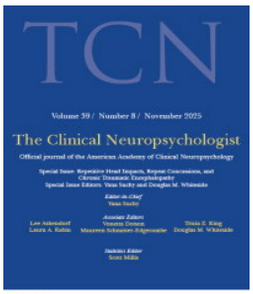

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Reliability and validity of the Oxford Visual Perception Screen in sub-acute adult stroke survivors

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ABSTRACT

Objective: Due to a lack of time-efficient standardized assessments, there is a high risk of unidentified visual perception difficulties in stroke survivors. The Oxford Visual Perception Screen (OxVPS) is a 15-min performance-based screen for visual perception difficulties through tasks like picture naming and face recognition. This study evaluates the inter-rater reliability, convergent, and discriminant validity of OxVPS. **Method**: In this cross-sectional study, 161 stroke survivors within 8 weeks of their stroke, sufficient understanding of English, ability to concentrate for 15 min, and capacity to consent took part across three UK rehabilitation units. Video-recordings of OxVPS assessments were rated by an independent rater for inter-rater reliability. Convergent validity was assessed by comparing OxVPS scores with the Rivermead Perceptual Assessment Battery (RPAB), a 45–90-min battery of visual perceptual tasks. Discriminant validity compared OxVPS scores with performance on the Blind Montreal Cognitive Assessment (MOCA-B) for cognition and with the Visual Impairment Screening Assessment (VISA) for sensory vision. **Results:** Inter-rater reliability showed equivalent ratings ($N = 107$, $t(106) = -14.77$, $p < .001$) and mean difference of −0.01 point on a 10-point scale in a Bland–Altman analysis (95% confidence interval [CI]: −0.14 to 0.13). Convergent and discriminant validity demonstrated a high correlation of 0.78 ($N = 58$, 95% CI: 0.65–0.86) between OxVPS and RPAB, lower correlations of 0.52 with MOCA-B scores ($N = 113$, 95% CI: 0.37–0.64) and .39 with VISA scores ($N = 110$, 95% CI: 0.22–0.54). **Conclusions**: Data indicate good inter-rater reliability and evidence that OxVPS predominantly measures visual perception difficulties (convergent validity) in stroke survivors and less so cognition or sensory vision (discriminant validity).

Abbreviations: OxVPS: Oxford Visual Perception Screen; RPAB: Rivermead Perceptual Assessment Battery; MOCA-B: Blind Montreal Cognitive Assessment; VISA: Visual Impairment Assessment Screen;

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Introduction

A stroke is a life-threatening condition affecting 15 million people globally each year (World Health Organization, 2023) with 21–76% of stroke survivors suffering with visual perception difficulties (Edmans & Lincoln, 1987; Rowe et al., 2019). Visual perception is an active process through which sensory input is interpreted and transformed into meaningful concepts based on visual knowledge of the surrounding environment (Bouska et al., 1990). Difficulties in visual perception can manifest as challenges in recognizing faces (prosopagnosia), identifying objects (associative agnosia), or reading text (alexia). It is vital for engaging in activities of daily living; visual perception difficulties following stroke impact functional outcomes (Jehkonen et al., 2000) and quality of life (Plante et al., 2010). Visual perception difficulties reduce overall independence and increase risk when engaging in activities of daily living, for instance when cooking or judging traffic (Mercier et al., 2001).

Research has indicated that identification of visual perception difficulties after stroke can be helpful in rehabilitation/care planning, reducing anxiety, and increasing independence (Vancleef et al., 2022). However, a systematic review of current screening instruments has demonstrated a lack of suitable standardized assessments, and suggests accuracy is lowered when patients are unable to report or are unaware of their symptoms (Hanna et al., 2017) thus leading to under-identification of visual perception difficulties with self-report (Rowe et al., 2009, 2025). Improving the identification of visual perception difficulties through systematic screening can enhance rehabilitation planning, which in turn may reduce the need for additional care (Hanna et al., 2017) by supporting the performance of activities of daily living, avoiding further medical issues (e.g. falls) and expanding social interactions to improve mental health (Cooke et al., 2005).

A recent survey with 214 clinicians in the UK and Ireland found that instead of standardized assessments, clinical observation, and self-report are the primary procedures for screening in clinical practice, with 94% of clinicians relying on these methods (Colwell et al., 2020). This is because current standardized assessments are time-consuming (30–120 min), equipment laden, not always suitable for patients with communication difficulties or dominant upper limb weakness and assess only a limited range of visual perceptual functions (Cooke et al., 2005; Rowe et al., 2020). For example, the occupational therapy adult perceptual test (Cooke et al., 2005) and the Rivermead Perceptual Assessment Battery (RPAB; Whiting et al., 1985) both require a table and the use of dominant upper limbs which can be impacted by stroke. The Loewenstein Occupational Therapy Cognitive Assessment (Itzkovich et al., 2000), Visual Object and Space Perception Battery (Warrington & James, 1991), and RPAB are the most time consuming with administration potentially taking up to 120 min. For some assessments, test administration requires extensive training, which can often be time intensive itself. Some tests are only available for people with postgraduate qualifications in a related field (e.g. Psychology, Occupational Therapy, Education) and can be costly (Pearson Clinical, 2025). Research with occupational therapists and orthoptists involved in visual perception screening after stroke in the UK emphasized the need for a quick evidence-based screening tool that requires minimal training and is suitable for stroke survivors with communication and concentration difficulties (Colwell

et al., 2020; Vancleef et al., 2022). In response to this clinical need, the Oxford Visual Perception Screen (OxVPS) has been developed (Vancleef et al., 2025).

The OxVPS (Vancleef et al., 2025), is a 15-min screening tool in paper format which requires a stimulus book containing the pictures for each of the subtests, a two-page examiner form, and two work sheets to be completed by the stroke survivors. This makes OxVPS portable, and with a clipboard the test can be done at a patient's bedside. The OxVPS screens for various visual perception difficulties including object and face agnosia, visuo-constructive difficulties, visuospatial neglect, and alexia (reading). Across ten tasks, patients are asked to read a short paragraph, identity objects, recognize faces, and draw a geometrical figure. All instructions and directions for administration of OxVPS are included on the examiner form, avoiding the need to consult the manual during administration. The OxVPS and its normative data are described in more detail in Vancleef et al. (2025).

To ensure that OxVPS offers clinicians a consistent and accurate tool to measure visual perception difficulties it is essential to determine the reliability and validity in the target population. Convergent validity reinforces that the test measures the construct of interests (visual perception), and discriminant validity confirms the ability for a test to differentiate from related domains (Thoma et al., 2018) like sensory vision or cognition (Clark & Watson, 2019). The reliability of a screening tool is integral to its clinical usefulness and inter-rater reliability seemed the most valuable choice given that stroke care is multi-disciplinary teamwork (McHugh, 2012).

In summary, whilst the high prevalence of stroke survivors with visual perception difficulties has been demonstrated (Rowe et al., 2019; Edmans & Lincoln, 1987), the lack of appropriate systematic screening with a standardized assessment often leads to under identification (Rowe et al., 2009). This study explores the reliability and validity of the OxVPS, to ensure consistent and accurate assessment of visual perception difficulties after a stroke.

Methods

Transparency and openness

The study design and analytic plan were preregistered, and the full protocol can be found at https://clinicaltrials.gov/study/NCT05981482. All data and analysis code are available on Open Science Framework: https://osf.io/s7ehx/?view_only=f6291a307b8d4583a75d8d41220389c1

Participants

The participants in this study were a cross-sectional sample of stroke survivors from three stroke rehabilitation units in the UK. To recruit a representative sample of stroke survivors, inclusion criteria were broad: to be within eight weeks of a clinical diagnosis of stroke (including ischemic stroke and intracerebral hemorrhage) for the duration of the study and be at least 18 years of age at the time of consent. Exclusion criteria were the inability to provide consent, insufficient understanding of English, and the inability to concentrate for 15 min. Trained members of healthcare staff systematically

screened all admitted patients against the eligibility criteria. The screening process was informed by a stroke consultant's diagnosis of stroke, and discussions amongst the multidisciplinary team regarding a patient's ability to concentrate and English comprehension. Subsequently, informed written consent was sought by a member of the research team. Ethical approval was granted from the Health Research Authority, REC reference 23/EM/0086 by the Derby Research Ethics committee.

Procedures

Participants were asked to complete the OxVPS, the RPAB (Whiting et al., 1985), the Blind Montreal Cognitive Assessment (MOCA-B; Nasreddine, 2020), and the Visual Impairment Screening Assessment (VISA; Rowe et al., 2020). To evaluate reliability, administration of OxVPS was video recorded in a subset of participants who agreed to video recording and scored by an independent assessor who was blind to all other assessment outcomes. The OxVPS and the RPAB were administered by different assessors blinded to the outcome of the other assessment. All assessments were completed within 2 weeks. Counterbalancing order was not possible due to availability of the researchers and scheduling assessments around clinical activities for participants on the unit.

Instruments

The Oxford Visual Perception Screening tool

The OXVPS version 2.1 (Vancleef et al., 2025) is a screening test for visual perception problems following stroke. It is suitable for most stroke patients, paper formatted, takes about 15 min to administer, and aims to detect 15 visual perception problems (e.g. agnosia, visuo-constructive difficulties, alexia) across 10 subtests (Vancleef et al., 2022).

Rivermead Perceptual Assessment Battery

The RPAB is a standardized assessment covering 8 categories of visual perception difficulties through 16 subtests (Whiting et al., 1985) and is widely used in the UK and Ireland (Colwell et al., 2020). Its concurrent validity (i.e.i.e. correlations between 0.44 and 0.76) and clinical usefulness have been strongly established (Matthey et al., 1993; Sloan et al., 1991; Whiting et al., 1985). Friedman and Leong (1992) suggest the RPAB offers a significant indicator of functional performance (see also Jesshope et al., 1991) and has excellent inter-rater reliability (correlations between 0.72 and 1, >0.9 in 14 out of 16 subtests), and fair test–retest reliability (correlations between 0.27 and 1, >0.7 in 10 out of 16 subtests) (Whiting et al., 1985).

Blind Montreal Cognitive Assessment

The MOCA-B (Nasreddine, 2020) was chosen to assess global cognitive impairment, inclusive for those with visual difficulties. This assessment is an adapted version of the original Montreal Cognitive Assessment (Nasreddine et al., 2005) without the subtests which require visual abilities. The MOCA-B (Nasreddine, 2020) is quick and

easy to administer in an acute stroke setting, has been widely used for some time (Blackburn et al., 2013), retains high internal consistency (Cronbach's alpha = 0.76) and concurrent validity (Pearson correlation = 0.77, $p < .05$) with sensitivity of 86.8% and specificity of 72.7% when compared to the mini-mental state Examination for visually impaired (Fadzil et al., 2022).

Visual Impairment screening assessment

To distinguish between visual perception difficulties and issues with sensory vision, the VISA (Rowe et al., 2020) was administered without the subtests on visual inattention or neglect. The VISA has been developed through consultation with an expert panel of stroke-specialist orthoptists, stroke survivors, occupational therapists, and neuro-ophthalmologists to test sensory visual impairment and visual inattention following a stroke. Clinicians have reported the usefulness of the VISA in practice, citing it as a valuable tool for identifying potential visual impairments without undergoing specialist training (Rowe et al., 2020). The diagnostic accuracy of VISA has been evaluated in 221 patients with sensitivity of >88%, specificity of >60% and the positive and negative predictive values of >93% and >68% suggesting agreement between the VISA and a comprehensive orthoptic assessment (Rowe et al., 2020, 2019).

Scoring

In line with the test manuals, patients' scores on the individual subtests of both OxVPS and RPAB were marked as intact if above the 5th centile of scores of healthy age-matched volunteers. The total number of subtests score within the normal range made up the total score on each assessment (range 0–10 and 0–16, respectively). A high score indicated better visual perception. The total score of VISA was calculated in a similar way (range 0–5). The criteria to classify a subtest in VISA as failed were reduced distance vision >0.2 logMAR, reduced near vision >0.3 logMAR (equivalent to N6), deviated eye position, eye movement abnormality (incomplete eye rotations in any position of gaze), and visual field loss (e.g. presence of hemianopia, quadrantanopia, constriction) (Rowe et al., 2020). The MOCA-B was scored in line with the manual (Nasreddine, 2020) with a total possible score of 22; scoring 19 or above is considered normal and an additional point is added for someone with fewer than 12 years of education.

Sample size

A sample size calculation was performed for each of the planned analyses and the target number for recruitment was based on the highest estimate. In all sample size calculations, we set acceptable probability of Type 1 error of 0.05 (alpha = 0.05) and the minimum power to detect an effect at 0.9 (beta = 0.1). For inter-rater reliability, a sample size of 109 participants would allow detection of an expected mean difference in scores between two raters of 0.231 with expected SD difference of 0.73 (7.3% of range of possible scores) and a maximum allowed difference of 1.9 (Bland–Altman analysis). Based on a pilot study ($N = 24$) we expected a correlation between the scores

on OxVPS and a standardized measure of visual perception problems of 0.84. We estimated our required sample size to detect a 95% confidence interval (CI) from 0.74 to 0.90 with an expected Pearson correlation of 0.84 at 56 participants. Based on the same pilot study, we expected a correlation between the scores on OxVPS and our discriminant tests (e.g. VISA and MOCA-B) of 0.24. For this, we estimated our required sample size to detect a 95% CI from 0.06 to 0.40 with an expected Pearson correlation of 0.24 at 116 participants.

Analyses

To ensure our analyses were sufficiently powered and our results were not biased against participants who successfully completed all assessments, a small number of missing values were imputed (see Results and Supplementary materials). Blank responses on multiple-choice questions in OxVPS were considered Missing At Random and imputed (Cowen et al., 2025). In the RPAB a value was considered Missing At Random and imputed if the participant did not attempt a single trial in the subtest. Blank responses in MOCA-B were reviewed on a task-by-task-basis: in some tasks a blank response indicated the participant's answer was incorrect (e.g. only correct answers are ticked), in other tasks it represented a true missing value. Any missing values were checked against the paper records to correct transcription errors and were imputed if required. In VISA, a value was considered Missing At Random and imputed if the participant did not have any answers for a question (e.g. on the question about symptoms, no symptoms were ticked, and 'none' was also not ticked). Missing values were replaced through random-forest imputation. Participants with more than 30% of their data missing on a certain assessment were removed from analyses involving that assessment.

The inter-rater reliability of OxVPS was evaluated through a Bland–Altman analysis (Giavarina, 2015). The prediction was that both raters would score OxVPS in a similar way, in that, equivalent scores or ratings were expected. Two one-sided test procedures were applied to statistically reject the null hypothesis of a true difference between ratings. Any effects larger than the pre-set equivalence bounds of −1 and 1 would be rejected (Lakens, 2017). Furthermore, the Spearman correlation was calculated between the scores of both raters alongside the intra class correlation (ICC) with two-way random effects, absolute agreement and single rater decisions or ICC (2,1). Values less than 0.5 indicate poor reliability, with values between 0.70 and 0.90 indicating good reliability with any value greater than 0.90 considered excellent (Lezak et al., 2012, Koo & Li, 2016).

The convergent validity of OxVPS was expressed as a Spearman's Rho correlation between the total score on OxVPS and the total score on RPAB alongside a 95% CI. The discriminant validity of OxVPS was expressed as a Spearman's Rho correlation between the total score on OxVPS and the total score on the assessments of cognition (MOCA-B) and sensory vision (VISA). *p* Values were calculated with exact tests. While there are no prescribed thresholds for convergent and discriminant validity measures, Lezak et al. (2012) propose a minimum correlation of 0.30 for convergent validity and correlations below .30 for discriminant validity.

All analyses were completed in R with support of RStudio and the packages TOSTER, BlandAltmanLeh, psych, DescTools, ggplot2, ggExtra, irr, statpsych. The dataset and analysis code are available on Open Science Framework: https://osf.io/s7ehx/

Results

Participant flow

A total of 198 stroke survivors met the inclusion criteria and consented to take part in the study. Of these, 161 completed at least two assessments within two weeks of each other and within eight weeks of their stroke: 111 participants completed at least OxVPS and VISA, 117 participants completed at least OxVPS and MOCA, 58 completed at least OxVPS and RPAB, and 107 participants agreed for their OxVPS assessment to be video recorded and rated by another member of the research team. The reason for changeable numbers of completion per assessment was due to prioritizing participant's needs, for example, avoiding over-exertion, and the logistics of collecting data on a busy clinical ward, for example, participant availability (e.g. therapy sessions, mealtimes, visitors) and the inability to contact a participant following discharge but prior to study completion. Additionally, data collection with RPAB was stopped as soon as the minimum required sample size was achieved. The RPAB placed considerable burden on the participants because it required them to move to a therapy room, sit-up and concentrate for approximately 45 min. This also posed logistical challenges because therapy rooms or assistance to safely transfer participants were not always available. The decision to limit the number of participants to the minimum required sample size was taken following advice from patient representatives and occupational therapists at our recruitment sites and reviewed by methodologists in our steering group. Recruitment occurred from June 2023 until September 2024 and the flow of participants is shown in Figure 1.

Not all participants completed all assessments (see above for reasons), and different-sized subsamples of our 161 participants were used for each of the analyses (see Table 1). In addition, some participants only partially completed assessments. The percentage of participants with at least one missing subtest score was 13–16%, 25%, 42%, 3%, and 1% for the in-person OxVPS, the video-rated OxVPS, RPAB, MOCA-B, and VISA, respectively. However, despite many participants having incomplete data, the percentage of subtest scores that was missing per participant was low: 90% of these participants (i.e. those with at least one subtest missing) had no more than 30% of subtest scores on an assessment missing. Below, we imputed missing data using random forest imputation for participants with no more than 30% of subtest scores missing. More details about missing values as well as analyses on complete data only can be found in the Supplementary materials. Results with and without imputations were aligned: there are only marginal differences in reliability and validity results with the exception from the Bland–Altman results where there is a small but non-significant trend for higher ratings of Rater 2 compared to Rater 1 in the dataset with complete cases only. A second exception is the correlation between OxVPS and RPAB scores which is lower in the dataset with complete cases only which could be explained by higher homogeneity in the sample.

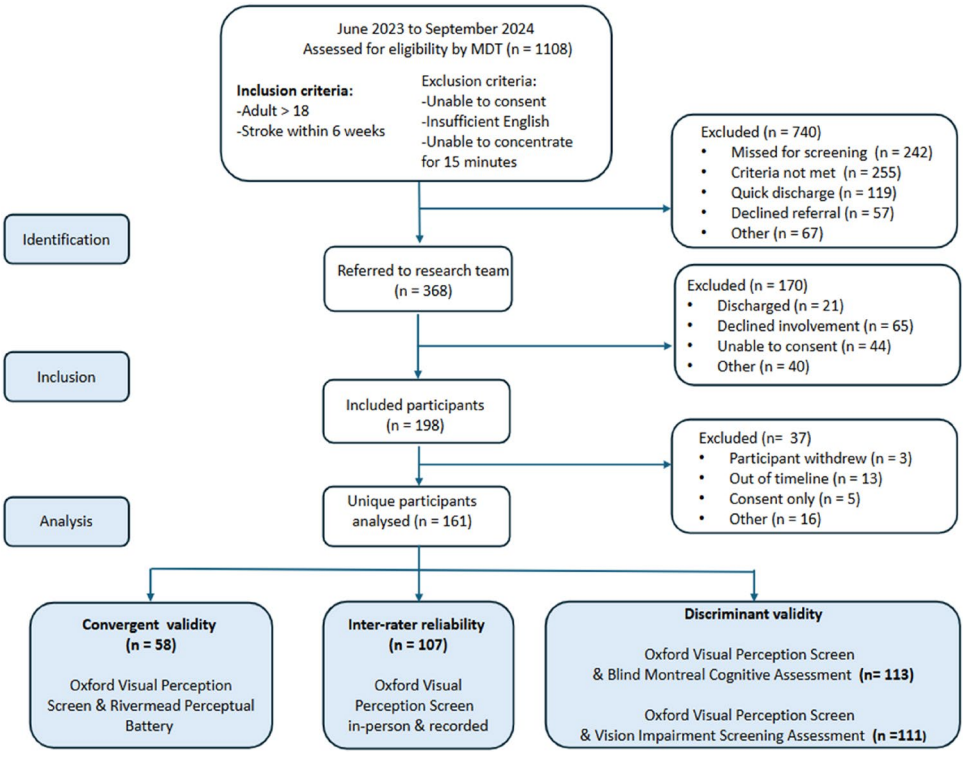

Figure 1. Participant flow chart. Some examples of reasons within the category of "other" include participant's condition changed, communication difficulties (e.g. unable to hear instructions, extreme aphasia) and blindness.

Inter-rater reliability

The Bland–Altman analysis showed a mean difference of −0.01 which was not significantly different from zero with a 95% CI ranging from −0.14 to 0.13 (Figure 2) on a 10-point scale ($t[106] = -0.14$, $p = .89$). Equivalence testing confirmed that the true mean difference was between −1 and 1 ($t(106) = -14.77$, $p < .001$) and that the scores of both raters were equivalent. The scores of both raters were strongly correlated (Spearman rho = 0.92, 95% CI: 0.89–0.95 $p < .001$). Furthermore, an ICC of 0.95 (ICC(2,1)) with a 95% CI from 0.93 to 0.97 ($F(106, 106) = 42$, $p < .001$) was observed which indicated excellent reliability (Koo & Li, 2016). Inter-rater reliability was similar across all subtests with a median correlation between raters of 0.95. Further details about subtest reliability are reported in Supplementary materials.

Convergent validity

The observed Spearman's Rho correlation between the total scores on OxVPS and the total RPAB score was 0.78 (Figure 3). Statistical testing indicated that the true population correlation is significantly different from zero ($S = 7221.70$, $p < .001$), likely lies between 0.65 and 0.86 (95% CI), and can be described as large according to Cohen's

Table 1. Description of the sample.

Variables	Inter-rater reliability ($n = 107$)	Convergent validity ($n = 58$)	Discriminant validity with Montreal Cognitive Assessment ($n = 113$)	Discriminant validity with Visual Impairment Screening Assessment ($n = 110$)
Age in years (M [SD])	73.26 [11.65]	73.85 [12.65]	73.44 [12.07]	73.94 [12.29]
Gender (count or percentage)				
Female	52 (49%)	32 (55%)	56 (50%)	54 (49%)
Male	55 (51%)	26 (45%)	57 (50%)	56 (51%)
Ethnicity (count or percentage)				
White	104 (97%)	57 (98%)	111 (98%)	108 (98%)
Asian	2 (2%)	1 (2%)	2 (2%)	2 (2%)
African	1 (1%)	0 (0%)	0 (0%)	0 (0%)
Handedness (count or percentage)				
Right-handed	98 (92%)	55 (95%)	105 (93%)	102 (93%)
Left-handed	8 (7%)	3 (5%)	8 (7%)	8 (7%)
Ambidextrous	1 (1%)	0 (0%)	0 (0%)	0 (0%)
Qualifications (count or percentage)				
Information not available	21 (20%)	22 (38%)	28 (25%)	28 (25%)
Primary education	25 (23%)	8 (14%)	18 (16%)	17 (15%)
Secondary education	42 (39%)	20 (34%)	47 (42%)	45 (41%)
University	8 (7%)	2 (3%)	10 (9%)	10 (10%)
Other	11 (10%)	6 (10%)	10 (9%)	10 (10%)
Time since stroke in days (M [SD])	24.18 [12.12]	28.12 [10.55]	26.73 [11.89]	26.45 [11.49]
Stroke severity (count or percentage)				
Minor (National Institute of Health Stroke Scale 1–4)	33 (31%)	19 (33%)	38 (34%)	39 (35%)
Moderate (National Institute of Health Stroke Scale 5–15)	57 (53%)	33 (57%)	54 (48%)	52 (47%)
Severe (National Institute of Health Stroke Scale 16–20)	7 (7%)	4 (7%)	9 (8%)	9 (8%)
Information not available	10 (9%)	2 (3%)	12 (9%)	10 (9%)
Type of stroke (count or percentage)				
Ischemic	82 (77%)	44 (76%)	88 (78%)	86 (78%)
Hemorrhagic	25 (23%)	14 (24%)	25 (22%)	24 (22%)
Oxford stroke classification (count or percentage)				
Total anterior circulation stroke	18 (17%)	14 (24%)	21 (19%)	23 (21%)
Partial anterior circulation stroke	43 (40%)	21 (36%)	40 (35%)	38 (35%)
Posterior circulation Syndrome	13 (12%)	5 (9%)	16 (14%)	16 (15%)
Lacunar Stroke	33 (31%)	18 (31%)	36 (32%)	33 (30%)
Side of stroke (count or percentage)				
Left	43 (40%)	17 (29%)	39 (35%)	43 (39%)
Right	62 (58%)	39 (67%)	71 (63%)	64 (58%)
Bilateral	2 (3%)	2 (3%)	3 (3%)	3 (3%)
Other neurological conditions (count or percentage)				
None	93 (87%)	47 (81%)	92 (81%)	90 (82%)
Any other neurological conditions	14 (13%)	11 (19%)	21 (19%)	20 (18%)

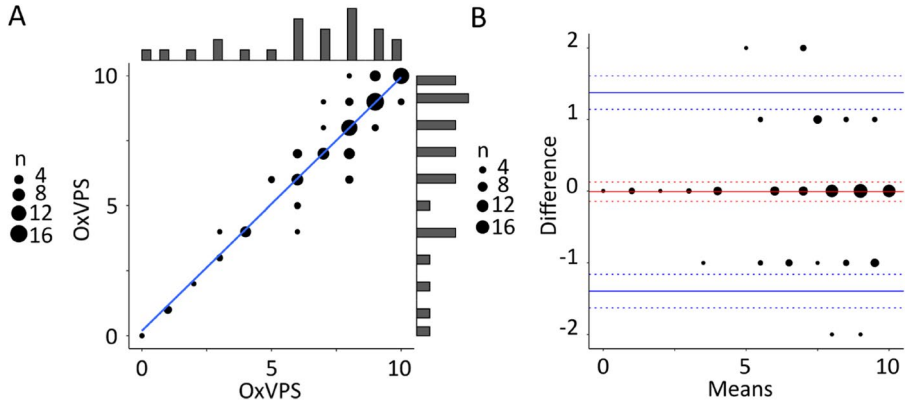

Figure 2. Oxford Visual Perception Screen Scores of Rater 2 in Function of Rater 1 in A and Bland–Altman Plot in B (n = 107). (A) The size of the dots is proportionate to the number of patients with that score. The diagonal line shows the best fitting linear regression model. Histograms with the frequency distribution for each rater are displayed in the margins. (B) Bland–Altman plot showing the average score of both raters in function of the difference score between raters. The central solid lines show the average difference; the upper and lower solid lines show the upper and lower limits of agreement. Dotted lines represent 95% confidence intervals.

criteria (Cohen, 1992). These results suggest OxVPS measures visual perception difficulties similarly to RPAB.

Discriminant validity

The Spearman's Rho correlation between the score on the Oxford Visual Perception Screen and the score on the MOCA-B was 0.52 with a 95% CI ranging from 0.37 to 0.64 (Figure 4(A)) and is significantly different from zero ($S = 115063$, $p < .001$). The magnitude of the observed correlation suggests a moderate relationship between OxVPS and cognition as measured with the Blind Montreal Cognitive Assessment (Cohen, 1992).

Discriminant validity for sensory vision was estimated through a Spearman's Rho correlation of 0.39 between the scores on OxVPS and VISA (Figure 4(B)). The 95% CI around the estimate indicated that the true population correlation likely lies between 0.22 and 0.54 and is significantly different from zero ($S = 134973$, $p < .001$). Following Cohen's criterion, this suggests the scores on OxVPS are moderately related to sensory vision issues.

The differentiating effect of cognition and sensory vision on different subtests of OxVPS is reported in detail in the Supplementary materials. In short, OxVPS subtests with a clear cognitive component have a higher correlation with MOCA-B (e.g. Spearman rho between OxVPS Figure Copy and MOCA-B = 0.41, 95% CI: 0.14–0.55) than subtests relying on lower visual perception skills (e.g. Spearman rho between OxVPS Simple Feature and MoCA = 0.13, 95% CI: −0.05 to 0.31). Subtests Achromatopsia, Reading, and Item Counting have the highest correlations with VISA (Spearman rho 0.33 – 0.42).

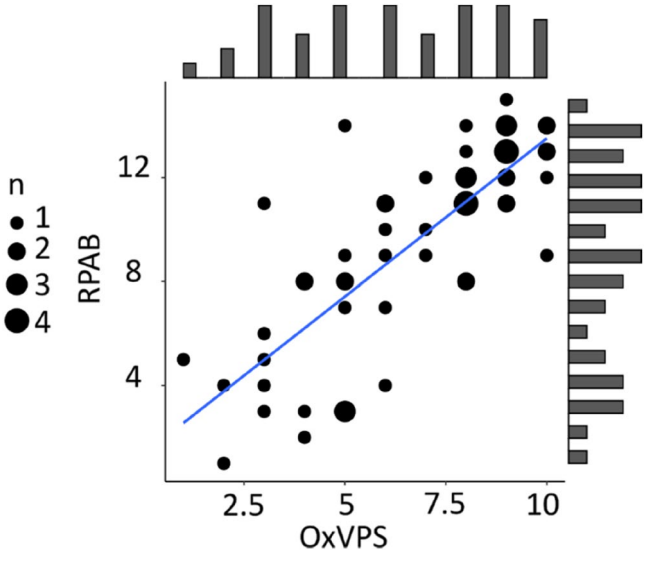

Figure 3. Stroke Survivors Scores on Rivermead Perceptual Assessment Battery in Function of Scores on OxVPS. The size of the dots is proportionate to the number of patients with that score (n = 58). The diagonal line shows the best fitting linear regression model. Histograms with the frequency distribution for each assessment are displayed in the margins.

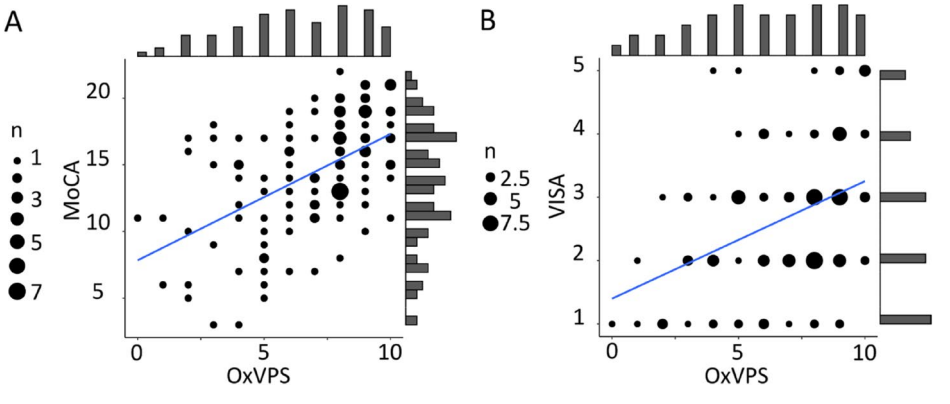

Figure 4. Stroke Survivors' Scores on the Blind Montreal Cognitive Assessment and the Visual Impairment Screening Assessment in Function of Their Score on the Oxford Visual Assessment Screen. Panel A shows scores on the Oxford Visual Assessment Screen and the Blind Montreal Cognitive Assessment (n = 113) and panel B shows scores on the Oxford Visual Assessment Screen and the Visual Impairment Screening Assessment (n = 110). The size of the dots is proportionate to the number of patients with that score. The diagonal line shows the best fitting linear regression model. Histograms with the frequency distribution for each test are displayed in the margins.

Discussion

This cross-sectional study aimed to establish the inter-rater reliability and convergent and discriminate validity of the OxVPS, a novel screening tool for visual perception difficulties following a stroke. The results indicate excellent inter-rater reliability with

raters' scores differing by less than one point on the 10-point scale of OxVPS. A large correlation between OxVPS and RPAB scores suggests that OxVPS indeed measures similar visual perception difficulties as RPAB. Correlations between OxVPS and assessments of cognition and sensory vision suggest adequate discriminant validity, however OxVPS scores are, to a certain extent, impacted by sensory vision (e.g. a patient needs to be able to see the images) and cognition (e.g. to understand task instructions and plan actions).

The excellent inter-rater reliability of OxVPS is comparable to other visual perception assessments in stroke survivors, for example, Cooke et al. (2005) assessment of the inter-rater reliability of the OT-APST showed an ICC ranging from 0.66 to 1 between nine raters (Cooke et al., 2005). As mentioned in the introduction, while other forms of reliability could have been evaluated (test–retest/intra-rater), inter-rater reliability seemed the most clinically relevant given the collaborative nature of multi-disciplinary acute stroke services in the UK (SSNAP, 2021).

The large observed correlation (rho = 0.78) between OxVPS and RPAB was higher than the correlations between other visual perception assessments and higher than the suggested minimal threshold of 0.30 for convergent validity (Koo & Li, 2016; Lezak et al., 2012). For example, in Cooke et al. (2006a) study comparing the Occupational Therapy Adult Perceptual Screening Test (OT-APST) to the Lowenstein Occupational Therapy Cognitive Assessment 2nd Edition (LOTCA; Itzkovich et al., 2000), a standardized cognitive screen used to evaluate basic cognitive and visual perceptual abilities following stroke or brain injury, most correlations fell between 0.40 and 0.80. Similarly, correlations between the Leuven Perceptual Organization Screening Test (LPOST; Torfs et al.,2014) and other neuropsychological tests of visual perception were on average 0.47 (range 0.03–0.78) (Vancleef et al., 2015).

Despite choosing the MOCA-B to avoid the measure of cognition being impacted by visual difficulties; a moderate correlation was found between scores on OxVPS and MOCA-B (rho = 0.52), which was well above the criteria of a maximum of 0.30 (Lezak et al., 2012). This suggests that OxVPS performance is not entirely independent of broader cognitive impairments. That is, patients require at least a basic level of cognitive ability, for instance to understand and remember instructions, but also some tasks within OxVPS rely on attentional and executive skills. These findings are similar to correlations in Cooke et al.'s (2006a, 2006b) study (rho = 0.25 and rho = 0.80) comparing OT-APST with the LOTCA. Likewise, high correlations (average r = 0.55) were found between performance on the LPOST (Torfs et al., 2014) and measures of executive function in the Birmingham Cognitive Screen (Vancleef et al., 2015), another stroke-specific cognitive assessment.

Our findings resonate with the debate on the interplay between cognition and visual perception: although evidence from cognitive neuroscience, computer vision, and neuropsychology case studies point to largely independent processing of visual features (e.g. colors, line orientations, textures) and integration of these features into coherent wholes without the influence of cognition (Pylyshyn, 1999), the impact of cognition gets more profound at later stages of visual perception when these coherent wholes are matched to object representations in memory or when attention or expectations prioritize identification or localization of certain objects over others during

tasks like visual search (Tacca, 2011). The OxVPS and especially RPAB focus on these later stages of visual perception where the impact of cognition is more profound. For instance, in the Figure Copy task of OxVPS and the Left Right Copying Shapes of RPAB, a patient is not only required to process simple features like line orientation and shape recognition, but also higher-level cognitive processes like sustained attention, and error detection/correction, requiring organization and planning (Watanabe et al., 2005). Other tasks in OxVPS, like the Simple Feature Perception, only require a judgment of line orientation and are less influenced by cognitive processes (see Supplementary materials). This suggests that although there is overlap between cognitive function and visual perception, there are distinct elements in OxVPS demonstrating some discriminant validity.

Our study further confirmed that the scores on OxVPS are also related to sensory visual impairments. This is despite the size of images and text within OxVPS following the recommendations from the Royal National Institute of Blind People (RNIB, 2025) to mitigate sensory vision difficulties. Nevertheless, our results are in line with a previous study on OxVPS (Vancleef et al., 2025) that demonstrated in a few case studies that while sensory vision issues (e.g. glaucoma, macular degeneration, and cataract) may impact performance on OxVPS, sensory vision issues are unlikely to be mistaken for visual perception difficulties because the pattern of subtest scores is distinct. In the current study, we did not evaluate the patterns of subtest scores on OxVPS but instead summarized a patient's performance in one criterion score. In clinical practice, the criterion score would be accompanied by a qualitative interpretation of the pattern of subtest scores as detailed in the manual (Vancleef, 2024). For instance, a pattern of low scores on the Picture Naming and Semantic Information but not on Item Counting, Global Shape Perception, and Simple Feature Perception is indicative for associative agnosia (Vancleef, 2024). The moderate impact of sensory vision on OxVPS criterion score highlights the need for an assessment of sensory vision in conjunction with OxVPS.

A strength of the study is that our sample includes patients with multiple strokes, severe strokes, visuo-spatial neglect, and aphasia (Shiggins et al., 2024). On average 23.5% of our participants had a hemorrhagic stroke compared to only 13.6% in the Sentinel Stroke National Audit Programme (SSNAP) (SSNAP, 2024). When comparing stroke severity using the National Institutes of Health Stroke Scale (NIHSS) (Ortiz & Sacco, 2007) on average 33.7% of participants had a minor stroke compared to 42.3% from SNAPP, 51.75% had moderate strokes compared to 35.6% in SNAPP and 7.5% suffered a severe stroke compared to 6.8% in SNAPP data. This suggests that our participants experienced more severe strokes than average and provides indirect evidence that OxVPS is suitable for all stroke types including severe strokes. Regarding age and gender our sample had slightly more female participants, 53% compared to 46% in SSNAP, and the average age of 74 years was slightly lower than the median age of 77 in SSNAP (but this includes non-survivors) suggesting that our sample is representative of the UK stroke survivor population.

Education data are not available in SSNAP so no comparison can be made with the national population of stroke patients. In our study, educational data were collected because of the known impact of education on neuropsychological assessments

(Finlayson et al., 1977) and as an indicator of deprivation. Data on education was available from only 61% of participants and 69% of them either had no qualification or a certificate of secondary education as their highest level of education. The national census of 2011 indicated that 52% of the UK population had similar education levels (Office for National Statistics, 2011). This suggests that our sample included more lower educated participants compared to the general population (Hewitt, 2020) thus increasing generalizability within social determinants.

There is a lack of ethnic heterogeneity within our sample with 98% considered White compared to 81.5% in SSNAP. This reflects the predominantly White population in the catchment area of each of our three sites: ~93% at two sites and ~96% at one (Office for National Statistics, 2021). Ethnicity could potentially impact performance on OxVPS, for example, the other-race effect (Wong et al., 2021) may impact scores in the face recognition tasks since all the faces are of White European ethnicity. There is evidence that no matter the amount of immersion in a multi-racial society, the other-race effect is not necessarily eliminated (Wong et al., 2020). While it is the aim to develop cultural variations of the OxVPS to meet the needs of multiracial society, the current study does not sufficiently demonstrate the reliability and validity of OxVPS in participants across a range of ethnicities.

Conclusion

The results of this study indicate that OxVPS has good validity and reliability for screening stroke survivors for visual perception difficulties. Although OxVPS is related to cognition and sensory vision, there is enough evidence to suggest adequate discriminant validity. This means OxVPS offers clinicians a screening assessment which reliably measures visual perception difficulties consistently across administrators.

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Ethical approval and informed consent statement

This study has received ethical approval from the Health Research Authority, REC reference 23/EM/0086, by the Derby Research Ethics Committee. All participants described in the study have provided written informed consent for all aspects of the study, including dissemination of the results in accordance with the approved ethical guidelines.

Authors' contributions

KC: Methodology, Validation, Investigation, Resources, Visualization, Supervision, Project administration, Writing-Original.

FT, AK, SW: Investigation, Writing-Review, and editing.

RD, RT: Supervision, Resources, Writing-Review, and editing.

LS: Conceptualization, Methodology, Validation, Writing-Review and editing, Funding acquisition.

ND: Conceptualization, Methodology, Validation, Supervision, Writing-Review and editing, Funding acquisition.

KV: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Resources, Data Curation, Writing-Original draft, Visualization, Supervision, Project administration, and Funding acquisition.

All coauthors have approved the final version of the manuscript for submission.

Disclosure statement

KV and ND are developers of the Oxford Visual Perception Screen but do not receive any remuneration from its use.

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Data availability statement

The dataset and analysis code are available on Open Science Framework: https://osf.io/s7ehx/. Cowen, K., Tabone, F., Webb, S. S., Kusec, A., DaSilva, R., Thomas, R., … Vancleef, K. (2025, September 19). Reliability and Validity of the Oxford Visual Perception Screen in Sub-Acute Adult Stroke Survivors. https://doi.org/10.17605/OSF.IO/S7EHX

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