# Tower of London

I. Test Overview

A. The Tower of London test is meant to test the user's executive function of cognitive planning. The user is given several stacks of different colored disks in which they can remove the top disk of a stack and place it on another (given the other has space). The user is also given an image in which they must match the colored disks to.

B. **Stimuli**

- Visual Cues: In the VR space, we'll show the target arrangement up top as a reference. Users will see the stacks of colored disks they can interact with.
- Disk Interaction: Users will be able to grab and drop disks using the VR controllers.

II. Test Setup and Environment

- VR Environment: Everything happens in the Meta Quest 2/3 VR headset, so it'll feel like you're right there with the disks.
- Game Rules: Players can only pick up the top disk in a stack and need to drop it on another stack with space.

III. Game Scenario

- Goal: Move the disks around until you get them in the same setup as the target.
- Difficulty Levels: We could make different levels, each one a little harder with more disks and stacks. – ASK MOON FOR THIS (move limit–each level has a max number of moves?)

IV. Scoring

- Move Efficiency: Fewer moves means more points.
- Completion Time: The quicker you finish, the better your score.
- Accuracy: Mistakes like moving a disk to the wrong place will be logged and impact the score.

V. Test Procedure

- Setup Display: We show the target arrangement and your starting arrangement.
- Game Play: Move the disks around to match the target, one at a time, within the move limit.
- End Condition: The game ends when you match the target or run out of moves.

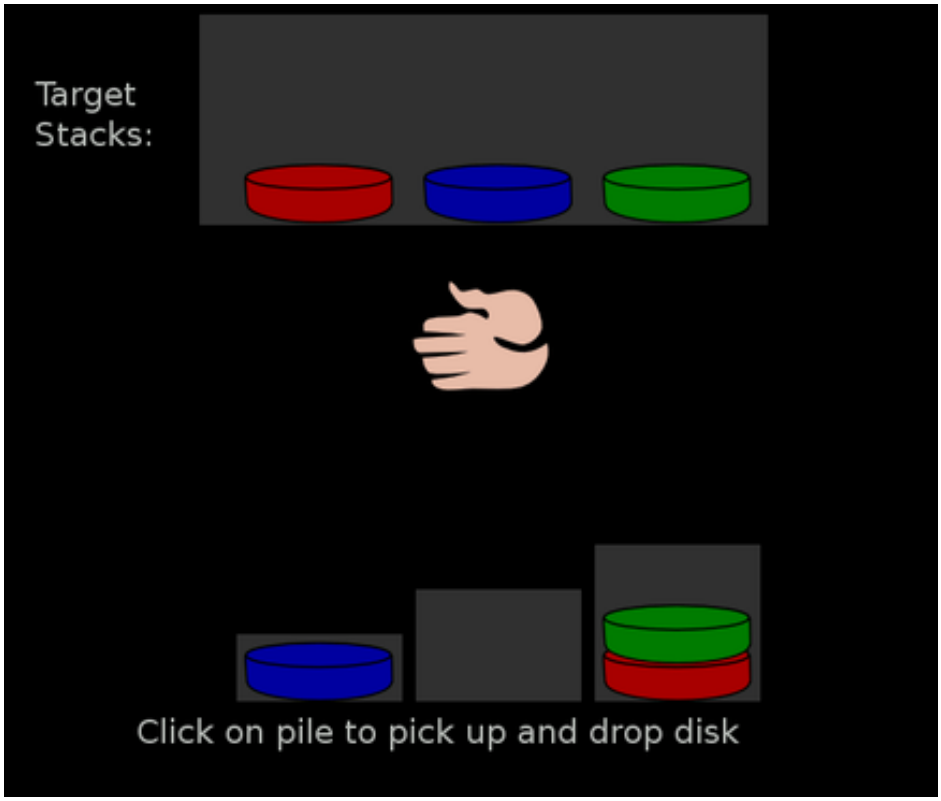
VI. Data Analysis (ASK MOON)

- Looking for Patterns: We'll check if there's any link between how well someone does (move efficiency and time) and their balance.

- Performance Tracking: See if users get better or worse over time, especially those with cognitive challenges.
- Data Collected:
    - Number of moves taken
    - Total time spent
    - Mistakes or incorrect placements
    - Balance data from force plates to see if balance shifts during gameplay(ask Moon)

VII. Possible Fail-Success Scenarios

- **Success**: You complete the configuration within the move limit.
- **Fail**: If you use up all the moves or take too long, the test is marked as incomplete.



# N-Back Test

VIII. Test Overview

A. The n-back test is a cognitive task that is used to measure working memory and cognitive control in the test patient. Participants are asked to monitor a presented visual or auditory stimuli and correctly indicate when a current stimulus matches one presented earlier in the sequence.

1. **Stimuli** - Presentation can be visual or auditory, but within the virtual reality space a visual stimulus such as a flashing button or other interactable is currently being considered.
2. **N-Back Level** - A participant identifying a match between the current stimulus and the one that immediately precedes it is 1-back, while identifying a match between the current and one presented two steps earlier is 2-back and so on.

IX. Test Requirements and Environment

A. Tests will be conducted in the motion lab at New Hampshire Hall utilizing the balance test technology within the lab. Within the preconfigured test environment patients will have enough room to move around while remaining on the balance platform.

X. Game Scenario

**A. Scoring**

1. When a stimuli match is correctly identified, points are awarded to the patient for correctly identifying a match. Although missing a match will not deduct points from the user, it will be flagged in the data when the match is not identified, and false matches will be labeled for review. The response time of each match will also be recorded and more points will be awarded depending on N-back level.

**B. Controls**

1. The testing environment will be entirely contained within the Meta Quest virtual reality environment. The test patient will interact with the game through the headset and correlating controller hardware in order to identify the matches.

XI. Test Procedure

A. Different cases of test
B. Metrics pass fail conditions test speed etc

XII. Data Analysis

A. Can ask Moon for more input on this field
B. Purpose of test “what is a successful game win”

**N-Back Protocol**

- Instruction screen display- 5 seconds
- Each test included 30 randomly selected letters
- Each letter remained on the screen for 500 milliseconds
- Subject has 1500 milliseconds to press space button if a target presents itself

**N-0 (X, D, F, Y, K, L, W, H) – F IS TARGET LETTER**

1. XYKL F HDY F KLWYD F LKHWDY F XDKLK F XD
2. X F KLHWW F XXDDY F KWWKYX F DLHWHXDWX
3. KHLYW F KXXDKLDKLWX F DDHWK F KWDLHL
4. F WHWHW F HDXY F KLL
5. WDDXXW F DWHHKLHK
6. DD F WKLK F DHLKK F YDXDY F HL F DXDLWHH
7. LHWD F WKDHX F XLXLX F F DWLHLWDWLXLY
8. KWLD F HYYLW F L F YXLWD F DHWYDHLW F YY

NASA TLX_____

**N-1**

1. DFYYKLWHHXDKLWHDFFKHLFDDWYYD
2. YKLWHDDYXDLWWKLWHDFFXDHWFHHK
3. DFYKWLLXDYKLFFXDFWHKLLDYKLXX
4. KKWLYKDXWHHLFYKDFXLKH
5. DWHLXDDLKYDDXWDFXL
6. DFDDKLWWHYFDXXKLHDXXYKLKXDLLHK
7. YKLWHHXDDYKLWHXDYYKLXDFYDKDDF
8. XDFFYKKLWHXDDYKFYYXDFYKLWHWH

NASA TLX_____

**N-2 (X D F Y K L W H)**

1. DXDYKLLLKDXHHXHFWKXHWKWLFKFHLW
2. KXHLHXWWLWKXHLFYKYLXXXFWLHWHXY
3. KLKYXWWYHKYKXLFLYWFXFYWKLFYXLW
4. YKWLWKYFXLKFYHL
5. HXHKHXLWYWLKHFL
6. KFYWXLHLYXFYKHXHWYLWYFYLHFWXLX
7. KLKXWYWWYLKHFXFYHLKXWXLHFXFLYW
8. LHKXLXHFWXHFLFYDXWKLKKLWXFXWHL

NASA TLX_____