2-24-2023

Videoconference Administration of the Delis-Kaplan Executive Function System

Zachary T. Stine

Videoconference Administration of the Delis-Kaplan Executive Function System

Zachary T. Stine

Presented to the Faculty of the

Graduate School of Clinical Psychology

George Fox University

in partial fulfillment

of the requirements for the degree of

Doctor of Psychology

in Clinical Psychology

Newberg, Oregon

Approval Page

Videoconference Administration of the Delis-Kaplan Executive Function System

by

Zachary T. Stine

has been approved

at the

Graduate School of Clinical Psychology

George Fox University

as a Dissertation for the PsyD degree

Committee Members

Kenneth Logan, Psy.D., Chair

Rodger Bufford, Ph.D., Member

February 24, 2023

Abstract

Neuropsychological assessments rely on standardization, reliability, validity, and normative data to increase the accuracy of clinicians' interpretations (Lezak et al., 2012). One particular assessment that focuses on examining comprehensive executive functioning is the Delis-Kaplan Executive Function System (D-KEFS; Delis et al., 2001). Videoconference is gaining in use to provide services within multiple healthcare domains to increase access to care and convenience, potentially reduce costs, and sustain patient satisfaction (Brearly et al., 2017). The literature has shown support for the growing field of telehealth neuropsychology (Brearly et al., 2017); however, many neuropsychological assessments, such as the D-KEFS, have not been normed for telehealth administration. This study examined D-KEFS verbal tests administered via videoconference and in person to determine whether there are significant differences when administered via videoconference. Using random assignment, 37 participants from a private university in Oregon were administered the D-KEFS in person or via videoconference. Years in college was found to be a significant covariate factor for Letter Fluency, Category Fluency, Category Switching, Word Context, and Proverbs Test. Results did not reject the null hypothesis as we did not find significant differences between the control and experiment groups' scores on each of the subtests after controlling for age. Treatment effects were $\leq \eta_p^2 = 0.10$. While this was a small study with limitations, it provides preliminary evidence that videoconference administration of the verbal subtests of the D-KEFS may result in comparable scores. Further exploration of the D-KEFS verbal subtests in the future is recommended to ensure the appropriateness of using current normative data to compare results.

Keywords: telemedicine, executive function, videoconferencing, normative data, neuropsychology, assessment

Table of Contents

Table of Tables

Videoconference Administration of the Delis-Kaplan Executive Function System

Chapter 1

History of Neuropsychology

Clinical neuropsychology is the science connecting brain dysfunction and behavioral expression. As controlled observation became an acceptable mode of research in the 19th century, the general foundation was set for the earliest neuroscientists to study relationships between brain and behavior during the 20th century (Lezak et al., 2012). During the first World War, there was a need for diagnosis and assessment of service members who suffered from brain injury and were behaviorally atypical in order to provide helpful rehabilitation. Neuropsychological examinations and treatment continued to become more elaborate during World War II, wars in East Asia, and wars in the Middle East. Clinical neurosciences and psychology continued to contribute to neuropsychological assessment (Lezak et al., 2012).

As the cultural acceptance and demand grew for the understanding and assessment of neuropsychological functioning, evaluations such as the Wechsler Intelligence Scales were formed out of educational psychology and implemented to understand individuals' abilities related to neuropsychological functioning (Lezak et al., 2012). The value of reliable and valid means of understanding people's neuropsychological abilities grew and standardization, normative data, analysis of research findings, and validation studies became prevalent. Neuropsychological assessment is utilized to identify and clarify different neurological disorders that underpin behavioral abnormalities in order to accurately diagnose and provide effective treatment planning. Assessments rely on standardization, reliability, validity, and normative data to increase the accuracy of clinicians' interpretations (Lezak et al., 2012).

Executive Functioning

One particular type of neuropsychological assessment evaluates individuals' executive functioning. Decision-making and planning, volition, purposive action, and effective performance are all included in the construct of executive functions of cognition (Lezak et al., 2012; Suchy, 2016). The array of neuropsychological abilities is important for navigating social interactions and behaving effectively in complex situations. Executive functioning was once associated with the frontal lobe. However, executive functioning is now understood to be a more complex, multifaceted process that goes beyond just the frontal lobe. Executive functioning is a set of higher-order neurocognitive processes involved in socially informed, adaptive, future-oriented, and goal-directed decision making (Suchy, 2016). Suchy (2016) discussed five different subdomains including executive cognitive functions, meta-tasking, response selection, initiation and maintenance, and social cognition. The associated syndromes when the subdomains are in dysfunction include dysexecutive syndrome, disorganized syndrome, disinhibited syndrome, apathetic syndrome, and socially inappropriate syndrome.

Executive Cognitive Functions

According to Suchy (2016), executive cognitive functions are descriptions of cognitive processes that may or may not preclude certain behavioral outcomes, as an individual who may be able to plan, organize, and flexibly apply information may not execute a specific behavior. Suchy (2016) proposes that main components of executive cognitive functions include goal-directed retrieval of information, manipulation of information in working memory, and mental flexibility. These processes generate solutions to problems, create plans, and manage organizational systems. These cognitive processes rely on neuroanatomical networks including but not limited to cortical, striatal, diencephalic, and hindbrain regions. Since executive cognitive functions involve a vast array of cortical and subcortical networks, impaired executive cognitive

function may be a result of neurodevelopmental, neurodegenerative, and psychiatric conditions.

Meta-Tasking

Meta-tasking describes an individual's ability to execute multifaceted plans in a cohesive manner over periods of time by use of event-based prospective memory, time-based prospective memory, and meta-monitoring where prospective memory is the ability to remember to carry out tasks in the future (Suchy, 2016). Meta-tasking also encompasses task switching, or the ability to switch between mental tasks. A disruption in meta-tasking, termed disorganized syndrome, can lead an individual to be disorganized or unable to complete complex tasks, unable to remember important steps or tasks based on context cues and timing, or prone to losing track of time and experiencing chronic tardiness. Suchy (2016) discusses particular lesion studies in which these processes primarily rely on neuroanatomical networks including the rostral and lateral prefrontal cortex. Dysfunction in meta-tasking abilities have been found in individuals with traumatic brain injuries, neurodegenerative diseases, developmental conditions such as autism spectrum disorder and attention deficit hyperactivity disorder, and psychiatric conditions such as schizophrenia.

Response Selection

Response selection comprises constructs such as threat sensitivity, contingency updating, and discrepancy detection and describes the behavioral choices involving the inhibition of a previously reinforced response (Suchy, 2016). Dysfunction of response selection is called disinhibited syndrome. Suchy (2016) advises that individuals with disinhibited syndrome may display more impulsive responses, perseveration, and inability to detect error feedback. These processes primarily rely on neuroanatomical networks between the ventral and medial convexities of the frontal lobe, temporal regions of the anterior insula, and the amygdala. Dysfunction in response selection has been found in populations with traumatic brain injury,

ischemic injuries, frontotemporal lobar degeneration behavioral variant, attention deficit hyperactivity disorder, addictions and substance abuse disorders, personality and conduct disorders, and mood disorders (Suchy, 2016).

Initiation and Maintenance

Initiation and maintenance describe an individual's ability to initiate behavioral and mental action and sustain behavioral and mental output while monitoring cognitions (Suchy, 2016). Dysfunction of initiation and maintenance, called apathetic syndrome, lead individuals to appear slow in output, lack motivation, and lack persistence. Initiation primarily relies on neuroanatomical networks including the anterior cingulate gyrus, the rostral medial prefrontal cortex and the supplementary motor area. According to functional imaging and lesion research discussed by Suchy (2016), maintenance appears to rely on networks including the dorsomedial and ventromedial prefrontal cortexes, anterior insula, intraparietal sulcus, temporoparietal junction, cerebellar vermis, thalamus, putamen, and midbrain. Effort mobilization involves neuroanatomical networks including the ventral striatum, cingulate gyrus, supplementary motor area, anterior insula, and thalamus. Apathetic syndrome is most commonly found in populations who have experienced an infarct affecting medial frontal structures, populations with neurodegenerative disorders, and populations with attention deficit hyperactivity disorder.

Social Cognition

Social cognition involves linguistic, paralinguistic, and situational modes of emotional communication, and emotional self-awareness (Suchy, 2016). Social cognition helps individuals understand the feelings of both self and others and recognize and adhere to social norms. Dysfunction of social cognition, termed "inappropriate syndrome" by Suchy (2016), may lead to an individual engaging in inappropriate behavior, disregarding rules, or inability to understand

others' feelings and desires. According to Suchy (2016), social cognition involves neuroanatomical networks including the amygdala, orbitofrontal cortex, and systems found in the right hemisphere. Inappropriate syndrome can be commonly found in populations with traumatic brain injury, autism spectrum disorder, agenesis of the corpus callosum, frontotemporal lobar degeneration behavioral variant, schizophrenia disorders, substance abuse disorders, and antisocial personality disorder.

Assessment

One particular assessment that focuses on examining aspects of executive functioning is the Delis-Kaplan Executive Function System (D-KEFS; Delis et al., 2001). The D-KEFS is comprised of nine subtests with both verbal and non-verbal components, which allows clinicians to select the tests that will be most helpful within context (Lezak et al., 2012).

Telehealth

Videoconference mediated telehealth provides services within multiple healthcare domains to increase access to care and convenience, potentially reduce patient travel costs, and sustain patient satisfaction (Brearly et al., 2017). As the profession of neuropsychology continues to grow along with the demand for neuropsychological testing, there is still limited access for some populations to receive neuropsychological assessment services in rural settings (Wadsworth et al., 2016). While there is already limited access for some populations in rural settings, the number of people suffering from dementia is projected to drastically rise over the next 40 years, potentially increasing the need for access to neuropsychological services (Hebert et al., 2013). One potential solution to provide neuropsychological assessments more broadly is to provide neuropsychological services via telehealth.

Within the domain of psychotherapeutic intervention, similar results were found for

clinical outcomes between face-to-face and video conference administered psychotherapy among a wide range of diagnoses and evidence-based treatments (Barak et al., 2008). Furthermore, a small study of 15 patients from a rural veteran's community clinic were referred to a multidisciplinary team integrating neurological evaluation and neuropsychological testing via videoconference assisted by a remote clinician at a community clinic (Barton et al., 2011). The multidisciplinary team effectively came to a working diagnosis for each patient, providing recommendations to patients and caregivers.

As technology advances, the American Psychological Association (2013) has developed ethical guidelines for best telehealth practices relevant to neuropsychological testing via telehealth. Telehealth providers must ensure competence with both the technologies being used and the impact of the technologies on individuals being tested, supervisees, and other professionals. Professional and ethical standards must be met throughout the interaction. Providers must obtain and document informed consent specifically addressing telepsychology services with cognizance of applicable laws, regulations, and organizational requirements governing informed consent. Providers must take reasonable steps to ensure security measures are in place to protect data related to unintended access or disclosure. Lastly, they must consider the unique issues that are possible to arise with test instruments and assessment approaches designed for in-person implementation when providing neuropsychological services via telehealth. Ethical guidelines provided by American Psychological Association are meant to provide a foundation for psychologists to utilize for best practices rather than simply following rules and laws while not considering other factors. Psychologists are pressed to consider cultural factors potentially hindering or inhibiting patients from engaging in telehealth psychology appropriately.

Neuropsychological Assessment via Telehealth

The literature has shown support for the growing field of telehealth neuropsychology (Brearly et al., 2017). A pilot study with 19 participants with possible Alzheimer's Disease and 14 participants with mild cognitive impairment found consistent test scores between face-to-face and video conference administration of commonly used tests, including Mini Mental Status Exam, Hopkins Verbal Learning Test-Revised, Digit Span, letter and category fluency tests, and the Boston Naming Test (Cullum et al., 2006). Parikh et al. (2013) studied preferences of healthy aging individuals and individuals with mild cognitive impairment. They found that telehealth neuropsychological assessment was preferable in comparison to face-to-face administration and had high acceptability among participants.

The Repeatable Battery for the Assessment of Neuropsychological Status was shown to have similar scores when administered via video teleconference compared with face-to-face administration in a study with 18 participants between the ages of 58 and 84 years having either no cognitive disorder, mild cognitive impairment, or Alzheimer's Disease (Galusha-Glasscock et al., 2016), but power was inadequate.

Telehealth administration of neuropsychological assessments was shown to be a valid medium of remote administration for a rural American Indian population from the Choctaw Nation in Oklahoma (Wadsworth et al. 2016). Participants (n=84) between the ages of 46 and 88 years with cognitive disorder, mild cognitive impairment, or Alzheimer's Disease were administered the Mini Mental Status Exam, Clock Drawing, Digit Span Forward and Backward, Oral Trails, Hopkins Verbal Learning Test-Revised, Letter and Category Fluency, and a short form Boston Naming Test. Intraclass correlation coefficients compared test scores for face-to-face and video conference administration.

The ability to discriminate between cognitively impaired and non-impaired groups via teleconference administration of neuropsychological assessments was similar to face-to-face administration (Wadsworth et al, 2018). Older participants (*n*=197) with and without cognitive impairment completed Mini Mental Status Exam, Hopkins Verbal Learning Test-Revised, category and letter fluency, the Boston Naming Test-15, Digit Span forward and backward, clock drawing, and the Geriatric Depression Scale-15. Tests in both conditions accurately identified level of cognitive impairment.

Brearly et al. (2017) performed a literature review to assess the effect of videoconference administration on adult neuropsychological assessments that were standardized for in-person administration. They established several rules for inclusion and exclusion criteria. First, they included studies with adult participants that used a counterbalanced crossover design, meaning each participant was tested in both conditions with condition order being alternated across the samples. Secondly, they accepted studies that let assistants help participants set up necessary technology but excluded studies where assistants intervened during the testing process. Thirdly, they excluded studies using proprietary hardware or software designed for remote use as they wanted to focus on assessments standardized for in-person assessment. Lastly, they included studies that examined neuropsychological assessment data rather than screeners, self-report measures, and personality assessments.

Brearly et al. (2017) examined 25 full articles and 12 studies met inclusion and exclusion criteria. In total, the meta-analysis included 497 participants with a range of characteristics including healthy participants, participants being medically treated, participants from inpatient and outpatient psychiatric or substance use treatment, and participants diagnosed with mild cognitive impairment, Alzheimer's disease, or various other neurocognitive disorders. Overall,

Brearly et al. (2017) found a small mean effect size for videoconference conditions while a significant difference was not found between conditions. They found that videoconference scores were around one thirty-third of a standard deviation less than in-person scores, they found significant heterogeneity between studies, and they found variation in the direction of the effects as 26 mean scores were higher in videoconference conditions, 48 mean scores were higher for in-person conditions, and 5 mean scores were equal. For timed and single-trial assessments where administration might be negatively affected by disruptions in information transmission, videoconference administration was significantly different than in-person administration. For other tests, videoconference administration was also significantly different but the effect was small, where videoconference scores yielded approximately one-tenth of a standard deviation lower than in-person scores. For primarily verbal tests, the mean effect for videoconference assessments were small and not statistically significant, being approximately one-tenth to one-fiftieth of a standard deviation different from in-person assessments. For tests requiring verbal and visual components, videoconference assessments were significantly different but yielded a small effect, being approximately one-tenth of a standard deviation lower than in-person scores. Brearly et al. (2017) concluded that the meta-analysis provides support for the use of videoconference administration of neuropsychological assessments, especially solely verbal assessments.

Current Study

As the current literature has shown some support for the field of telehealth neuropsychology, further research is warranted before telehealth administered instruments can be interpreted with confidence using the original normative data. In particular, many neuropsychological assessments, including the D-KEFS, have not been normed for telehealth

administration. It appears that neuropsychologists who decide to administer tests via telehealth are currently using the normative data gathered, particularly for in-person administration. Some studies have suggested that it may be acceptable to interpret findings from telehealth neuropsychological testing with caution (Brearly et al., 2017). However, developing research that compares the normative data of face-to-face administration and videoconference administration is preferable to account for possible interactions.

The focus of this study was to discover if the D-KEFS four verbal subtests scores are significantly affected when administered via videoconference versus in-person. The independent variable is the type of administration: in person and videoconference. The hypothesis tested in this current study is that the D-KEFS Verbal Fluency, 20 Question, Word Context, and Proverb Tests will be significantly different when administered by videoconference administration, demonstrating that the current norms are inappropriate for use with virtual administration. The author expected to see the null hypothesis, in which we would find no significant differences between telehealth and in-person administrations.

Chapter 2

Methods

Participants

We recruited undergraduate students from a private university in Oregon at the beginning of the 2021 Spring Semester's General Psychology class using SONA. Participants were offered a portion of their research lab credit for the class if they participated in the study. We also recruited graduate students from the same university as additional participants were needed to increase the sample size. The demographics of participants for this study reflected that of the student body. In this sample of 37 participants, 64.9% were female, the rest were male; 83.8 %

were single in relationship status, the rest were married; 67.6% identified as White, 2.7% identified as biracial, 8.1% identified as Black or African-American, 5.4% identified as Asian-American, and 16.2% identified as Hispanic or Latin-American (see Table 1). After completing an a priori power analysis, we concluded that it would be preferable to have 70 participants for this study (Mayr et al., 2007). The goal of the study was to have 35 participants randomly assigned to the control group (in-person administration) and 35 participants randomly assigned to the experimental group (virtual administration). At the end of the experiment, 19 participants were completed in the control group and 18 were completed in the experimental group.

Materials

Materials used prior to the experiment included an invitation to participate that provided basic information about the study and a time estimation for participation in the study. Additionally, this study utilized an informed consent form (see Appendix A) and a demographics questionnaire (see Appendix D). The demographics questionnaire included: age;

Table 1

Demographics

Variable	Response	*N*	%
Gender			
	Female	24	64.9
	Male	13	35.1
Marital status			
	Single	31	83.8
	Married	6	16.2
Race/ethnicity			
	Biracial	1	2.7
	Black/African-Am.	3	8.1
	Asian-Am.	2	5.4
	Hispanic/Latin-Am.	6	16.2
	White/European-Am.	25	67.6
Age (years)			
	18	10	27.0
	19	9	24.3

Variable	Response	*N*	%
	20	2	5.4
	22	1	2.7
	23	3	8.1
	24	1	2.7
	25	2	5.4
	26	2	5.4
	27	1	2.7
	28	1	2.7
	30	1	2.7
	31	1	2.7
	33	1	2.7
	37	1	2.7
	41	1	2.7

gender; ethnicity; disability; academic major; history of whiplash, concussions, and traumatic brain injuries; previous mental health diagnoses; and socioeconomic status.

Delis-Kaplan Executive Functioning System

The study included four Delis-Kaplan Executive Functioning System (D-KEFS) verbal scales, the Verbal Fluency Test, Twenty Questions Test, Word Context Test, and Proverb Test (Delis et al., 2001). The D-KEFS was standardized on a stratified sample of 1750 participants ages 8–89 years old that was nationally representative. According to Delis et al. (2001), age, sex, race/ethnicity, years of education, and geographic region stratification were based on the 2000 U.S. Census figures as target values for the normative sample. Because of the wide age range of normative data provided, it was deemed acceptable to use the D-KEFS on the sample.

Verbal Fluency. Verbal Fluency (VF) consists of Letter Fluency (LF), Category Fluency (CF), and Category Switching (CS; Delis et al., 2001). In each condition, the examiners give the examinee 60 seconds to come up with as many words as possible starting with a specified letter, belonging to a specific semantic category, or while alternating between two semantic categories. The task involves the ability to generate words fluently and effortfully while abiding by the

specific rule of each task. The number of correct responses in each condition, comparison of relative performances across conditions, error types, and 15-second time intervals are analyzed.

Out of the verbal fluency tasks, letter fluency produced the highest internal consistency coefficients with a moderate to high range (.68–.90), while internal consistencies for category fluency (.53–.76) and switching (.37–.68) were lower. Test-retest measures for Letter Fluency (r^2 = .67–.88) and Category Fluency (r^2 = .70–.88) indicated good to high reliability (Delis et al., 2001). The test-retest reliability was lower for Category Switching (r^2 = .49–.65). Letter Fluency, Category Fluency, and Category Switching correlated moderately for average functioning individuals.

A study exploring criterion validity of the D-KEFS verbal fluency subtests found modest criterion validity (classification accuracy of 65.39%, likelihood ratio of 1.87) in the assessment of patients with complicated mild-severe traumatic brain injury (Strong et al., 2010). According to Strong et al. (2010), the 65 clinical participants ages 16–84 years old were from a Midwestern rehabilitation facility, had a diagnosis of traumatic brain injury, were without a history of other neurological impairment, and scored in the valid range on effort tests.

Twenty Question Test. For the Twenty Question (TQ) test, the examinee looks at a stimulus page with 30 common objects (Delis et al., 2001). The examinee is told to ask yes or no questions to identify an unknown target object while using the lowest quantity of questions possible. To be more efficient, the examinee will attempt to ask questions that effectively eliminate the maximum number of objects per question. In order to do this, the examinee must utilize a high level of abstract thinking rather than more concrete initial questions, which will only eliminate a few objects. The test measures the examinee's ability to identify various categories and subcategories of the 30 common objects to inform their questions which, in turn,

can potentially eliminate the maximum number of objects. Internal consistency utilizing Spearman-Brown corrected split-half reliabilities were moderate to high correlations (.72–.87) for initial abstraction and low to moderate (.10–.55) for total weighted achievement (Delis et al., 2001). Test-retest reliability was in the moderate range (r^2 = .24–.62) for the initial abstraction and in the low range (r^2 = .06–.39) for total weighted achievement. The Total questions asked score and the total weighted achievement score were highly correlated, while there were lower correlations with the same variables and the initial abstraction score.

Word Context Test. For the Word Context (WC) test, the examiner asks the examinee to decipher the meaning of a pseudoword, or words, based on context clues of sentences (Delis et al., 2001). For each pseudoword, the examiner gives the examinee five sentence clues helping them to decode the meaning of the pseudoword. Each sentence of the five total gives progressively more detail about the pseudoword to the examinee. The test evaluates deductive reasoning, integration of information, hypothesis testing, and flexibility of thinking. Internal consistency utilizing Spearman-Brown correction formula displayed moderate to good correlations (.47–.74; Delis et al., 2001). The Word Context Test yielded good test-retest reliability (r^2 = .58–.78). Results from intercorrelations found in Word Context portray a positive moderate correlation between the total first trial consistently correct measure and the repeated incorrect responses score. Furthermore, a moderate correlation was found between the total first trial consistently correct measure and consistently correct ratio. Normal functioning individuals have higher accuracy scores and usually make fewer errors.

Proverb Test. For the Proverb Test (PT), the examinee is presented with eight different sayings in Free Inquiry and Multiple-Choice conditions, measuring the examinee's ability to interpret with accuracy and abstraction (Delis et al., 2001). The Free Inquiry condition tests the

examinee's ability to interpret common and uncommon proverbs orally, measuring the examinee's accuracy of interpretation and level of abstraction. The Multiple-Choice condition forces the examinee to choose among four interpretations of the same eight proverbs. The four interpretations include a correct abstract interpretation, a correct concrete interpretation, an incorrect, phonemically similar interpretation, and an unrelated saying. Internal consistency utilizing the Spearman-Brown correction formula displayed moderate to high correlations (.68–.81; Delis et al., 2001). The Proverb Test yielded moderate to high test-retest reliability (r^2 = .66–.90). The highest correlations for the Proverb test were observed between accuracy-only and abstraction-only scores for Free Inquiry, while other variables displayed moderate correlations.

In-Person Administration Equipment

We conducted face-to-face administration of the D-KEFS in one private room with a sign labeled "testing in progress" posted on the door to limit outside distractions. The room met the requirements of being approximately 8 ft (2.44 m) by 8 ft (2.44 m) and thus large enough to fit materials, administrator, and participant. The room met the requirements of the study by having a desk, two chairs, and the D-KEFS testing materials.

Virtual Administration Equipment

We conducted videoconference administration of the D-KEFS in two separate, private rooms in the same building with a sign labeled "testing in progress" posted on both doors to limit outside distractions. Both rooms were approximately 8 ft (2.44 m) by 8 ft (2.44 m) and were large enough to fit necessary materials and administrator or participant. Each room met the established requirements of the study and had a desk, a desk chair, and a computer with a 13-inch (330 mm) monitor and 720p front-facing camera. The teleconference computer equipment needed to be capable of consistent and reliable, real-time audiovisual connection and appropriate

resolution and recovery rate to ensure clear communication between the participant and the administrator. The virtual administration utilized Zoom as the videoconference platform (zoom.us, n.d.). The administrator's room had the D-KEFS testing materials and a protocol with the initial standardized conversation to introduce the videoconference administration processes.

Procedure

Following IRB approval (GFU# 2202010), we recruited undergraduate participants via SONA and graduate students using a deidentified google form. SONA is a software commonly used in university and research settings to manage recruitment. Participants signed up for a pre-set session day and time. Participants met the examiner at the specified location at their scheduled time. The examiner asked the participant to read and sign an informed consent form and to complete the demographic information form. The examiner placed participants in either control or experimental groups prior to gathering any information about the participant besides an identification number, and prior to meeting the administrator of the study to limit any potential bias in the grouping process. The examiner placed odd numbered participants in the control group and even numbered participants in the experimental group. The order of test administration was counterbalanced and thus involved rotating the administration order between participants. For both control groups and experimental groups, the examiner administered the first subtest first for the first participants, the second subtest first for the second participants, the third subtest first for the third participants, and the last subtest first for the fourth participants. The examiner then repeated the rotation process and administered the first subtest first for the fifth participants. The examiner rotated the order of administration for both groups similarly throughout the experiment.

Control Group

The in-person administration of the D-KEFS subtests followed standardized administration procedures.

Experimental Group

The participants were assisted to the separate and private room and oriented to the equipment by the administrator. The examiner began virtual administration of the D-KEFS after testing connection quality and documenting the process. The administrator read through the initial conversation protocol to orient the participant to videoconference procedures. The examiner administrated D-KEFS subtests following the standardized process as closely as possible with the restrictions of the videoconference platform. All stimuli were with the administrator and shown to the participant via webcam.

The test administrator had view of both participant and self-view during administration of the subtests to ensure participant could see administrator and testing materials fully. The participant did not have a view of themselves during assessment administration to limit distraction.

Debrief

Participants were thanked for their participation in the study, informed of the study's purpose, and told not to disclose information about the study. Participants received their lab course credit.

Data Analysis

First, we tested correlations of dependent, independent, and potential covariate variables with SPSS to determine significance of various factors including gender, age, years in college, and socioeconomic status. Next, we analyzed data from both control and experimental groups

with six analysis of covariances (ANCOVAs). We considered alternative options including multivariate analysis of covariance for our primary analysis. However, we determined multivariate analysis of covariance would be less effective in detecting differences for the purpose of this experiment while it may be more effective in avoiding false positives. Additionally, we wanted to investigate alternative factors of the sample and their effects on the test results. We included analysis of years in college as a covariate because it was largely correlated with other variables. We decided to not include other factors as covariates because they were not largely correlated and we wanted to reduce degrees of freedom. The overall goal of the study was to discover if type of administration (virtual and in person) had a significant effect on test results.

Chapter 3

Results

Descriptive Statistics

First, we analyzed the data with an independent samples *t*-test to observe differences between the virtual group (V) comprised of participants (n = 18) ages 18–33 years old and the in-person group (IP) comprised of participants (n = 19) ages 18–41 years old. We observed no significant differences between the two groups for age, gender, nor years in college (see Table 2). Although both in-person and virtual groups had undergraduate and graduate participants, the virtual group had 12 undergraduates and six graduates, while the in-person group had 10 undergraduates and nine graduates.

Before conducting the ANCOVA analyses, it was ensured that assumptions were met including multivariate normality and homogeneity of covariance. Additionally, there did not appear to be any missing data or significant outliers.

Table 2

Descriptive Statistics for Sample, Virtual, and In Person

	M	*SD*	Skew	SE Skew	Kurtosis	SE Kurtosis	
Age (years)	22.57	5.79	1.57	0.39	2.17	0.76	
Years in college	3.14	2.50	0.43	0.39	-1.72	0.76	
Gender	1.65	0.48	-0.65	0.39	-1.67	0.76	
Socioeconomic status	2.00	0.33	0.00	0.39	7.37	0.76	
Virtual vs. in person	1.51	0.51	-0.06	0.39	-2.11	0.76	
VFLF	10.81	3.36	0.30	0.39	0.05	0.76	
VFCF	12.32	3.77	0.32	0.39	-0.87	0.76	
VFCS	11.81	3.63	0.17	0.39	-0.73	0.76	
TQ	12.22	2.03	-0.67	0.39	-0.49	0.76	
WC	11.57	1.97	-0.05	0.39	0.25	0.76	
PT	11.89	2.21	-1.16	0.39	1.41	0.76	
	Virtual *M*	*SD*	In Person *M*	*SD*	*t* (35)	*p*	*d*
Age (years)	21.39	4.41	23.68	6.78	-1.21	.12	0.40
Gender	1.67	0.49	1.63	0.50	0.22	.42	0.08
Year in college	2.83	2.36	3.42	2.65	-0.71	.24	0.24
SES	2.00	0.34	2.00	3.33	0.00	.50	0.00
VFLF	10.83	3.22	10.79	3.57	0.04	.48	0.01
VFCF	12.67	3.91	12.00	3.71	0.53	.30	0.17
VFCS	10.56	3.50	13.00	3.42	-2.15	.02	0.71
TQ	12.06	2.01	12.37	2.09	-0.46	.32	0.15
WC	11.33	2.11	11.79	1.84	-0.70	.24	0.23
PT	11.39	2.25	11.39	2.11	-1.37	.09	0.00

Note. VFLF = Verbal Fluency Letter Fluency; VFCF = Verbal Fluency Category Fluency; VFCS = Verbal Fluency Category Switching; TQ = Twenty Question; WC = Word Context; PT = Proverb Test;

YC = Years in College; SES = Socioeconomic Status. *N* = 37. *Cohen's d* value was calculated based on *t*-test for descriptive statistics. Please see η_p^2 in Table 4 for effect sizes of analysis of covariance results.

Primary Analyses

Correlational Analysis

We completed a correlational analysis to determine the effects of several demographic factors of the sample including gender, age, years in college, and socioeconomic status (see Table 3). We observed correlations between the D-KEFS subtests in our sample as expected. Additionally, years in college was positively correlated with Verbal Fluency Letter Fluency (VFLF), Verbal Fluency Category Fluency (VFCF), Verbal Fluency Category Switching (VFCS), WC, and PT, and positively correlated with age at the time of testing. Age appeared to be positively correlated with PT. Socioeconomic Status was positively correlated with VFCF and TQ.

ANCOVAs

We completed 6 one-way ANCOVAs to determine if there were significant differences between virtual and in-person administration groups on each subtest including VFLF, VFCF, and VFCS Total Correct Scaled Scores, TQ Total Weighted Achievement, WC Total Consecutively Correct, and PT Total Achievement Free Inquiry Scaled Scores (see Table 4). We selected years in college as a covariate, as this was hypothesized to be a confounding variable given that it was

Table 3

Correlations Between Dependent Variables and Select Demographic Variables

Variable	1	2	3	4	5	6	7	8	9
1 VFLF									
2 VFCF	.560**								

Variable	1	2	3	4	5	6	7	8	9
3. VFCS	.485**	.618							
4. TQ	-.088	.031	.062						
5. WC	.316*	.199	.245	.365*					
6. PT	.537**	.358*	.552**	.185	.482**				
7. Age	.217	.126	.074	-.015	.147	.318*			
8. Gender	-.059	-.042	.072	.079	.099	.067	.004		
9. YC	.444**	.394**	.383**	-.072	.369*	.416**	.732**	.040	
10. SES	.223	.354*	.115	.328*	.085	.189	-.072**	.000	-.067

Note. VFLF = Verbal Fluency Letter Fluency; VFCF = Verbal Fluency Category Fluency; VFCS = Verbal Fluency Category Switching; TQ = Twenty Question; WC = Word Context; PT = Proverb Test; YC = Years in College; SES = Socioeconomic Status. **correlation is significant at the 0.01 level, *correlation is significant at the 0.05 level. $N = 37$.

positively correlated with the majority of the D-KEFS verbal subtests. We also considered adding age, gender, and socioeconomic status as covariates. However, we decided to use years in college as the only covariate because we preferred to limit degrees of freedom for the small sample size. Years in college was a significant factor on VFLF, VFCF, VFCS, WC, and PT with moderate to large effect sizes. Years in college did not appear to be a significant variable for TQ. We observed no significant differences between administration types on VFLF, VFCF, VFCS, TQ, WC, and PT after controlling for years; the largest effect size after controlling for years was $\eta_p^2 = 0.10$.

Table 4

ANCOVAs Virtual vs In Person with Covariate Years in College

Variable	*MS*	*F*(1, 34)	*p*	η_p^2
VFLF				
Years	81.42	8.54	.01	0.20
Administration	1.46	0.15	.70	0.00
VFCF				
Years	84.88	6.82	.01	0.17
Administration	9.68	0.78	.38	0.02

Variable	*MS*	*F*(1, 34)	*p*	η_p^2
VFCS				
Years	56.39	5.30	.03	0.14
Administration	42.03	3.95	.06	0.10
TQ				
Years	0.99	0.23	.64	0.01
Administration	1.13	0.26	.61	0.01
WC				
Years	17.77	5.06	.03	0.13
Administration	0.76	0.22	.64	0.01
PT				
Years	26.97	6.56	.02	0.16
Administration	5.46	1.33	.26	0.04

Note. VFLF = Verbal Fluency Letter Fluency; VFCF = Verbal Fluency Category Fluency; VFCS = Verbal Fluency Category Switching; TQ = Twenty Question; WC = Word Context; PT = Proverb Test; YC = Years in College; SES = Socioeconomic Status. *N* = 37.

Chapter 4

Discussion

Discussion of the Sample

All participants were college students from a private university. The majority of the sample were undergraduates in various majors while a minority were in a graduate program. The average participant was in their third year of college, female, single, and 22.57 years old. The entire sample denied previous experience with the D-KEFS. The sample was small and we finished after completing 19 control participants and 18 experimental participants.

Summary of Hypothesis and Results

This study examined the D-KEFS Verbal Fluency, Twenty Question, Word Context, and Proverb Tests when administered via videoconference versus in person. The goal was to gather evidence to support or refute the use of the D-KEFS current norms when administered via videoconference. The author expected to see the null hypothesis in which no significant differences between videoconference and in-person administrations would be found, thus

supporting the use of the current normative data for videoconference use. As expected, we found no significant differences between videoconference and in-person administrations of the D-KEFS verbal tests after analyzing the data. We also looked at the covariate years in college. Significant differences were found with the covariate years in college on subtests LF, CF, CS, WC, and PT. There are many possible speculative explanations to account for these differences. However, it is assumed that the small sample size and differences in age account for a large portion of these findings. Overall, this study serves as a small pilot study implicating no significant difference in scores between virtual and in person administration types. Our conclusions implicate support for videoconference administration of the D-KEFS verbal tests and it may be useful to further investigate whether the D-KEFS current normative data is appropriate to use when administered via videoconference. This finding is consistent with the established literature suggesting neuropsychological assessments, especially ones with mainly verbal components, may be affected minimally when administered via videoconference compared to in person (Brearly et al., 2017).

Limitations and Recommendations

Studying the college population had advantages and disadvantages. Firstly, we chose the college population because of convenience, access, and time limitations. Additionally, we hypothesized that if the college sample, who may be more familiar with using videoconference capabilities compared to other potential samples, displayed significant differences between administration types, we would expect that other groups with less familiarity in using this platform may also experience difficulties when being tested via videoconference. As far as disadvantages, we predicted that this sample is less likely to display difficulties using the videoconference platform and specific issues that may arise when testing other groups via

videoconference may have been missed in this study. We suggest that future studies include a more diverse sample of the population to better generalize results. Additionally, a larger sample would increase power of future studies.

We discovered a few notable observations during the experiment. Despite not displaying true significant differences between V and IP administrations, Verbal Fluency subtest CS did display results that were close to significant (p = .06, d = 0.10) while the magnitude of change was similar to what was found by Brearly et al. (2017). Other Verbal Fluency subtests including LF and CF were not as close. CS is a subtest that demands individuals use more complex abilities than the counterpart Verbal Fluency subtests. It was unusual that this was the closest subtest to being significant as it does not require many visual components. Although it is based on speculation, one hypothesis is that the stress experienced by the examinee may differ with the presence of the examiner physically in the room. The examinee's stress may decrease when the examiner is in a separate room and seen virtually. It may be useful to investigate CS further in a larger sample to see how the results may change.

Additionally, we observed that the Twenty Questions subtest might rely on and require an accurate depiction of color if the examinee chooses to use color to help identify the correct items. Consequently, the examinee's computer and the examiner's camera must be calibrated to show an accurate depiction of color to avoid complications. We recommend that examiners set the examinee's screen brightness to a comfortable level and that the examiner disable the computer's blue-light filter.

Lastly, providers may consider using a few different models for telehealth neuropsychological assessment given the constraints and preferences of the population they serve and available resources. Brearly et al. (2017) discusses different possible strategies and

decisions for implementing telehealth neuropsychological assessment successfully. For instance, examinees may be at a remote location associated with the organization (such as an offsite hospital or clinic closer to the examinee's residence), at the same location as the examiner but in a separate room to limit contact or exposure, or fully remote at home. Additionally, some models may have an assistant in the same location as the examinee to help with technology issues that may arise during the process and to help manage any test stimuli on the examinee's end for test security purposes. Formats may include use of a telephone for some specific tests that do not require visual stimuli, computer, tablet, or special software designed for telehealth assessment.

Each format and strategy of telehealth comes with certain benefits and drawbacks. We recommend that providers consider the many different factors prior to engaging in the assessment. For the purpose of this study, we utilized a model in which the examinee was on site in a separate room without an assistant. The model limited in-person contact during the COVID-19 pandemic, the examiner was able to walk over to the examinee office to troubleshoot any technical issues if they occurred, and since we had the examinee use our devices for the assessment, there was less variability for test security, quality of hardware, and connectivity than there would have been if examinees used their own devices from home. This model does require examinees to travel to the same location as the examiner. For the purposes of this study, the model was effective.

Conclusions

Continuing to study neuropsychological tests administered via videoconference is important as this approach may decrease disparities of neuropsychological services in certain areas of the world that have limited access to the service in person. With the COVID-19 pandemic, many medical and psychological services were converted to being provided via

telehealth to increase access to services and decrease potential of exposure to others during the pandemic. This study showcases the importance of investigating the appropriateness of neuropsychological tests current normative data, rather than simply assuming tests are appropriate for videoconference administration. It appears from the literature that certain neuropsychological tests may be more suitable for this format while other neuropsychological tests may need modification, separate normative data for testing via videoconference, and further investigation of test-specific concerns. While this was a small pilot study with limitations, this study provides preliminary evidence to support videoconference administration of the verbal subtests of the D-KEFS. At this time, it is recommended that researchers continue to study the verbal subtests of the D-KEFS on a larger sample to better determine the appropriateness of administering the D-KEFS verbal tests via videoconference while continuing to use current normative data. However, these data provide preliminary support for using standard norms for videoconference administration of the selected D-KEF verbal tests as the magnitude of differences between live and videoconference assessment was very small for all scales examined.

References

American Psychological Association. (2013). *Guidelines for the Practice of Telepsychology*. Retrieved July 11, 2020, from https://www.apa.org/practice/guidelines/telepsychology

Barak, A., Hen, L., Boniel-Nissim, M., & Shapira, N. (2008). A comprehensive review and a meta-analysis of the effectiveness of internet-based psychotherapeutic interventions. *Journal of Technology in Human Services*, *26*(2–4), 109–160. https://doi.org/10.1080/15228830802094429

Barton, C., Morris, R., Rothlind, J., & Yaffe, K. (2011). Video-telemedicine in a memory disorders clinic: Evaluation and management of rural elders with cognitive impairment. *Telemedicine Journal and E-Health: The Official Journal of the American Telemedicine Association*, *17*(10), 789–793. https://doi.org/10.1089/tmj.2011.0083

Brearly, T. W., Shura, R. D., Martindale, S. L., Lazowski, R. A., Luxton, D. D., Shenal, B. V., & Rowland, J. A. (2017). Neuropsychological test administration by videoconference: A systematic review and meta-analysis. *Neuropsychology Review*, *27*(2), 174–186. Scopus. https://doi.org/10.1007/s11065-017-9349-1

Cullum, C. M., Weiner, M. F., Gehrmann, H. R., & Hynan, L. S. (2006). Feasibility of Telecognitive Assessment in Dementia. *Assessment*, *13*(4), 385–390. https://doi.org/10.1177/1073191106289065

Delis, D. C., Kaplan, E., & Kramer, J. H. (2001). *Delis-Kaplan Executive Function System (D-KEFS)*. Pearson.

Galusha-Glasscock, J. M., Horton, D. K., Weiner, M. F., & Cullum, C. M. (2016). Video teleconference administration of the repeatable battery for the assessment of

neuropsychological status. *Archives of Clinical Neuropsychology*, *31*(1), 8–11. psyh. https://doi.org/10.1093/arclin/acv058

Herbert, L. E., Weuve, J., Scherr, P. A., & Evans, D. A. (2013). Alzheimer disease in the United States (2010-2050) estimated using the 2010 census. *Neurology*, *80*(19), 1778-1783. https://doi.org/10.1212/WNL.0b013e31828726f5

Lezak, M. D., Howieson, D. B., Bigler, E. D., & Tranel, D. (2012). *Neuropsychological assessment* (5th ed.). Oxford University Press.

Mayr, S., Erdfelder, E., Buchner, A., & Faul, F. (2007). A short tutorial of GPower. *Tutorials in Quantitative Methods for Psychology*, *3*(2), 51-59.

Parikh, M., Grosch, M. C., Graham, L. L., Hynan, L. S., Weiner, M., Shore, J. H., & Cullum, C. M. (2013). Consumer acceptability of brief videoconference-based neuropsychological assessment in older individuals with and without cognitive impairment. *The Clinical Neuropsychologist*, *27*(5), 808–817. https://doi.org/10.1080/13854046.2013.791723

Strong, C.-A. H., Tiesma, D., & Donders, J. (2010). Criterion validity of the Delis-Kaplan Executive Function System (D-KEFS) fluency subtests after traumatic brain injury. *Journal of the International Neuropsychological Society*, *17*(2), 230–237.

Suchy, Y. (2016). *Executive functioning: A comprehensive guide for clinical practice*. Oxford University Press.

Wadsworth, H. E., Dhima, K., Womack, K. B., Hart, J., Weiner, M. F., Hynan, L. S., & Cullum, C. M. (2018). Validity of teleneuropsychological assessment in older patients with cognitive disorders. *Archives of Clinical Neuropsychology*, *33*(8), 1040–1045. Scopus. https://doi.org/10.1093/arclin/acx140

Wadsworth, H. E., Galusha-Glasscock, J. M., Womack, K. B., Quiceno, M., Weiner, M. F., Hynan, L. S., Shore, J., & Cullum, C. M. (2016). Remote neuropsychological assessment in rural American Indians with and without cognitive impairment. *Archives of Clinical Neuropsychology*: *The Official Journal of the National Academy of Neuropsychologists*, *31*(5), 420–425. https://doi.org/10.1093/arclin/acw030

Zoom.us (n.d.) retrieved at zoom.us

Appendix A

Informed Consent

Video Teleconference Administration
of the Delis-Kaplan Executive Function System

I authorize Zachary Stine of the Graduate School of Clinical Psychology, George Fox University, and/or any designated research assistants to gather information from me on the topic of comparing normative data for Delis-Kaplan Executive Function System administered via videoconference or face to face administration.

I understand that the general purposes of the research are comparing normative data for Delis-Kaplan Executive Function System administered via videoconference and in-person administration, that I will be asked to complete a demographics questionnaire and complete Delis-Kaplan Executive Function System subtests via in-person or videoconference administration, and that the approximate total time of my involvement will be one hour.

I am aware that I may choose not to answer any questions that I find uncomfortable.

I understand that my participation is voluntary and that I may refuse to participate or discontinue my participation at any time without penalty or loss of benefits to which I am otherwise entitled.

I understand that if, after my participation, I experience any discomfort or have questions about the research or my rights as a participant, I can contact Zachary Stine, M.A. (zstine18@georgefox.edu) or Glena Andrews, Ph.D. faculty supervisor (gandrews@georgefox.edu). Confidentiality of research results will be maintained by the researcher. My individual results will not be released without my written consent.

The potential benefit of the research study is help by expanding the research in order to increase access to important neuropsychological resources remotely. The potential risk of the research study is experiencing fatigue after potentially challenging questions.

I have read the information above and agree to be a participant in the study, Video Teleconference Administration of the Delis-Kaplan Executive Function System.

_____ _____

Signature of Participant Date

I am over the age of 18. YES NO

I have read the information above and agree to be a participant in the study, (enter title). YES NO

Questions and comments may be addressed to Glena Andrews, Ph.D., Graduate School of Clinical Psychology, George Fox University, Newberg, OR 97132.

Appendix B

Invitation to Participate

Hello, my name is Zac. I am a doctoral student at George Fox University in the Graduate School of Clinical Psychology. I am conducting research on telehealth neuropsychology, and I am inviting you to participate.

Participation in this research includes completing a brief demographics questionnaire and completing Delis-Kaplan Executive Function System subtests via face-to-face or videoconference administration. The approximate total time of my involvement will be one hour.

Please review the attached consent form and instructions. If you have any questions or would like to participate in the research, I can be reached at zstine18@georgefox.edu. Thank you for your time.

Sincerely,

Zachary Stine, MA

Appendix C

Initial Conversation

Introduce self and attending

First introduce yourself/your role in the clinic and make a brief statement about what will happen in the event you are disconnected. For example:

"**Hello! I am** xxxxx**, one of the PsyD Students leading the experiment. Can you hear and see me okay? Before we get started, I just have some things to go over with you about your visit, as some things will be different via Teleconference than if we were in person together.**

If disconnected…

First of all, if we are disconnected at any point during the evaluation, (if in separate rooms) I will walk over to your room and we will try to get reconnected (if they are doing it with their own computer and in their own room) we will call you back and get ourselves reconnected. Just to confirm your telephone number is xxx-xxx-xxxx (read aloud from the contact information attached to the Demographics questionnaire)"

Acknowledge surroundings (if done in separate location)

Then make a quick statement about where you are and your surroundings, as well as asking the participant about theirs. Some sample language:

"**Although I am calling from a different location, I want to assure you that I am alone in my room. Is anyone with you on your side of the call?**

Limits of confidentiality

Discuss confidentiality/privacy (i.e., everything is private except for suicide/homicide risk and child/older adult/dependent adult abuse, etc.), as well as telehealth specific things. For example:

"**Since we are using the internet/electronic means of seeing each other there are some things I would like you to be aware of in terms of your privacy. We are using a HIPAA compliant, end-to-end encrypted, program for the experiment, which means that we are doing our best to keep your information private and secure. However, even with these precautions, we cannot guarantee that your information will remain private because of things like viruses/malware or if someone were to walk into your room. We are doing everything in our power to keep your information confidential and secure and we have posted a note on your door to reduce the possibility of interruptions. Please let us know if anything changes on your end and we will let you know about our end, okay?**

If someone walks in…

Although it is unlikely to happen, if someone walks into the room while we are talking, just raise your hand (provide example). This will let us know to stop talking until you let us know that the person has left.

This is also a good way of letting us know if you have something to say, as sometimes this method of communication can make it difficult to know when someone is trying to jump into the conversation. Please let us know if you have any questions."

No recording/ notes/ cellphone/ assistance

Briefly discuss recording:

"**Although we may be taking notes during the experiment for your report, your appointment will not be recorded today. We also ask that you do not record us, including any screenshots/captures or using your cellphone to otherwise take a picture/record the visit.**

It is also important that you do not use any calculators, your cellphone, or take notes on the tests that you will be taking as part of the evaluation, due to test security restrictions. We want to get the best and most accurate representation of what you can do, so please don't take notes or look up any of the answers"

Right to withdraw consent

Also make sure that participant know that **consent can be withdrawn at any point** during the evaluation. For example:

"**It is also important that you know that you can withdraw your consent at any point during this evaluation. Keep us posted on how you are feeling, and we will make any changes in our power to help you feel more comfortable, but it is completely okay if you decide to stop at any point.**"

Any Questions?

Ask if they have any questions about the experiment/what to expect/limitations and answer any as they come up. Then ask if the participant gives you their **verbal consent** for the experiment and make sure to physically write down "**Mr./Ms./Mx./Dr. XX XXX provided verbal consent for the evaluation on xx/xx/2021**" on your experiment sheet and initial your name.

Also make sure to let the participant know to tell the administrator if they cannot see or hear the test stimuli!

Appendix D

Demographic Questionnaire and Contact in Case of Disconnect

1. Phone number (in case disconnected) _____
2. Age _____
3. Gender _____
4. Marital Status _____
5. Ethnicity _____
6. Disability (put NA if none) _____
7. Major _____
8. Year in college _____
9. History of traumatic brain injury, concussions, or whiplash _____
    a. Date of most recent _____
    b. Was there loss of consciousness? _____
10. Are you currently taking medications? _____
11. Socioeconomic status (circle one) (Lower / Middle / Upper)
12. How would you classify your physical health? (Excellent / Good / Fair / Poor)
13. How would you classify your mental health? (Excellent / Good / Fair / Poor)
14. Do you believe your memory is as good as others your age? (YES / NO)

Appendix E

Counterbalancing

Participant	Virtual or in-person	Test administration
1	Virtual	(1) Verbal Fluency, 20?, WC, Proverbs
2	In-Person	Verbal Fluency, 20?, WC, Proverbs
3	V	(2) 20?, WC, Prov, VF
4	I	20?, WC, Prov, VF
5	V	(3) WC, Prov, VF, 20?
6	I	WC, Prov, VF, 20?
7	V	(4) Prov, VF, 20?, WC,
8	I	Prov, VF, 20?, WC,
9	V	1
10	I	1
11	V	2
12	I	2
13	V	3
14	I	3
15	V	4
16	I	4
17	V	1
18	I	1
19	V	2
20	I	2
21	V	3
22	I	3
23	V	4
24	I	4
25	V	1
26	I	1
27	V	2

DKEFS

Tests

Verbal Fluency (VC)
20 questions (20?)
Word Context (WC)
Proverbs (Prov)

28	I	2
29	V	3
30	I	3
31	V	4
32	I	4
33	V	1
34	I	1
35	V	2
36	I	2
37	V	3
38	I	3
39	V	4
40	I	4
41	V	1
42	I	1
43	V	2
44	I	2
45	V	3
46	I	3
47	V	4
48	I	4
49	V	1
50	I	1
51	V	2
52	I	2
53	V	3
54	I	3
55	V	4
56	I	4
57	V	1
58	I	1
59	V	2
60	I	2
61	V	3
62	I	3

63	V	4
64	I	4
65	V	1
66	I	1
67	V	2
68	I	2
69	V	3
70	I	3