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Tereza Stillerova, Jacki Liddle, Louise Gustafsson, Robyn Lamont ...+1 more authors

**Institutions:** University of Queensland

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**Could everyday technology improve access to assessments? A pilot study on the feasibility of screening cognition in people with Parkinson's disease using the Montreal Cognitive Assessment via Internet videoconferencing**

**Abstract**

**Background:** The distances and distribution of people, and pressures on the health system in Australia mean that access to services for people living with a neurodegenerative condition may be inadequate. Telehealth may offer ways to provide timely and efficient monitoring and support. People with Parkinson's disease require regular screening of their symptoms and needs, but may have limited access to health professionals. Cognitive changes can impact on occupational performance, thus timely monitoring of cognition is important for informing occupational therapy interventions. **Aim:** To evaluate the feasibility of screening cognition in people with Parkinson's disease using available technology in their homes. **Method:** Eleven participants with Parkinson's disease completed the Montreal Cognitive Assessment face-to-face and then via videoconferencing one week later using the technology available at their home. Participants and assessors provided feedback on their experience. **Results:** All Montreal Cognitive Assessment items could be completed over videoconference (e.g. Skype), with a median difference of 2 (IQR 1-2.5) between face-to-face and videoconference scores. Higher scores were not favoured by either mode of assessment. Three participants received inconsistent cognitive classifications between the two assessment methods. Participant and assessor feedback indicated reported benefits including convenience as well as technological limitations. **Conclusions:** Given the pressures on the health system and the apparent acceptability to consumers, occupational therapists may explore the utility of readily accessible technology to enable timely monitoring of cognition for people with

Parkinson's disease. Further research is needed to develop and demonstrate the reliability and validity of this approach.

### **Keywords**

Remote Consultation, Symptom Assessment, Telemedicine

### **Introduction**

In a context where health systems are struggling to meet the demands of a growing and ageing population, and people living with health conditions are strongly preferring to have their healthcare needs met in their own communities, telehealth options are becoming increasingly relevant (Russell, Gillespie, Hartley, Theodoros, Hill, Gray, 2015). In their position statement regarding telehealth, the World Federation of Occupational Therapists have reported "*Telehealth can be an appropriate service delivery model for occupational therapy, and may improve access to occupational therapy services*" (World Federation of Occupational Therapists, 2014, p. 3).

People living with a condition where fluctuations and deterioration are characteristic, require regular screening of their symptomatology and needs (Little, Wicks, Vaughan, & Pentland, 2013). Parkinson's disease (PD) is the second most common neurodegenerative disease (Foster, Bedekar, & Tickle-Degnen, 2014) and promoting continued quality of life and participation requires regular monitoring of symptoms and needs (Little, Wicks, Vaughan, & Pentland, 2013). People living with PD have difficulty with safe mobility and subsequently accessing regular monitoring and support (Abdolahi, Scoglio, Killoran, Dorsey, & Biglan, 2013). It is difficult

particularly in regional and remote Australia, where the prevalence of PD is 20% higher than in metropolitan areas, yet the relative density of relevant health professionals is significantly lower (Parkinson's Australia Inc, 2010). Access to symptom monitoring for people with PD is affected by accessibility of health services and waiting lists (Parkinson's Australia Inc., 2010). As the prevalence of PD rises, it is expected to increase the burden on health resources, such as occupational therapists, which may adversely affect a client's access to monitoring and intervention (Dorsey et al., 2007). Remote monitoring has been investigated to address barriers to regular monitoring including a client's geographical location and inequalities in dispersion of health professionals in rural locations (Parkinson's Australia Inc., 2010).

Research has found a high prevalence of cognitive dysfunction in early PD, with routine screening of cognition essential for identification and management as the disease progresses (Kandiah et al., 2014). As cognition plays an important role in instrumental activities of daily living, changes in cognition can have a significant negative influence on occupational performance and result in decreased quality of life and independence (Koerts, Tucha, Leenders, van Beilen, Brouwer, & Tucha, 2011; Pirogovsky, Martinez-Hannon, Schiehser, Lessig, Song, Litvan & Filoteo, 2013). Thus, monitoring cognition is important for informing occupational therapy interventions with this population, which target optimising functional performance and engagement in activities of daily living and life roles (Sturkenboom, et al., 2013).

The Montreal Cognitive Assessment (MoCA) is becoming an increasingly popular cognitive screen for PD and has been found to be an accurate screening tool for all levels of cognition in this population (Dalrymple-Alford et al., 2010). The MOCA

was created as a rapid screening instrument for mild cognitive impairment, and takes approximately 10 minutes to administer. It assesses eight different cognitive domains including attention and concentration, calculations, conceptual thinking, executive functions, language, memory, orientation and visuoconstructional skills (Nasreddine et al., 2005).

A recent study has investigated the feasibility of administering the MoCA remotely to people with PD. The study concluded that it was feasible, with minor complications common to technology including corrupted imaging for participants with low connection speeds, and delayed sound (Abdollahi, Bull, Darwin, Venkataraman, Grana, Dorsey, & Biglan, 2014). However, the study design excluded people with PD who did not have printers or high-speed Internet connection, and the remote follow-up was completed 7 months after the face-to-face baseline assessment. To the authors' knowledge, to date no research has investigated the use of free to download videoconferencing software to remotely assess a person with PD's cognition using the MoCA. The feasibility of this concept needs to be determined.

The purpose of feasibility studies in occupational therapy research is to investigate the process of developing and implementing an intervention, and a participant's response to the intervention. A feasibility study's scope is to evaluate whether an intervention shows promise; it is the initial phase of intervention development. Feasibility studies are regarded in the literature as important in accelerating the development of effective occupational therapy interventions. Attributes of a quality feasibility study include opportunity for evaluation and refinement of recruitment, data collection procedures and outcome measures, the intervention and study procedures, resources and

management of the study implementation, and participant responses to the intervention (Orsmond & Cohn, 2015). The purpose of this study was to evaluate the feasibility of remotely screening cognition in people with PD using readily available and free to download technology in their own home. Feasibility was also investigated in terms of the assessors' and participants' experiences of using Internet videoconferencing to assess cognition.

## **Method**

### **Participants.**

This exploratory, feasibility study was approved by the Behavioural and Social Sciences Ethical Review Committee, the University of Queensland (#2013000913) and the UnitingCare Health Human Research Ethics Committee (#1312). The inclusion criteria were: diagnosis of PD, access to an electronic device with Internet and a webcam, and the availability for two appointments one week apart. Participants used the electronic devices (computer, smartphone, tablet) that they already possessed at home. All participants provided informed consent and there was no remuneration other than covering parking costs.

### **Data collection.**

A demographic questionnaire collected information about the participant's gender, age, postcode and PD diagnosis. The MoCA has three different versions that can be used to negate the effects of memorisation bias through repeated use. To prevent learning and recall effects, this study used version 2 for the face-to-face assessment,

and version 3 for the videoconferencing assessment. In the PD population, the MoCA test–retest correlation coefficient has been shown to be 0.79, and the inter-rater correlation coefficient as 0.81 (Gill, Freshman, Blender, & Ravina, 2008). When using the MoCA as a screening tool, a score of 26 or above out of 30 is considered representative of normal cognition, with a standard deviation of 2.2 in the normal population (Nasreddine, 2015). Feedback forms were used to gather information about the participant's experiences of completing the MoCA over videoconferencing, and consisted of open and closed questions targeting perceived advantages and concerns. The participant chose whether the feedback form was administered via interview or by personally filling it in (Appendix I).

Assessments were conducted by four assessors, each with a tertiary level health professional education. Participants completed the MoCA on two occasions, one week apart, with the same assessor. The first appointment was conducted face-to-face and included completion of the demographic questionnaire and the MoCA version 2. At the end of the appointment, participants were given a sealed envelope containing a paper copy of the first three items of the MoCA version 3, as these items require the participant to physically draw on the assessment. The envelope also contained a feedback form and a return envelope. Participants were asked not to open the envelope until instructed by the assessor during the second appointment.

The second appointment was conducted via videoconference with the participant in their home and the assessor in a remote location, for example in a clinic room, connecting with the free to download videoconferencing software of Skype or Google+ Hangouts. Participants were asked to open the envelope given to them in the prior session, complete the first three MoCA items and hold up their written responses

to the webcam for the assessor to see and, if possible, score. The rest of the assessment was then completed. Participants were asked to complete the feedback form and then send it in conjunction with their written MoCA responses to the assessor using the return envelope. Assessors were asked to record their experiences of the videoconference assessment after each one was completed. The first and second assessments were conducted at approximately the same time since dopaminergic medication to keep symptoms as consistent as possible between assessments.

### **Data analysis.**

Hypothesis testing was not conducted as this was a feasibility study. Sample demographics were reported using descriptive statistics. The median and range was calculated to explore differences in scores between face-to-face and videoconference assessments. Inductive content analysis was used to organise the open response data from assessor and participant feedback (Elo & Kyngäs, 2008). An individual researcher (TS) identified content categories that arose from the data, and then classified data as belonging or not belonging to a particular category. A second researcher (JL) independently checked the categorisation.

### **Results**

Eleven participants with a median age of 69.0 years (IQR 57.0-76.0) were included in this study. The participants were seven men and four women with PD living in Queensland, Australia. The median number of years since diagnosis was three years (IQR 2.5-9.5) and the median age of PD diagnosis was 59.0 years (IQR 54.0-71.5). To complete the videoconferencing assessment, ten participants used Skype, and one



participant used Google+ Hangouts. Nine participants used a computer, and two participants used a Smartphone or Tablet.

There were no missing data; all items could be completed using videoconference. The overall scores for ten participants changed marginally between the two assessments. Higher scores were not favoured by either method of assessment with five participants scoring higher and five scoring lower in the videoconference assessment. The median difference in MoCA scores between videoconferencing and face-to-face assessment was 2.0 (IQR 1.0-2.5) out of a possible 30 points. The MoCA item “delayed recall” resulted in different scores for eight out of the 11 participants and “serial sevens” resulted in different scores for five out of the 11 participants. Two participants changed from a screening classification of impaired to normal cognition in the videoconferencing assessment, while one participant moved from the normal to impaired cognition threshold for the videoconferencing assessment. Table 1 reports the total MoCA scores and contextual information for face-to-face and videoconference assessments for each participant.

Insert table 1 here

Every participant indicated a positive experience completing the MoCA over videoconference. Table 2 describes the content categories identified through content analysis of participant feedback. The most common feedback was convenience, especially for participants living away from major health centres. Despite reporting positive experiences for themselves, some participants also reported concerns for others who may not experience the same ease of use.

Insert table 2 here

Despite the two limitations (described in Table 3) that were highlighted through the content analysis of assessor feedback, all four assessors reported that each item of the MoCA could be successfully completed.

Insert table 3 here

## **Discussion**

The context of this feasibility study was to determine whether a readily available option that does not require specialised technology could be utilised by clients with PD to remotely monitor their cognition. Clinically, this could be used by occupational therapists to identify, monitor and inform interventions relating to cognitive dysfunction.

Overall the results from this study suggest that videoconferencing may be a viable option to screen cognition for people with PD. An equal number of participants scored better and worse during the videoconferencing assessment compared to the face-to-face assessment, suggesting that neither method is biased towards higher scores. Practice effects were prevented through using alternate versions of the MoCA during face-to-face and videoconference assessments (Costa et al., 2012).

The differences in scores suggested that if this mode was used clinically for screening, three out of 11 clients could have potentially been incorrectly classified as being within the normal or impaired screening threshold. However, it is important to consider that fluctuations in a person's cognition are likely, and thus differences in MoCA scores could be attributed to this, instead of a limitation of the videoconferencing method to conduct the assessment. Many factors impact on PD

symptoms, such as general health, psychosocial factors and co-morbidities (Mosley, Romaine, & Samii, 2009). Additionally, contextual issues may impact scores. As described in Table 1, the score of participant 1 improved from the face-to-face assessment where she appeared distressed after becoming lost attempting to find the clinic, to the videoconference assessment when she was at home and appeared more comfortable. Conversely, one participant appeared to have a less conducive context for the home assessment. Participant 9 was asleep when the assessor videoconference called her and appeared distracted by noise at her home, potentially resulting in the slightly lower score on the videoconference assessment. Table 1 demonstrated that two participants described themselves as “Very Unfamiliar”, and another participant told the assessor he felt anxious about using Skype. The high prevalence of anxiety in people with Parkinson's disease should be noted (Dissanavaka et al., 2010). On completion of the assessment, these three participants rated their experience as “Good”, suggesting lack of experience or feeling concerned about use may not preclude people from having a positive experience with support. Asking about and noting the contextual situation (for example having just woken or having noise or distractions) is also recommended.

The results from this study are consistent with the results of the study conducted by Abdolahi and colleagues (2014) who also reported that every item in the MoCA could be completed remotely for all participants, and that all participants expressed a positive experience with completing the MoCA remotely. The participants predominant feedback was also consistent between studies, with the aforementioned study also reporting acceptability related to convenience factors (including reduced burden on caregivers and less time commuting and waiting in offices). Similarly, they

also reported minor technological issues that did not prove contraindicative to the feasibility of remotely administering the MoCA to people with PD.

Limitations of this study that need to be taken into consideration includes the ability for participants to perform artificially better on the screen through rehearsal or assistance. Protocols such as asking the client to open the envelope in front of the webcam to verify it was sealed, and explaining the importance of clients completing the assessment independently may be small measures against this limitation.

Alternatively, another study prevented this limitation by emailing the sections of the MoCA requiring physical drawing to the participant immediately prior to the videoconference assessment commencing and asking them to print it (Abdolahi, Bull, Darwin, Venkataraman, Grana, Dorsey, & Biglan, 2014). However, this would exclude participants who do not own a printer. A technological solution such as using touchscreen devices to deliver the item and record responses may assist in future. The MoCA has recently been released as a tablet application, which would support delivering of content only at the time of assessment (Nasreddine, 2015). Other technology (for example eHAB) is also developing more secure and low cost ways of sharing screens and recording and scoring responses (Russell, Hoffmann, Nelson, Thompson, & Vincent, 2013). These developers use software or applications rather than requiring specialised hardware and this may make the use of these options with the clients' own hardware more cost effective and feasible in the future.

From an occupational therapy perspective, it is important to note that screening tests of cognition, such as the MoCA, have limitations in ecological validity as an indicator of occupational performance (Koerts, van Beilen, Leenders, Brouwer, Tucha, &

Tucha, 2012). Research has found that global cognition does not significantly correlate with performance on functional measures, and some functional skills may not be predicted based on global cognitive functioning (Pirogovsky, Martinez-Hannon, Schiehser, Lessig, Song, Litvan & Filoteo, 2013). Furthermore the results from subjective and objective assessments of executive function in PD are not reflective of one another. Thus the problems in executive function experienced in daily life by people with PD may not be reflected by objective cognitive measures (Koerts, van Beilen, Leenders, Brouwer, Tucha, & Tucha, 2012; Koerts, Tucha, Leenders, van Beilen, Brouwer, & Tucha, 2011). However, it has been concluded that objective and subjective assessments contribute information in a different way, and therefore a multidimensional approach including different sources of information is most appropriate when assessing different aspects of cognition (Hirsch & Röhrle, 2011; Koerts, Tucha, Leenders, van Beilen, Brouwer, & Tucha, 2011).

During the evaluation process, occupational therapists investigate cognition and occupational performance using multiple perspectives and methods. Within the occupational therapy process, cognitive screening tools, including the MoCA are used to inform an initial overview of the client's strengths and weaknesses. Once cognitive performance deficits have been established, performance-based assessments can be used to identify occupational performance concerns (Giles et al., 2013).

Thus, the method of cognitive assessment described in this study does not represent the whole occupational therapy information gathering process, rather an important step. Furthermore, the use of an objective measure such as the MoCA plays an important role in research and in clinical occupational therapy practice as an outcome measure to facilitate improvement through monitoring progress and improving

accountability of services (Samsonraj, Loughran, & Secker, 2012). Objective assessment scores are also required to monitor cognition (and identify changes) in an objective manner, especially in occupational therapy research. Observational assessments of performance, commonly used by occupational therapists, may also be possible using this technology however future research would need to explore it's feasibility and utility.

The privacy and security of free to download videoconferencing software must be considered by occupational therapists to protect client confidentiality, as per the Occupational Therapists Code of Ethics (World Federation of Occupational Therapists, 2005). In their position statement regarding telehealth, the World Federation of Occupational Therapists asserts "*therapists shall inform clients about the nature of the occupational therapy services to be provided, risks, benefits, alternate treatment options, and any limits to protection of privacy, security, and confidentiality of personal health information associated with the technology*" (World Federation of Occupational Therapists, 2014, p. 2). When providing web-based services, the role of telehealth should ideally be evidence-based and assess safety, security and privacy for the intended videoconferencing platform (Armfield, Gray, & Smith, 2012). These readily accessible videoconferencing technologies were regarded as acceptable in the current study as Skype consultations were regarded as acceptable by Medicare, who define technical requirements for a video consultation as capable of providing sufficient video quality for the clinical service being provided and sufficiently secure to ensure normal privacy requirements for health information are met (Department of Health, 2012). Furthermore, it contributes to a growing body of

research exploring the feasibility of Skype in healthcare (Armfield, Bradford, & Bradford, 2015).

## **Conclusion**

This feasibility study has shown promising results, and provided an important step in broadening occupational therapy approaches to assessment by using readily available, free to download videoconferencing software, which may increase availability and accessibility of assessment. This pilot used Skype and Google+ Hangouts to remotely screen cognition in people with PD, with some promising preliminary findings. It should be pursued further due to consumer interest, and its potential to facilitate more regular and convenient cognitive monitoring in this population for both clinical and research purposes. Further research should confirm the reliability and validity of remote cognitive assessment using the MoCA with a larger sample of people with PD, noting particularly contextual issues and any technological difficulties encountered. Research exploring practical or technological solutions to the issues encountered by assessors in this study is also required. Further research should also investigate the feasibility of remotely completing functional assessments, in-home observation and interview at a distance using readily available technology with people with PD, to develop a contextual understanding of the impact of a person's cognitive symptoms on occupational performance. Clinicians need to consider telehealth in order to provide services to people requiring ongoing monitoring in their home environments. Everyday technology may provide a pragmatic approach, if all concerns are addressed.

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**Appendix I: Participant Feedback Form**

**1. How familiar are you with using Skype?**

<b>Very familiar-</b> I use Skype often	<b>Quite familiar-</b> I am comfortable with using Skype	<b>Neither familiar nor unfamiliar</b>	<b>Quite unfamiliar-</b> I am not comfortable using Skype	<b>Very unfamiliar-</b> I have never used Skype before.
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**2. What was your experience of using Skype for monitoring Parkinson's symptoms?**

<b>Excellent</b>	<b>Good</b>	<b>Neither good nor bad</b>	<b>Bad</b>	<b>Terrible</b>
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**3. Do you think monitoring the symptoms in this way accurately reflects your current functioning? Yes/No**

**Can you explain why?**

**4. Do you have any concerns about the use of Skype for monitoring Parkinson's disease symptoms? Yes/ No**

**Can you explain why?**

**5. Do you think there are advantages for you to monitoring Parkinson's disease symptoms remotely? Yes/No**

**Can you explain why?**

**TABLE 1:** *Participant scores and contextual notes*

Participant number	Face-to-face assessment score	Contextual notes	Videoconference assessment score	Contextual notes
1	20	Participant drove from a regional centre to attend the clinic, arrived 1.5 hours late due to being unfamiliar with the location, appeared distressed on arrival and had difficulties settling. Her daughter was present for the assessments entirety.	22	Appeared settled during assessment. Her daughter was present, however not in the room for all of the assessment.
2	27	Assessment was conducted in the participant's home.	26	Participant noted being "Very Unfamiliar" with Skype. No

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				difficulties encountered.
				Reported experience as "Good".
3	30	Conducted in assessment rooms.	29	Nil
4	28	Conducted in assessment rooms.	24	Initially the sound was not working. Restarted assessment and participant used a headset.
5	25	This participant had a hearing impairment.	26	Nil
6	25	Assessment was conducted in the participant's home.	25	Participant reported high anxiety about use of technology and requested a break. Re-commenced videoconferencing an hour later; completed with

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Reported experience as "Good".

11

23

Nil

25

Nil

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**TABLE 2:** *Content categories from participant feedback*

Content categories	Frequency reported	Example quote
Convenience	7/11	<i>“Cheaper and less stressful then travelling”</i>
Concern for others	3/11	<i>“Some people still do not have access to a computer”</i> <i>“Elderly patients unfamiliar with computers”</i>

**TABLE 3:** *Content categories from assessor feedback*

Content categories	Frequency reported	Example quote
Opportunity to artificially enhance score	1/4	<p><i>“Difficult to tell how much the [participant’s] daughter is helping, [I] couldn’t see [the daughters] hands”</i></p> <p><i>“Unable to guarantee the participant had not opened the envelope with the hardcopy sections of the MoCA prior to the videoconferencing assessment, giving them extra time to practice the items”</i></p>
Technology limitations	3/4	<p><i>“When completing memory tasks it was difficult to hear words, causing interruptions. This was improved with headphones”.</i></p> <p><i>“Delay for letter clap task”</i></p>