

Background : The COVID-19 pandemic has limited in-lab cognitive testing. While at-home alternatives exist (testing over the phone), differences in test design and delivery complicate direct comparison of most in-lab and at-home tests.

Here we describe the design, infrastructure, and implementation of the California Cognitive Assessment Battery (CCAB), a cognitive test battery and administration system. Using automated remote administration over cellular networks, identical computerized cognitive tests can be administered at-home or in the lab.

Method: The CCAB comprises 30+ computerized cognitive tests. Test delivery is automated through text, text-to-speech, and graphical instructions; test scoring is also automated, using automatic speech recognition for verbal responses.

The test delivery infrastructure consists of two components: the test kit (MS Surface Pro tablet computer with mouse, headset, and cellular dongle) , and a web-browser application “CCAB Examiner,” used by the test administrator to control test delivery, view real-time progress and scores, and monitor/chat with the participant via AV feeds.

The system is coordinated by a cloud-based server which also delivers the CCAB Examiner application to any browser. Once connected, the “CCAB Test Station” application and CCAB Examiner communicate over a commercial Communication as a Service (CAAS) provider, which transmits AV streams and a text messaging protocol. CCAB Test Station is designed to isolate control, communications, and testing functions for maximal fault tolerance. For example, test administration continues automatically even if Examiner and Test Station lose connection. Test data is uploaded to the server during sessions and re-synced when the test kit returns.

Results: 442 participants underwent three 90-minute CCAB test sessions on successive days (72 total tests per participant). More than 98% of participants finished all three sessions, and >99% of tests were completed. Cellular connection failures occurred occasionally, but >98% resulted only in the loss of A/V feeds for the examiner, while tests continued automatically and examiners were able to monitor real-time performance data.

Discussion: The CCAB permits identical tests to be administered at home or in the laboratory, while cellular-network based remote administration allows for nationwide access for all socioeconomic groups, even for people in remote areas without Wi-Fi, or those with limited technical expertise.