mission?

5. Understand the needs of our primary stakeholders (e.g., customers, top management,

other organizational units)?

***Goal Specification***

6. Set goals for the team?

\*7. Ensure that everyone on our team clearly understands our goals?

8. Link our goals with the strategic direction of the organization?

9. Prioritize our goals?

10. Set specific timelines for each of our goals?

***Strategy Formulation and Planning***

\*11. Develop an overall strategy to guide our team activities?

12. Prepare contingency (“if-then”) plans to deal with uncertain situations?

13. Know when to stick with a given working plan, and when to adopt a different one?

14. Periodically re-evaluate the quality of our working plans?

15. Specify the sequence in which work products should be accomplished?

**Action Processes**

To what extent does our team actively work to ...

***Monitoring Progress Toward Goals***

16. Regularly monitor how well we are meeting our team goals?

17. Use clearly defined metrics to assess our progress?

\*18. Seek timely feedback from stakeholders (e.g., customers, top management, other

organizational units) about how well we are meeting our goals?

19. Know whether we are on pace for meeting our goals?

20. Let team members know when we have accomplished our goals?

***Systems Monitoring***

21. Monitor and manage our resources (e.g., financial, equipment, etc.)?

\*22. Monitor important aspects of our work environment (e.g., inventories, equipment and

process operations, information flows)?

23. Monitor events and conditions outside the team that influence our operations?

24. Ensure the team has access to the right information to perform well?

25. Manage our personnel resources?

***Team Monitoring and Backup***

26. Develop standards for acceptable team member performance?

27. Balance the workload among our team members?

\*28. Assist each other when help is needed?

29. Inform team members if their work does not meet standards?

30. Seek to understand each other’s strengths and weaknesses?

***Coordination***

31. Communicate well with each other?

32. Smoothly integrate our work efforts?

\*33. Coordinate our activities with one another?

34. Re-establish coordination when things go wrong?

35. Have work products ready when others need them?

**Interpersonal Processes**

To what extent does our team actively work to ...

***Conflict Management***

\*36. Deal with personal conflicts in fair and equitable ways?

37. Show respect for one another?

38. Maintain group harmony?

39. Work hard to minimize dysfunctional conflict among members?

40. Encourage healthy debate and exchange of ideas?

***Motivating and Confidence Building***

41. Take pride in our accomplishments?

42. Develop confidence in our team’s ability to perform well?

\*43. Encourage each other to perform our very best?

44. Stay motivated, even when things are difficult?

45. Reward performance achievement among team members?

***Affect Management***

46. Share a sense of togetherness and cohesion?

47. Manage stress?

\*48. Keep a good emotional balance in the team?

49. Keep each other from getting overly emotional or frustrated?

50. Maintain positive work attitudes?

Note: The first three items listed under each subscale represent the 30-item shorter form.

The \* items represent the 10-item short form.

Response scale: 1 = not at all; 2 = very little; 3 = to some extent; 4 = to a great extent; 5 = to a very great extent

# Team Cognition

## Perception Measures of Shared Knowledge

(Sikorski et al., 2012; Sikorski 2009; Johnson et al., 2007)

Five-point scale ranging from one (strongly disagree) to five (strongly agree) with a midpoint of three (neutral).

*Factor 1—General Task and Team Knowledge*

My team usually discusses our goals and attains the agreement of each other.

My team knows specific strategies for completing our tasks.

My team knows the general process involved in carrying out our tasks.

*Factor 2—General Task and Communication Skills*

My team communicates effectively with each other while per forming our tasks.

My teammates consistently demonstrate effective listening skills.

Everybody in my team strives to express his or her opinion.

*Factor 3—Attitude Toward Teammates and Task*

My team likes to do various team tasks.

My team encourages each other in order to improve our outcomes.

My team takes pride in our work.

*Factor 4—Team Dynamics and Interactions*

My team is likely to make decisions together.

My team understands how we can exchange information for doing our tasks.

My team solves problems that occur while doing our tasks.

*Factor 5—Team Resources and Working Environment*

My team creates a safe environment to openly discuss any issue related to the team’s success.

My team has the right experience so that a critical mass of experienced people is available on the team.

My team knows the environmental constraints when we perform our tasks.

## Objective Measures of SMM

(Lim & Klein, 2006)

**Taskwork and teamwork models**

**Lim, B. C., & Klein, K. J. (2006). Team mental models and team performance: A field study of the effects of team mental model similarity and accuracy. *Journal of Organizational Behavior, 27(4),* 403-418.**

**Taskwork mental model survey items**

1. Team members are proficient with their own weapons.
2. Team members are proficient with other members’ weapons.
3. Team members are very good at IA drills.
4. Team members have a good understanding of the characteristics of the enemy’s weapons.
5. Team members conduct routine maintenance of their equipment and weapons in the field.
6. Team members are allowed to bring their personal weapon home.
7. Team members understand the team’s task.
8. Team members agree on a strategy to carry out the team task.
9. Team members understand other members’ tasks.
10. Tasks in the team are assigned according to individual member’s ability.
11. Team members are cross-trained to carry out other members’ tasks.
12. Team members adhere strictly to the team’s SOP.
13. Team members understand the battlefield situation.
14. The team is highly effective.

**Teamwork mental model survey items**

1. Team members work well together.
2. Team members often disagree with each other on issues faced by the team.
3. Team members trust each other.
4. Team members communicate openly with each other.
5. Team members agree on decisions made in the team.
6. Team members accept decisions made by the leader.
7. Team members interact with one another outside the camp compound.
8. Team members back each other up in carrying out team tasks.
9. Team members are similar to each other (*e.g.*, personality, temperament, and abilities).
10. Team members are aware of other team members’ abilities.
11. Team members are aware of other team members’ personal backgrounds (*e.g.*, family background, hobbies, and habits).
12. Team members know other team members’ family members.
13. Team members treat each other as friends.
14. The team is highly effective.

## Objective Measures of TMS

(Lewis, 2003)

**Transactive Memory System Scale Items**

**Lewis, K. (2003). Measuring transactive memory systems in the field: scale development and validation. Journal of Applied Psychology, 88(4), 587-604.**

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Specialization

1. Each team member has specialized knowledge of some aspect of our project.
2. I have knowledge about an aspect of the project that no other team member has.
3. Different team members are responsible for expertise in different areas.
4. The specialized knowledge of several different team members was needed to complete the project deliverables.
5. I know which team members have expertise in specific areas.

Credibility

1. I was comfortable accepting procedural suggestions from other team members.
2. I trusted that other members’ knowledge about the project was credible.
3. I was confident relying on the information that other team members brought to the discussion.
4. When other members gave information, I wanted to double-check it for myself. (reversed)
5. I did not have much faith in other members’ “expertise.” (reversed)

Coordination

1. Our team worked together in a well-coordinated fashion.
2. Our team had very few misunderstandings about what to do.
3. Our team needed to backtrack and start over a lot. (reversed)
4. We accomplished the task smoothly and efficiently.
5. There was much confusion about how we would accomplish the task. (reversed)