

GENFI Ignite – a computerized cognitive testing battery for presymptomatic frontotemporal dementia

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Background The GENetic Frontotemporal dementia Initiative (GENFI) is an international multicentre study investigating genetic forms of frontotemporal dementia (FTD). A shortcoming of the GENFI study has been its use of traditional neuropsychometric measures, which although well-validated may not be sensitive enough to pick up very early cognitive changes. There is therefore a need to develop a more sophisticated approach to presymptomatic cognitive testing in genetic FTD.

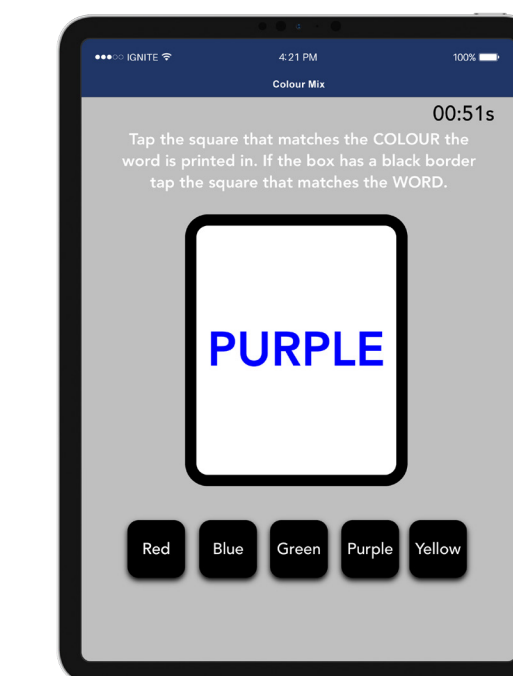
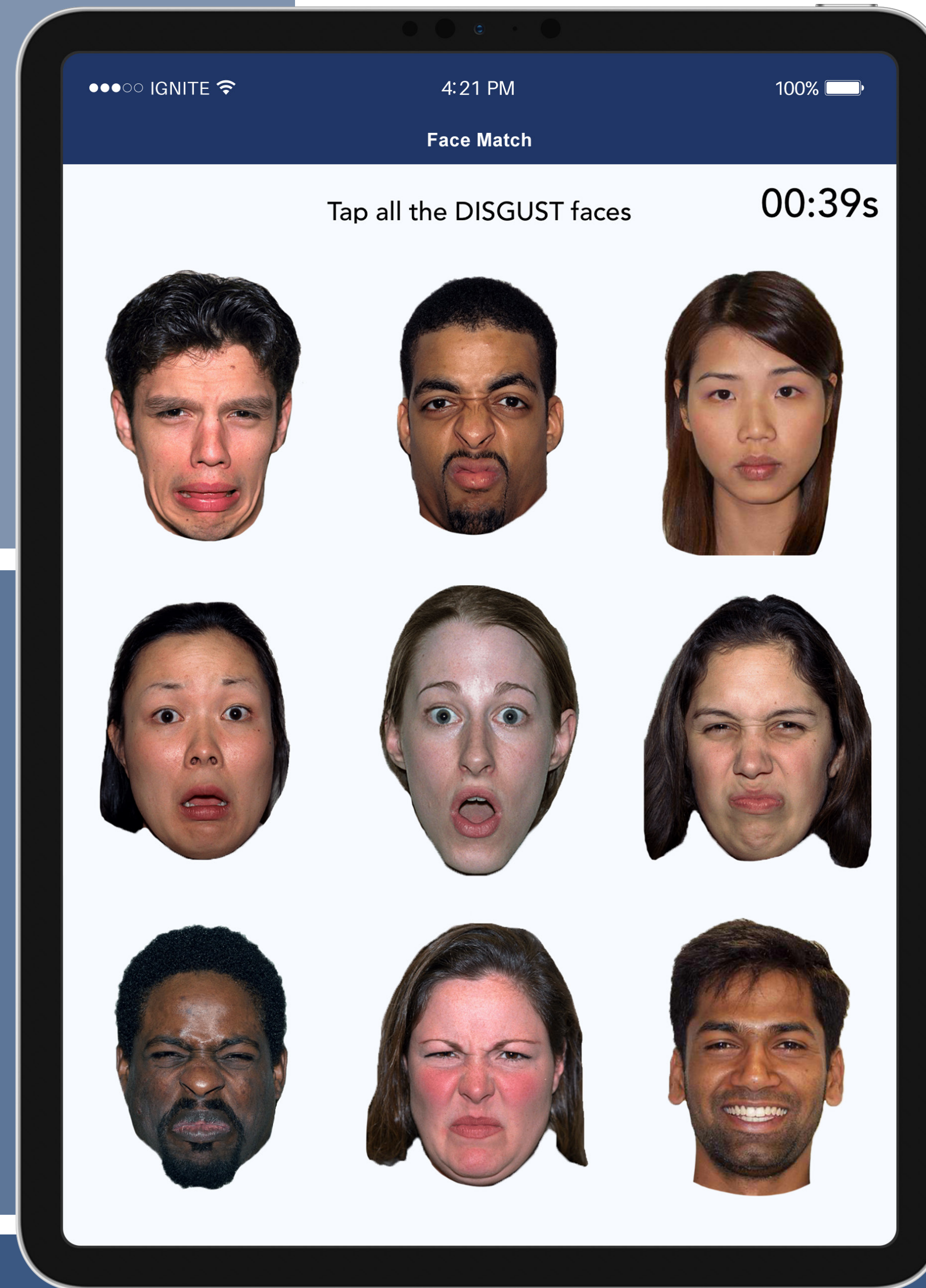
Methods Ignite is a self-administered cognitive assessment tool on the iPad designed for early detection of presymptomatic FTD and measurement of its progression. The app consists of 18 modified neuropsychological assessments selected to be sensitive to presymptomatic change. Ignite is readily portable and able to record a participant's reaction time to a high degree of accuracy. So far, Ignite has been tested in 40 subjects: 18 presymptomatic mutation carriers, 12 symptomatic mutation carriers, and 4 controls. Independent sample tests were used to compare performance of carriers against controls.

Results Results from Ignite have shown that presymptomatic mutation carriers completed significantly less items and were significantly less accurate across several tests of executive function: Colour Mix Level 3 [a version of the Stroop Task; $p=0.020$] and Swipe Out [$p=0.051$] and arithmetic: Sum Up [$p=0.004$]. On average there is a 30-40% increase in reaction time across a number of tasks.

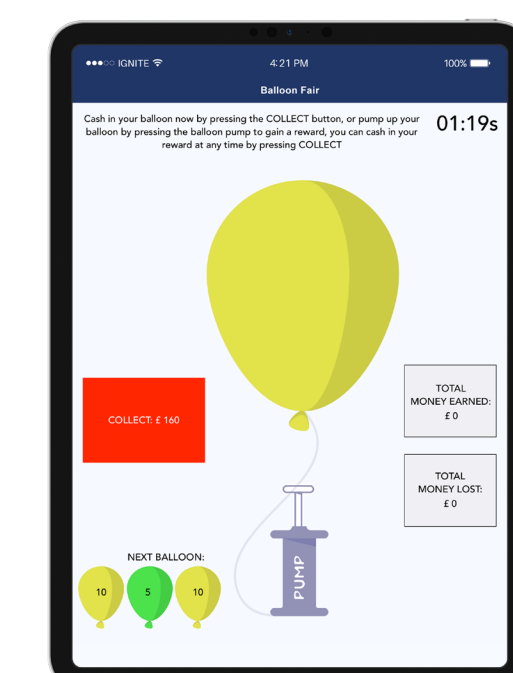
In addition, we found that Ignite is sensitive to significant changes in performance across presymptomatic mutation carriers who are in their 30s such as Swipe Out [$p=0.035$, Figure 2] and Sum Up [$p=0.049$, Figure 3]. Summarized in Table 1.

Conclusion In a preliminary analysis we show that the performance of presymptomatic mutation carriers is significantly worse than controls across a number of assessments using this novel cognitive assessment tool. Testing so far shows that the use of Ignite is feasible and can be self-administered by both presymptomatic and symptomatic participants. It has the potential to be more sensitive to cognitive decline than existing assessments, detecting significant changes in performance in individuals in their 30s.

To our knowledge this is the only app to date designed specifically for genetic FTD and preliminary findings suggest that Ignite has the potential to be used in clinical trials as a primary outcome measure.

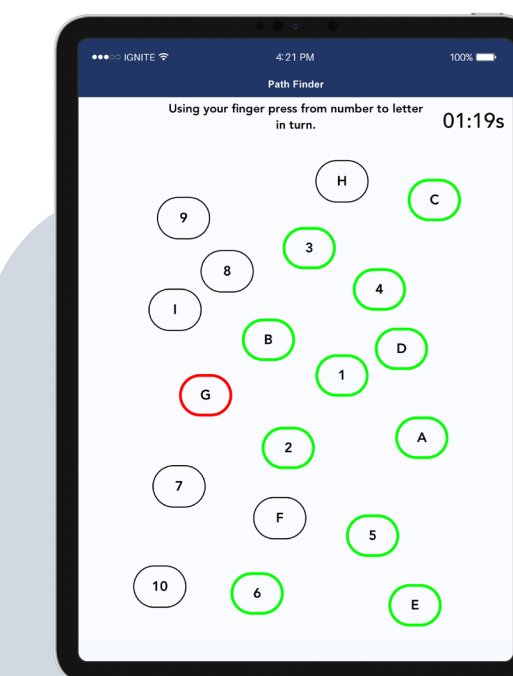


Colour Mix Level 4 (60 seconds)
Task: Subjects tap the square matching the colour the word is printed in. If the box has a black border, the subject must tap the square matching the written word.
Stimuli (50): Colour names printed in the following colours: red, blue, green, purple, yellow. A black border.
Output measures: Reaction time to respond with an answer. Accuracy measured through number of errors made, and total number of correct responses.

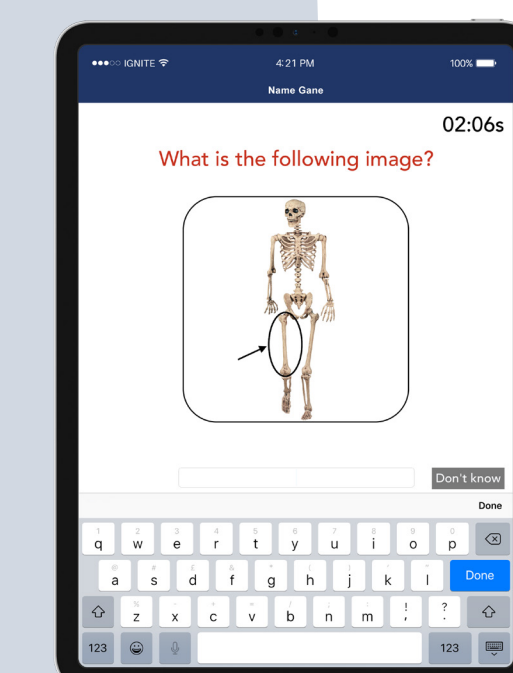


Balloon Fair (90 seconds)
Task: Gain as much money as possible to spend at the fairground. Different colour balloons have different values. Subjects can either immediately cash in their money or try to gain more money by pumping up their balloon.
Stimuli: Balloons - 3 different colours worth different values: Yellow [£5], Green [£10], Blue [£50].
Output measures: Number of pumps per balloon, total money gained, total money lost, balloon bursts.

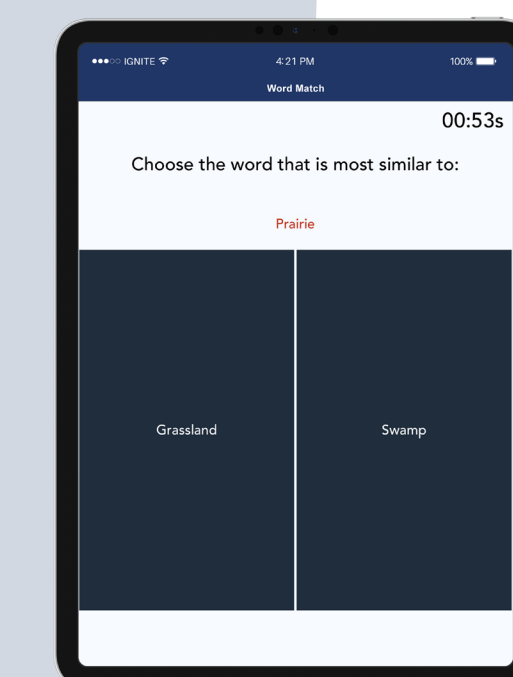
Face match (60 seconds [10 seconds per target emotion])
Task: Participants are asked to tap all of the faces corresponding to one of the following emotions: happiness, sadness, anger, surprise, fear or disgust. There are five correct targets per emotion. Faces are highlighted when tapped by the participant (whether correct or incorrect). If the fifth correct target face is tapped before 10 seconds has elapsed, the task moves on to the next target emotion.
Stimuli: Nim-Stim faces
Output measures: Reaction time to tap each face, total number of correct responses and total number of errors.



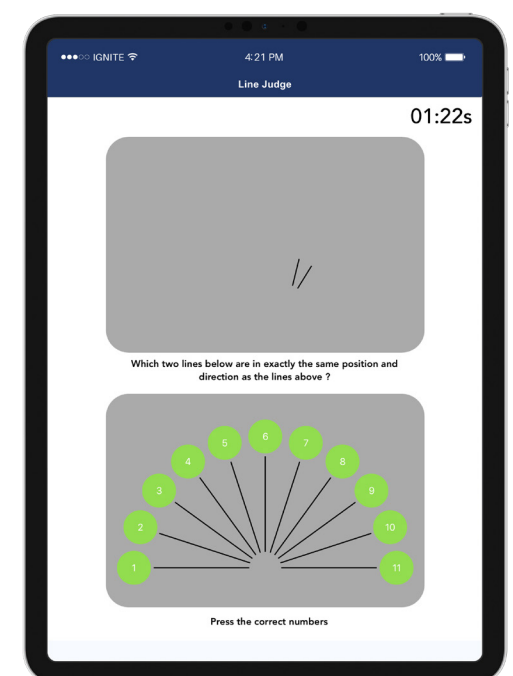
Path Finder (level 1: 60 seconds, level 2: 90 seconds)
Task: Subjects are asked to press the circles one after the other in order (either numerical or alternating between numbers and letters).
Stimuli (19): Letters and numbers in circles.
Output measures: Number of correct presses, number of errors, reaction time to press the stimuli.



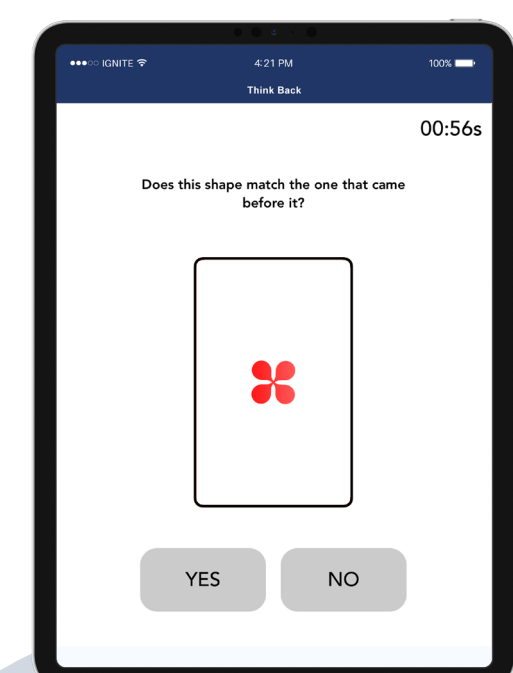
Name Game (2 minutes 30 seconds)
Task: The subject is required to name the target picture. This is done by typing their answer into the text box provided. Subjects can press the 'done' button or enter key to submit their answers. The 'don't know' button can be pressed to indicate when a participant does not know the answer. Reaction time is recorded, and the task will then move onto the next image.
Stimuli: Pictures of objects.
Output measures: Stimuli shown, user answer, accuracy, response time (measured by the participant beginning to type the first letter), first letter typed.



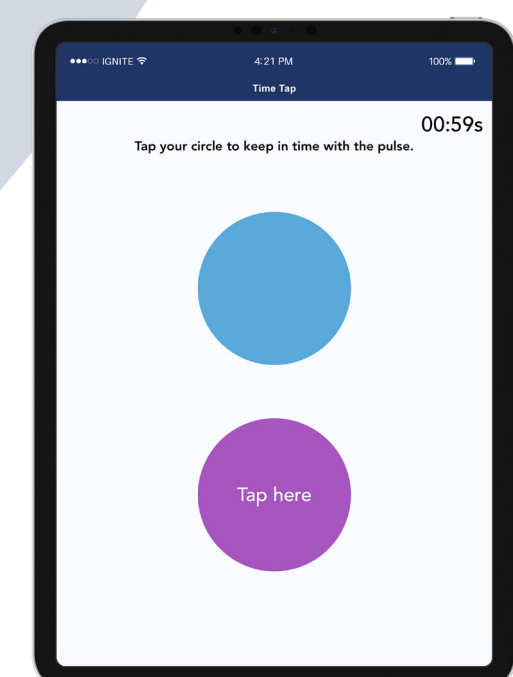
Word Match (90 seconds)
Task: Participants are presented with a word at the top of the screen, and are required to select from the pair of words below which is most similar.
Stimuli: 3 words: 1 target word and 2 possible word answers. Users have the option to hear the words being spoken out loud.
Output Measures: Reaction time to press a word. Accuracy is measured through number of errors made, and total number of correct responses.



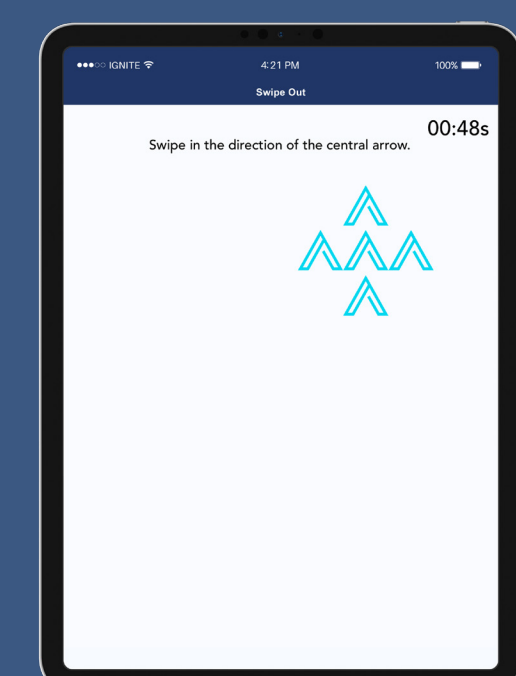
Line Judge (90 seconds)
Task: Subjects are to correctly match the pair of target lines to the numbered radii below by pressing the numbered buttons.
Stimuli: Two lines of different angles.
Output measures: Stimuli item, stimuli answers for item, user answer, accuracy, response time.



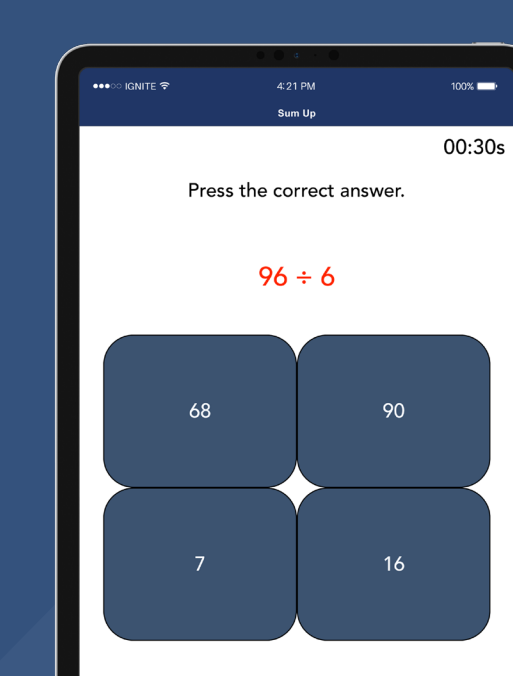
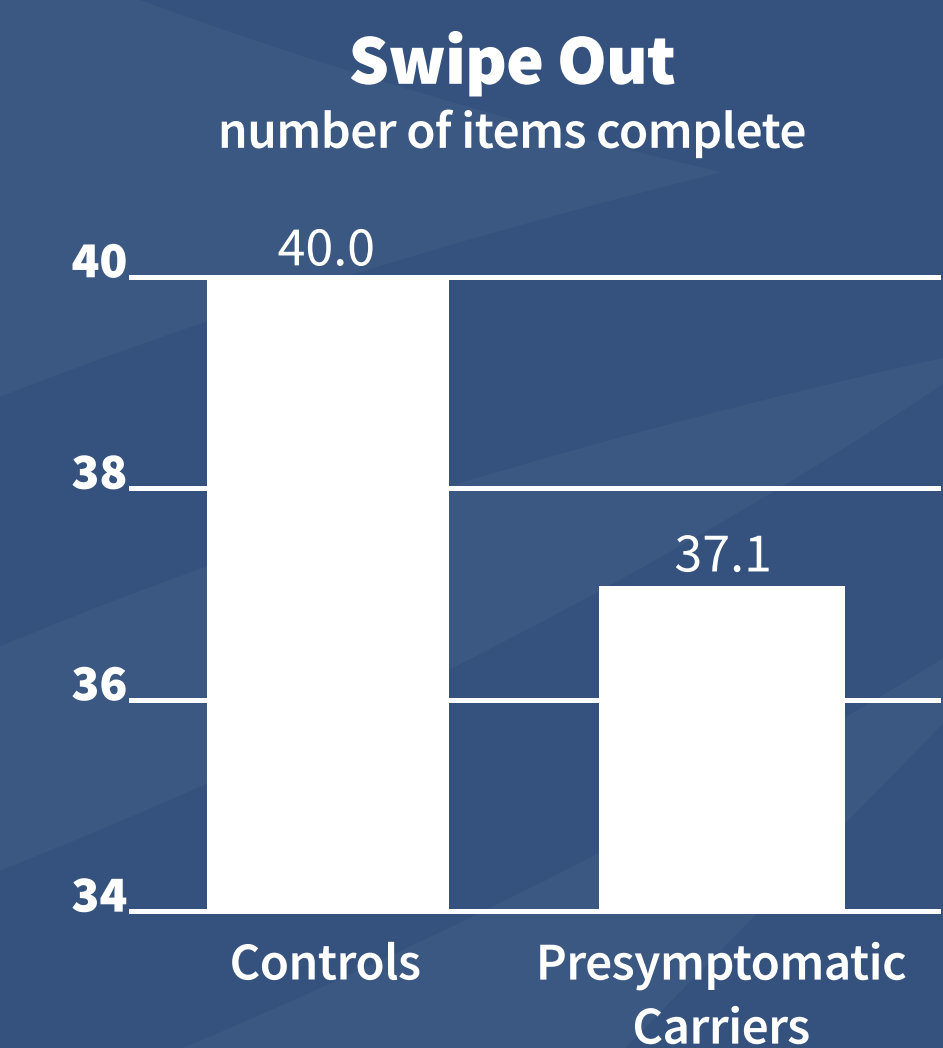
Think Back (2 levels - 60 seconds each)
Task: A series of shapes appear on the screen, which subjects are asked to memorise. Subjects then compare each shape to the next (1-back), or compare each shape to the shape shown two steps before the current one (2-back). If the shape matches the previous shape (1-back), or the shape shown two steps before the one shown (2-back), subjects should press the 'YES' button. If the shape does not match the shape shown participants should press the 'NO' button.
Stimuli (72): Cards with different colour shapes.
Output measures: Reaction time to press 'YES' or 'NO' button. Accuracy is measured in the number of errors made, and the total number of correct responses.



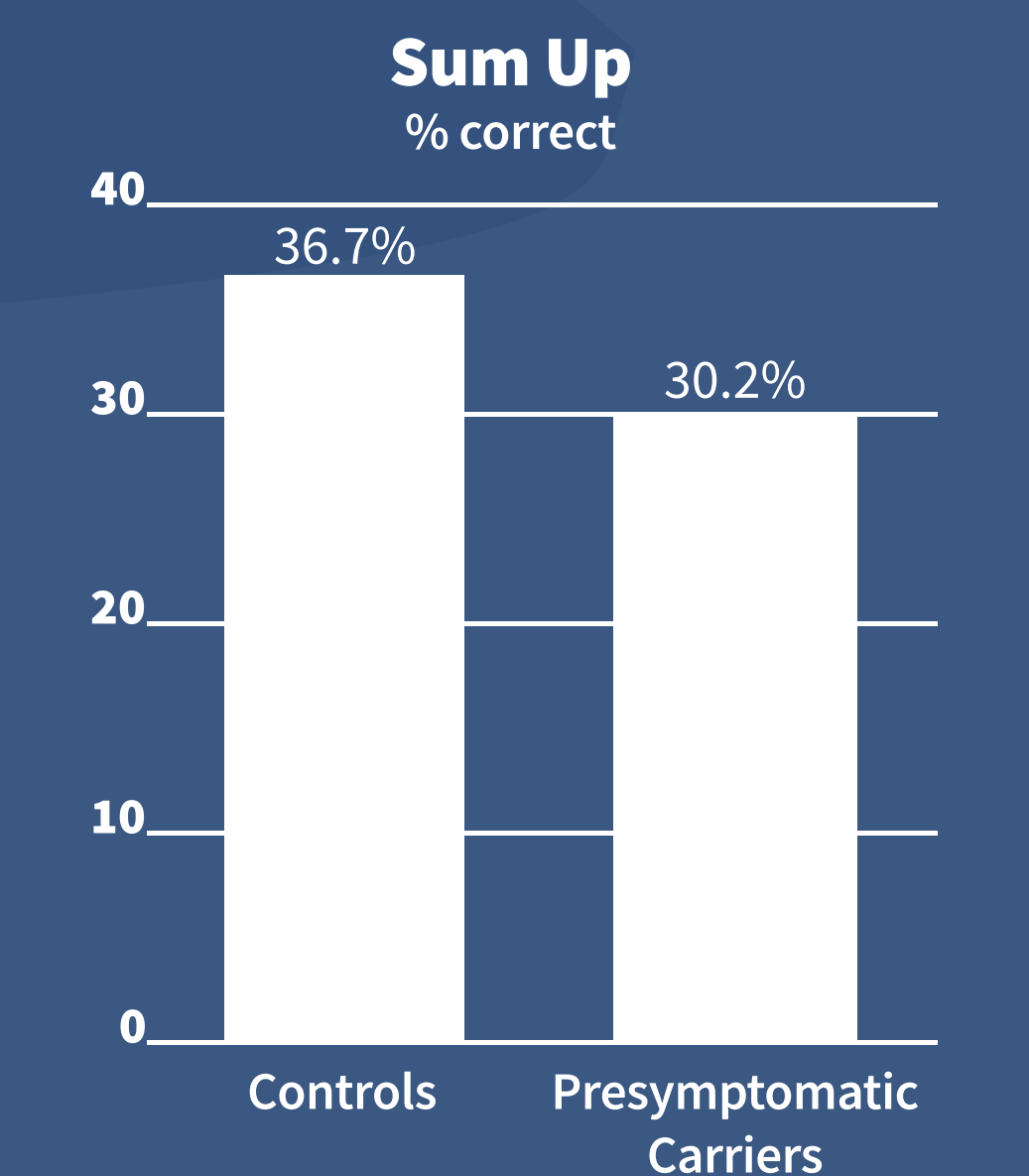
Time Tap (60 seconds - 30 seconds with, 30 seconds without target stimulus)
Task: The target stimulus is a pulsating circle and subjects are asked to tap the same pulse (tempo/meter) on the response circle below the target. The pulsating circle then disappears and the subject is required to maintain the pulse by continuing to tap the response circle.
Stimuli: Pulsating circle.
Output measures: Accuracy and speed, how accurately participants maintain the pulse.



Swipe Out (60 seconds)
Instructions: Participants are presented with a set of arrows. These arrows will be facing either up or down, left or right. Participants are required to swipe in the direction of the arrow at the centre of each formation.
Stimuli (40): Arrow formations in 4 colours.
Output measures: Reaction time to swipe in any direction. Accuracy measured in number of errors made (incorrect swipes), and total number of correct swipes.



Sum-Up (60 seconds)
Task: Participants are required to press the correct answer to the arithmetic operation shown.
Stimuli: Target calculation + 4 possible answers.
Output measures: Reaction time to respond. Accuracy measured through the number of errors made, and total number of correct responses.



Presymptomatic Age 30s – Controls n=8 Presymptomatic n= 8			
Task	Sig	Controls	Presymptomatic Carriers
Colour Mix Level 1			
% Correct of items completed	$p=0.035$	100%	99.2%
Colour Mix Level 2			
% Correct of items completed	$p=0.035$	100%	99.7%
Sum Up			
% Correct	$p=0.049$	36.7%	30.2%
Path Finder Level 1			
% Correct of items completed	$p=0.035$	100%	99.4%
Swipe Out			
Number of items completed (max 40)	$p=0.035$	40	37.1



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