Institution: University of Oxford		
Unit of Assessment: 4 – Psychology Psychiatry and Neuroscience		
Title of case study: The Oxford Cognitive Screen: Providing domain-specific cognitive screening to transform stroke care		
Period when the underpinning research was undertaken: 2012 – 2019		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	**Role(s) (e.g. job title):**	**Period(s) employed by submitting HEI:**
Nele Demeyere	Associate Professor in Psychology	Oct 2011 - present
Glyn W Humphreys	Professor, and Watts Chair in Psychology	Sept 2011 - Jan 2016
M Jane Riddoch	Professor in Psychology	Oct 2011 - Jan 2014
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Period when the claimed impact occurred: 2015 – December 2020		
Is this case study continued from a case study submitted in 2014? N		

1. Summary of the impact

Researchers at the University of Oxford developed The Oxford Cognitive Screen (OCS), a stroke-specific cognitive screen, based on neuropsychological expertise, to assess different cognitive domains relevant to stroke (e.g. attention, praxis, memory, language).

For patients who have suffered a stroke the use of OCS contributes to multi-disciplinary team decisions on treatment plans and post-care discharge. Health service staff have benefitted from an easy to use tool, allowing emphasis on both patient strengths and weaknesses in cognitive domains, monitoring progress and improving communication around cognitive areas with patients, carers and other health professionals.

The clinical community world-wide has been able to access the OCS via a free of charge licence for publicly funded clinical and research use, with 1,214 licenced users to the end of December 2020. There has been global adoption with 13 linguistically validated versions published in peer reviewed publications and a further 22 translations under development. The 2016 Royal College of Physicians Guidelines included OCS as a first-line screen, only one year after OCS was published (RCP stroke guideline), and new national guidelines from the Danish Health Authority now also recommend the OCS for post-stroke cognitive screening (2020). It is estimated that 100,000 stroke survivors are being screened with OCS every year.

2. Underpinning research

Neuropsychological research in stroke has identified diverse cognitive problems after stroke,ranging from commonly occurring impairments, such as hemispatial neglect, aphasia or apraxia, to more specific detailed problems in each of the cognitive domains. For example, within reading disorders after stroke, researchers have documented neglect dyslexia, surface dyslexia, letter-by-letter reading and deep dyslexia. The diversity of cognitive problems experienced after stroke, with focal lesions affecting specific aspects and domains within cognitive functioning means that a different cognitive assessment approach is needed compared to that in other neurological conditions which have a different cognitive profile. For example, the most well-known form of cognitive impairment in Alzheimer's dementia is characterised predominantly by memory impairments. The complexity of cognitive impairment in stroke requires a neuropsychology based approach assessing the different domains.

A first attempt had been made by Prof Humphreys to develop a stroke specific cognitive assessment based on neuropsychological principles to assess a range of cognitive domains,

before he moved to the University of Oxford. However, the resulting Birmingham Cognitive Screen was of limited value because its use required significant training, the test itself takes over an hour to administer, and was not suitable for use at the bedside in acute stroke. After confirming the importance of measuring domain-general as well as domain-specific cognitive processes in a group of 287 post-stroke patients [1], the University of Oxford team developed a new tool, the Oxford Cognitive Screen (OCS), with support from an NIHR programme development grant. The OCS breakthrough was to develop a first-line cognitive screen which can be administered in only 15-20 minutes while still validly assessing deficits in: attention & executive function, language, memory, number processing and praxis. The initial OCS research established normative data and demonstrated its reliability and validity as a standardised screen in acute stroke [2].

The OCS was developed in response to NICE guidelines (2013) which advised *"As soon as possible, … , perform a full medical assessment of the person with stroke, including cognition (attention, memory, spatial awareness, apraxia, perception*)". Given that acute stroke survivors are unable to sustain lengthy testing sessions, and acute stroke units do not have expertise in neuropsychology routinely available, the brief OCS provided a much needed solution. OCS provides a screening tool, which can be easily administered at the bedside, by occupational therapists rather than neuropsychologists, and requires minimal training. Most importantly, it provides clinicians with an easy to understand visual snapshot of a patient's cognitive deficits and areas of preserved function.

University of Oxford researchers compared OCS to the commonly used Montreal Cognitive Assessment (MoCA) [3] and the Mini Mental State Examination (MMSE) [4], the latter in collaboration with the Italian OCS Group. In both studies, OCS was found to be more sensitive in diagnosing cognitive impairment, and showed higher inclusion of patients with neglect and aphasia. In addition, in a University of Oxford study of the importance of performative measures (e.g. the neglect test), OCS was shown to be superior to routine observational measures such as the NIH Stroke Severity scale, which failed to adequately pick up hemispatial neglect [5].

In summary, due to the length of testing and the lack of trained neuropsychology staff, comprehensive neuropsychological assessment is not feasible in clinical practice. Therefore, most stroke units need to rely on brief cognitive screening tools. Traditional screens such as MoCA or MMSE were developed for dementia - with frequently occurring post stroke deficits such as aphasia and hemispatial neglect confounding the measure and an "overall cognition" pass/fail outcome which is not necessarily relevant or helpful for the types of cognitive impairment prevalent after focal injury in stroke. The OCS combines the efficiency of broad, global screens with the neuropsychological expertise from detailed domain-specific assessment batteries, thereby addressing an unmet clinical need.

3. References to the research (University of Oxford authors in **bold)**

1. **Massa MS, Wang N**, Bickerton W-L, **Demeyere N, Riddoch MJ, Humphreys GW**. (2015). On the importance of cognitive profiling: A graphical modelling analysis of domain-specific and domain-general deficits after stroke. *Cortex.* 71:190–204. (19 Citations) DOI: 10.1016/j.cortex.2015.06.006
2. **Demeyere N, Riddoch MJ, Slavkova ED,** Bickerton W-L, & **Humphreys GW.** (2015). The Oxford Cognitive Screen (OCS): Validation of a stroke-specific short cognitive screening tool. *Psychological Assessment* 27(3):883–894. (120 citations) DOI: 10.1037/pas0000082
3. **Demeyere N, Riddoch MJ, Slavkova ED**, Jones K, Reckless I, Mathieson P and **Humphreys GW** (2016) Domain-specific versus generalized cognitive screening in acute stroke. *Journal of Neurology,* 263:306-315. (58 citations) DOI: 10.1007/s00415-015-7964-4
4. Mancuso M, **Demeyere N**, Abbruzzese L, Damora A, Varalta V, Pirrotta F, Antonucci G, Matano A, Caputo M, Caruso MG, Pontiggia GT, Coccia M, Ciancarelli I, Zoccolotti P and the Italian OCS Group. (2018). Using the Oxford Cognitive Screen to detect cognitive impairment in stroke patients: a comparison with the mini-mental state examination. *Frontiers in Neurology*, 9:101. DOI: 10.3389/fneur.2018.00101.
   [N Demeyere contributed to experimental design and critique of the manuscript.]

5. **Moore MJ**, **Vancleef K, Shalev N, Husain M** and **Demeyere N**. (2019) When neglect is neglected: NIHSS observational measure lacks sensitivity in identifying post-stroke unilateral neglect. *Journal of Neurology, Neurosurgery & Psychiatry.* 90(9):1070–1. DOI: 10.1136/jnnp-2018-319668

Funding received from The Stroke Association to the University of Oxford for N Demeyere, 'Aligning assessments for predicting the natural history of post-stroke cognition', GBP214,495 (TSA LECT 2015/02, 10-2105 to 09-2020).

4. Details of the impact

Following a stroke, it is common for a patient to experience cognitive deficits and failure to detect these can have a significant impact on post-stroke recovery. Cognitive screening is vital to facilitate rehabilitation, ensure appropriate support and enhance the quality of life of stroke survivors. The psychological consequences of stroke are some of the most disabling and are also the complications most feared by people living with stroke. In clinical practice, guidelines recommend that stroke survivors are assessed for cognitive issues, but until recently, the brief tools used for assessing post stroke cognitive problems were 'borrowed' from other conditions such as Alzheimer's disease.

OCS – a validated, brief, clinically-applicable and stroke-specific cognitive assessment

The OCS was the first tool to provide a short, neuropsychology based cognitive assessment, in line with the NICE guidelines on domain specific screening. The current Chair of the Organisation for Psychological Research in Stroke (OPSYRIS), a consultant stroke physician, substantiated the role of the Oxford Cognitive Screen in improving standards in post-stroke assessment, writing that

> *"... the stroke specific Oxford Cognitive Screen, which is free to use and has accompanying comprehensive, easy access training materials exactly matches the clinical needs. Indeed, the Oxford Cognitive Screen (OCS) has rapidly gained visibility and traction within the clinical and research fields since its publication only a few years ago.*
>
> *I am now using OCS in preference to other tools in our clinical stroke setting, and I know that other Principal Investigators and lead clinicians are following suit. In a recent International consensus statement (Stroke Recovery and Rehabilitation Roundtable) we collated the essential and desirable characteristics of a cognitive assessment tool for stroke research. It was not our remit to name a preferred tool but OCS maps to all the criteria we specified*". [A(i)]

OCS uptake in clinical communities

The OCS is licensed free of charge for publicly funded clinical use through Oxford University Innovation (OUI), with 1,214 users licenced from 31 March 2014 to 31 Dec 2020 [B]. It has been widely adopted for clinical use in the NHS: 169 out of 217 NHS Trusts in England and Wales had taken a licence by July 2020. Outside the UK, other major clinical licensees include: New South Wales, Australia, where the OCS will be the standard screen adopted throughout the care pathway in all of NSW; Policlinico Gemelli IRCCS (a large hospital in Rome); all large hospitals in Belgium (Gent, Leuven, Antwerp, Hasselt) and the Veterans hospital in the USA covering Medicare/Medicaid patients.

Frequency of use of OCS

In order to estimate the frequency of use by each licencee, a survey was conducted of OCS licensees and training attendees [C(i)], returning responses from a subset of 164 users. The reported use of OCS ranged from occasional and regular use to OCS being the standard screen on the unit, where everyone is screened with OCS (reported by 21 out of 164 survey responses including Oxford University Hospitals and Oxford Health NHS Foundation Trust, Somerset Partnership NHS Foundation Trust, Gloucestershire Health, and Care NHS Foundation Trust Early Supported Discharge). A subset of respondents reported using OCS for specialist screening particularly with patients who have language deficits (21% of respondents). On average, survey responders reported screening 10 patients per month with OCS (responses ranging from 0 to 150). Extrapolating to all licensees suggests that over 100,000 stroke survivors are being screened with OCS every year.

The high frequency of use and familiarity with OCS 'on the ground' is further corroborated by an independent study in which the 21 occupational therapists interviewed named both OCS and MoCA as the main tools being used in post stroke cognitive screening [D].

Global adoption of the OCS

So far, 13 linguistically validated versions of OCS have been published in peer reviewed publications (including Spanish, Russian, Chinese, Brazilian-Portuguese, Italian, Danish, Dutch). These include new normative data and new validation testing against local standard clinical practice. In each case, the Oxford team work closely with the translating teams, providing advice and guidance, and supporting cultural adaptations (e.g. ensuring no meaning is lost, and in adapting stimuli to be appropriate for the country and culture). All translations are done under licence from Oxford University Innovation. A further 22 translations are under development including in German, Greek, Polish, Korean, Arabic, Urdu, Lithuanian and Norwegian. The eagerness of international clinician researchers to translate this tool, along with labour-intensive normative and psychometric data collection demonstrates the perceived gap in domain-specific screening throughout the world, which is being filled by OCS. These adaptations and translations have had widespread uptake: licences have been taken out across the world, including (number of licences in brackets): Australia (56), Belgium (79), Canada (23), China (11), Denmark (34), Hong Kong (7), Ireland (56), New Zealand (17), South Africa (18) and USA (36) [B].

Training and capacity building

Between 2016 and 2020, 11 in-person training sessions have taken place at local and regional stroke units on request (approx 20 allied health professionals each), and a 'train the trainer' event organised by Oxford University Innovation (March 2019). Example training feedback from a session organised by the College of Occupational Therapists, on Specialist Section Neurological Practice (February 2020), attended by 36 specialist OTs, found that 57% would 'definitely' change their practice and 43% were 'quite likely' to change their practice having learnt about OCS. Larger externally organised events in which OCS training and dissemination was included include two Stroke Association Masterclasses in 2016 (approx 50 clinicians); and clinical audiences at the regional South-West Conference for Stroke in 2018 and the 2019 Welsh Stroke Conference (approx 200 each). A course is offered by the Somerset Partnership as part of the Stroke-Specific Education Framework [E(i)].

Yearly platforms and invited presentations at the UK Stroke Forum have formed the most direct, national dissemination to clinicians. The UK Stroke Forum is a coalition of over 30 organisations all committed to improving stroke care in the UK, underwritten by the Stroke Association and the British Association of Stroke Physicians. In 2019, the Royal College of Occupational Therapists organised two back-to-back training sessions at the UK Stroke Forum (1,200 attendees). This OCS training was attended by over 200 delegates. The most popular and accessible training consists of a demonstration video on administering the OCS has been widely viewed (over 12,000 views on YouTube) [E(ii)].

OCS impact on patient care plans and experiences

Testimonial letters, online conversations and survey responses [A, C] attest that the OCS has had impact on clinical decision making, in particular regarding therapy plans, discharge planning (care packages), and in changing approaches to patient and family communications regarding cognition. In addition, a key attribute of the OCS reported by users is the ability to conduct the screen in patients with aphasia and neglect. This was clear from comments such as *"I really like using the OCS with patients who have language deficits, as it gives them the opportunity to score well with a cognitive (standardised) test"*, and *"Allows different aspects of cognition to be assessed in the presence of visual inattention".* [C(ii)]

The survey by OUI of OCS licencees found that of the 74 respondents to the question, "Has the OCS impacted on clinical decision making? e.g. regarding therapy plans, discharge planning (care packages) or in changing approaches to patient and family communications regarding cognition?", 64 (90%) answered affirmatively (3 no responses) [C(i)]. Examples of free comments include:

> *"It has supported and provided evidence in MDT meetings, and to support discharge plans. It has supported education of family members, and patients. It has been an integral part of assessment and treatment planning of the more complex cognitive patients. Particularly*

around praxis, visual perception and executive function. It has been particularly helpful for patients with language deficits."

"Yes, the OCS has helped change how we understand cognition on the ward. Whereas before cognition was considered an all or nothing entity based on using a cut off score on a dementia screening test, now the staff feel more confident discussing the individual domains of cognition, and integrating this information into their formulations, discharge plans etc." [C(i)]

Impact on clinical guidelines

The 2016 Royal Colleges of Physicians Guidelines included OCS alongside MoCA as a first-line screen, only one year after OCS was published [Fi]. Though the Montreal Cognitive Assessment (MoCA) is still a much used cognitive screen in stroke patients, due to historic embeddedness, the research on its usefulness in stroke, sensitivity for detecting impairments and inclusivity (e.g. [3]), as well as newly introduced costs related to training qualifications, has led to a steady rise of clinicians switching to the OCS. New guidelines in countries where OCS has recently been translated are also emerging. For example, the Danish Health Authority has published guidelines in which OCS is recommended [F(ii)]. Chapter 4 of the guidelines, 'Tracing Cognitive Function', recommends that: "*Cognitive function in adults with acquired brain damage is initially assessed with the tool Oxford Cognitive Screen (OCS)...*".[F(ii), translated]. Other independent studies include a systematic review in 2019 [G] which reported that, "*The Oxford Cognitive Screen (OCS), a multidomain tool, was found to be a better predictor of PSCI/PSD than the MOCA or MMSE."*

5. Sources to corroborate the impact

A. Testimonials: (i) Letter from Chair of OPSYRIS,
(ii) Letter from Head of Clinical Neuropsychology, Aalborg University Hospital jointly with the Lead Developer of the OCS-Dansk [Danish version of OCS], University of Copenhagen

B. Statement on OCS licensing by Oxford University Innovation.

C. (i) Evaluation of feedback report on survey sent by OUI to OCS licensees, December 2019.
(ii) Comments from attendees at UK Stroke Forum event, 3-5 December 2019.

D. Journal article: Ablewhite J, Geraghty J, das Nair R, Lincoln N and Drummond, A (2019). Cognitive Management Pathways in Stroke Services (COMPASS): A qualitative investigation of key issues in relation to community stroke teams undertaking cognitive assessments. British Journal of Occupational Therapy. 10.1177/0308022619841320
Independent research conducting structured interviews on cognitive screening practice (22 stroke occupational therapists) highlighting OCS and MoCA as the most common cognitive screens used.

E. Evidence of training provided: (i) UK Stroke Forum Education and Training: The Oxford Cognitive Screen – Somerset Partnership https://stroke-education.org.uk/course/the-oxford-cognitive-screen-somerset-partnership/training day workshop schedule
(ii) YouTube video: Administering the Oxford Cognitive Screen (OCS): A demonstration. https://youtu.be/9BTCEYdMJOI Demonstration tutorial with more than 12,000 views.

F. Clinical Guidelines:
(i) National Clinical Guideline for Stroke, Oct 2016, Royal College of Physicians https://www.rcplondon.ac.uk/guidelines-policy/stroke-guidelines
(ii) National clinical guidelines in Denmark (Danish Health Authority), Chapter 4, 'Opsporing af kognitiv funktionsevne' [translated: Tracing Cognitive Function] https://www.sst.dk/-/media/Udgivelser/2020/Hjerneskade/Anbefalinger-redskaber-hjerneskade.ashx?la=da&hash=4C3A852D04792582A8CAF3A0868B9500533765A1

G. Journal article: Kosgallana A, Cordato D, Kam Yin Chan D, Yong J (2019) Use of Cognitive Screening Tools to Detect Cognitive Impairment After an Ischaemic Stroke: a Systematic Review. *SN Comprehensive Clinical Medicine* 1(8):1-8. DOI: 10.1007/s42399-018-0035-2