The Cats-and-Dogs Test: A Tool to Identify Visuoperceptual Deficits in Parkinson’s Disease

There are no robust features to predict which patients with Parkinson’s disease (PD) will develop dementia. Those with involvement of visual processing regions are at highest risk of dementia. However, current measures of visuoperception are poorly sensitive. We have developed a sensitive test of visuoperception based on the clinical observation that patients with PD have difficulty reading distorted CAPTCHA (completely automated public Turing test to tell computers and humans apart) images.

Methods

Participants

Twenty patients with PD and 11 age-matched controls without eye disease or dementia were recruited. Clinical and detailed neuropsychological assessment was performed (Supplemental Table 1). Participants gave written informed consent. The study was approved by the local Research Ethics Committee.

Procedure

Images of cats and dogs were skewed by a variable amount (11 levels, 0-5 arbitrary units [a.u.]) and combined with white noise (Fig. 1A and Supplementary Methods). On each trial the skewed image was shown for 280 milliseconds. Participants indicated whether the image was a cat or dog using the keypad.

Results

Patients with PD performed worse than controls at identifying skewed images: PD mean threshold, 1.92 ± 0.5 a.u.; controls, 2.48 ± 0.26 a.u.; $t_{29} = -4.06$, $P = 0.00034$ (Fig. 1C). There was no other significant difference in cognitive or clinical tests, including the standard visuoperceptual tests, between PD patients and controls (excluding MDS-UPDRS; Supplemental Table 1). Mean reaction times and visual acuity did not differ significantly between the groups.

Discussion

We present pilot data suggesting that identifying skewed images in the Cats-and-Dogs test is a sensitive measure of visuoperception in early-stage PD, with greater sensitivity than standard cognitive and visuospatial tests.

Performance on the Cats-and-Dogs test correlated with age, vascular risk, and cognitive performance but not with standard visuoperception tests, most likely because participants were at ceiling in these tests. Performance in this test also correlated...
with a prediction score for cognitive impairment in PD, suggesting that it may have utility as an early marker of cognitive decline, consistent with the literature of PD patients with involvement of visual-processing regions being at the highest risk of dementia.\textsuperscript{1-3} However, our study will require replication in larger cross-sectional and longitudinal numbers.\hspace{0.5cm}$\blacklozenge$

Rimona S. Weil, MBBS, PhD\textsuperscript{1,2,*} Katerina Pappa, MSc\textsuperscript{3} Rachel N. Schade, BA\textsuperscript{1} Anette E. Schrag, MBBS, PhD\textsuperscript{4} Bahador Bahrami, PhD\textsuperscript{3} Dietrich S. Schwarzkopf, PhD\textsuperscript{3,5,6} Sebastian J Crutch, PhD\textsuperscript{2} Aidan G. O’Keeffe, PhD\textsuperscript{7} Huw R. Morris, MBBS, PhD\textsuperscript{1,4} 

\textsuperscript{1}Department of Molecular Neuroscience, University College London, London, UK 
\textsuperscript{2}Dementia Research Centre, University College London, London, UK 
\textsuperscript{3}Institute of Cognitive Neuroscience, University College London, London, UK 
\textsuperscript{4}Department of Clinical Neuroscience, University College London, London, UK 
\textsuperscript{5}Department of Experimental Psychology, University College London, London, UK, and Institute of Cognitive Neuroscience, University College London, London, UK 
\textsuperscript{6}School of Optometry & Vision Science, Faculty of Medical & Health Sciences, University of Auckland, Auckland, New Zealand 
\textsuperscript{7}Department of Statistical Science, University College London, London, UK

References

1. Williams-Gray CH, Mason SL, Evans JR, et al. The CamPaIGN study of Parkinson’s disease: 10-year outlook in an incident population-based cohort. J Neurol Neurosurg Psychiatry 2013; 84(11):1238-1264.
2. Bohnen NI, Koepp RA, Minoshima S, et al. Cerebral glucose metabolic features of Parkinson disease and incident dementia: longitudinal study. J Nucl Med 2011;52(6):848-855.
3. Toledo JB, Gopal P, Raible K, et al. Pathological alpha-synuclein distribution in subjects with coincident Alzheimer’s and Lewy body pathology. Acta Neuropathol 2016;131(3):393-409.
4. Hipp G, Diederich NJ, Pieria V, Vaillant M. Primary vision and facial emotion recognition in early Parkinson’s disease. J Neurol Sci 2014;338(1-2):178-182.
5. von AL, Maurer B, McMullen C, Abraham D, Blum M. reCAPTCHA: human-based character recognition via Web security measures. Science 2008;321(5895):1465-1468.
6. Schrag A, Siddiqui UF, Anastasiou Z, Weintraub D, Schott JM. Clinical variables and biomarkers in prediction of cognitive impairment in patients with newly diagnosed Parkinson’s disease: a cohort study. Lancet Neurol 2017;16(1):66-75.

Supporting Data

Additional Supporting Information may be found in the online version of this article at the publisher’s website.