Neuropsychological assessment of reading ability, cognitive performance and questionnaire-domains in people with Homonymous Hemianopia: a Feasibility study

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Abstract

Homonymous hemianopsia is a visual field defect that has a negative impact on activities in daily life and quality of life. Due to a lack of high-quality research into the effectiveness of many rehabilitation methods, this project investigates the feasibility of a neuropsychological test battery, which is used to measure the effectiveness of two reading training interventions in homonymous hemianopsia patients. In this project, a case study was used by means of a mixed method design. The neuropsychological test results were quantitatively examined for validity and feasibility. In addition, a semi-structured interview was qualitatively analyzed to assess the feasibility of the neuropsychological assessment. Although deviant or low scores have been found on several tests (reading speed, verbal fluency professions and letter fluency, Bourdon-Wiersma), no unambiguous indication has been found in this project that shows that the neuropsychological tests used are insufficiently feasible for the target group homonymous hemianopsia. Despite this, various studies show that visual impairments may have negative effects on several vision-dependent neuropsychological tests and question the validity of these tests for people with a visual impairment. The effect of the visual impairment on the vision-dependent neuropsychological tests seems to be dependent of the characteristics of various patient groups. Homonymous hemianopsia patients seems to be able to compensate through eye and head movements by preserving vision in the remaining visual field. However, this project has also shown that testing should carefully deal with the complaints common for people with homonymous hemianopsia (altered light sensitivity, fatigue and reading problems) as these can have an effect on test performance. The findings from this project have led to recommendations for improvement of the validity and feasibility of the tests used in the neuropsychological assessment. In addition, some suggestion are made for follow-up research into the feasibility of neuropsychological assessment in homonymous hemianopsia patients. The current findings may contribute to the quality and feasibility of the research into the effectiveness of reading training interventions in people with homonymous hemianopsia.
Keywords: Homonymous hemianopia, neuropsychological assessment, feasibility, validity

Introduction

Homonymous hemianopia (HH) is a condition in which people have lost vision in both eyes for half of their visual field (Hazelton et al., 2021; De Haan., 2016). Postchiasmatic damage of the visual pathway results in visual field loss ipsilateral of the retina in both eyes, also known as homonymous visual field defect (HVFD) and leads to vision loss in one side of the visual field (Hazelton et al., 2021; De Haan, 2016). Depending on the size and the location of the brain lesion certain parts of the visual field may be lost, which may appear as a hemianopia (half of the visual field affected), quadrantanopia (quarter of the visual field affected), scotoma (smaller part of the visual field affected) or any form in between (De Haan., 2016). HH is the most common form of HVFD and a common finding after acquired brain injury (Spikman., 2017). Due to the underlying brain injury that causes HH, the visual information may not be sufficiently processed in the brain, leaving the eyes' functionality unaffected. Most instances of HH in adults are caused by stroke (52% - 70% of the total HH prevalence), after which traumatic brain injury (14% of the total HH prevalence) and tumors (11% of the total HH prevalence) are the two most common causes (Goodwin, 2014).

Damage due to acquired brain injury often causes long-term invisible consequences, such as fatigue, forgetfulness, headaches and a reduction in concentration (Spikman, 2001; Van Beelen, 2018). Fatigue is by far the most common complaint, which often has a negative effect on cognitive functioning and the execution of activities of daily living (ADL) (Bol et al., 2009; Wu et al., 2015). Fatigue is also often experienced in HH patients, where NAH is at the root of the condition (de Haan et al., 2016). HVFD causes a clear impact on functioning in everyday life. Difficulties with mobility and navigation are reported by people with HH and lead to falls, injuries and unwillingness to leave home (Hazelton et al., 2015; Hazelton et al., 2019). In addition HVFD causes various limitations in ADL, including key ADL such as grooming and feeding. Furthermore, limitations in activities such as driving, shopping, financial management, telephone usage, reading performance and writing performance are often experienced (Warren., 2009). Reading problems are a frequently reported complaint, experienced by 80% of HH patients (de Haan et al, 2016; Ong et al., 2012). The research done by Warren (2009) showed both limitations in reading accuracy and in corrected reading speed in 46 quadrantanopia or hemianopsia patients. Of these patients, 79% had difficulty reading words and 59% reading numbers. In the research of Spikman (2017) it appears that a right-sided HH often causes problems with being able to read fluently and a left-sided HH with finding the beginning of the next line. In both cases, reading is more difficult for HH patients,

which may have a negative effect on the reading performance. In addition, severe persistent reading problems, also known as hemianopic dyslexia, are diagnosed in the majority of HH patients (Schuett et al., 2009) Hemianopic dyslexia is characterized by a decreased reading speed, visual omissions, guessing errors and altered reading eye-movement pattern (Leff et al., 2000; McDonald et al., 2006; Spitzyna et al., 2007; Trauzettel- Klosinksi et al., 1998; Zihl, 2010) The reading problems may be partly explained by the fact that HH patients are simply less able to see the text due to limited vision by the HVFD. In addition, altered reading eye-movement patterns contribute to making reading more difficult. Additionally people with HVFD often experience reading comprehension problems, because omitted words cause context to be lost a lost and because the high cognitive effort which is needed for visuoperceptual processes distracts the patient to from retaining information (Weinberg et al, 1979). Moreover, in a study into the consequences of HH for daily life, it was found that 94% of HH patients experience light differently after the onset of the NAH (de Haan et al., 2016). Of these HH patients, 52% indicated that everything seems darker, and therefore more light is needed to read than before the acquired brain injury. In addition, 54% experienced being blinded by bright light more quickly than before and 56% indicated that they had difficulty transitioning from a dark to a light environment and vice versa (de Haan et al., 2016).

The perceived difficulties in ADL and mobility cause psychological consequences, such as increased fear and reduced self-confidence (Hazelton et al., 2015; Rowe., 2017). Social isolation, depression and decreased quality of life (QoL) are also reported in people with HVFD due to the consequences of HVFD on functioning in everyday life (de Haan., 2016). In particular, vision-related quality of life (VRQoL), is correlated with the extent of the HVFD and can be severely reduced (Gall et al., 2010).

Full or partial recovery of HVFD may occur within the first months after the acquired brain injury, but is not guaranteed (Ali et al, 2013; Goodwin, 2014; Zhang et al., 2006). Most recoveries are observed within the first 3 months after the brain injury, and 50% to 69% of cases are observed in the first month (Spikman, 2017). The chance of further recovery severely decreases after 6 months (Spikman, 2017). In most patients the HVFD persists and with it the limitations in mobility, ADL and the consequences on mental well-being (de Haan., 2016; Warren., 2009).

The difficulties in ADL can be related to the amount of visual search capacity needed to complete them (Warren, 2009). A change in eye movements; insufficient and small saccades towards side of the vision loss, exacerbates the loss of visual information. As a consequence of the inefficient scanning method that is often used in people with HH, it takes more time to

gain a complete overview of the environment (Zihl., 1999; de Haan., 2016; Tant, Cornelissen, Kooijman, & Brouwer, 2002). Several studies found that effective visual search behavior is associated with successful completion of ADL (Hardiess et al., 2010; Martin et al., 2007; Papageorgiou et al., 2012; Pflugshaupt et al., 2009). Therefore, visual rehabilitation methods are of high importance to reduce the visual disability and improve ADL and QoL in people with HH (Goodwin., 2014).

Finding effective interventions for HVFD is a top ten research priority in stroke patients (Pollock et al., 2012). Three common treatment options for HH patients are prismatic correction, compensatory training and vision restoration therapy. Whereby the first focuses on expanding the remaining visual field, the second on adapting viewing behavior and improving visual search abilities, and the third on enhancing the vision itself (Goodwin, 2014; Spikman, 2017). In compensatory training, compensatory eye movements towards the side of the visual field loss are trained. The eye movement trainings aims at larger, less repetitive and more frequent eye movements and thereby improving visual search and mobility (Passamonti et al., 2009; Schuett., 2009; Aimola et al., 2014; Hayes et al., 2012). The compensatory principle is also applied in reading training that focuses on improving the reading ability in people with HH. Reading training focusses on small left-right eye movements, which are required to read a text (Hazelton et al., 2021).

Despite the promising developments in treatment approaches, there is a lack of high-quality evidence examining the effectiveness of the compensatory treatment approaches (Hazelton et al., 2021). This lack of evidence is a barrier to improving HVFD-related rehabilitation care (Pollock et al., 2011). Therefore, high quality and adequately powered studies providing evidence of the effectivity of the promising compensatory training are needed (Hazelton et al., 2021; Hazelton et al., 2019). A 2011 Cochrane review also underlined the need to conduct research into the effectiveness of compensation training for specific scanning tasks and reading tasks in stroke patients (Pollock et al., 2011). On many studies that have been done on the effect of the compensatory training, methodological comments can be made; such as that many of these studies do not include control groups and that there are insufficient research results to measure the effect of training on ADL (Spikman, 2017). For this reason, the advice in the 2011 Cochrane study was to investigate training effects by means of a randomized controlled trial (RCT), with ADL as outcome measures (Spikman, 2017). To this end, Bartiméus, Royal Dutch Visio and the University of Groningen have initiated a pilot study to gain insight into the effectiveness of two reading training interventions: a saccadic compensation training called ‘Vistra’ and a Rotated Reading training

in people with HH due to acquired brain injury. In the pilot study, the effectivity of two reading training interventions will be assessed using reading ability as primary outcome measure. The reading ability will be assessed by means of a 0-measurement and a 1-measurement using a composite neuropsychological test battery. The neuropsychological test battery includes questionnaires, a visual test and cognitive tests, where the cognitive tests are used to measure the domains of reading ability, attention, memory.

To ensure high quality and adequately powered studies providing evidence of the effectivity of the reading training in HH patients, it is important that the materials are sufficiently feasible and valid for people with HH (Bowen et al., 2009; Hazelton et al., 2021). Many neuropsychological tests are designed to detect cognitive disfunction, whereby the norm groups often correct for gender, age and education level (de Haan et al., 2018). However, many neuropsychological tests do not take into account the effect of possible sensory limitations such as visual impairment, blindness, hearing impairment and deafness on neuropsychological testing (Hill-Briggs et al., 2007). The test materials of many neuropsychological tests are presented visually. It is unknown to what extent people with a visual impairment, such as people with HH, have difficulty properly observing the test material (de Haan et al., 2018). For this reason, a visual impairment may negatively affect the neuropsychological test results of tests that are designed to measures cognitive domains, instead of visual impairment. This may jeopardize the validity of the vision-dependent neuropsychological test (de Haan et al., 2018). A number of neuropsychological tests do contain patient norm groups, but only in a few cases for patients with a visual impairment and no norm groups have been specifically developed for the target group HH (Gallagher et al., 2017). Since it is not known to what extent the visual impairment has an effect on test performance and many neuropsychological tests do not correct for the visual impairment, abnormally low scores in people with a visual impairment can be difficult to interpret. In these cases, it is unclear whether the low score can be explained by difficulty perceiving the visual test material or by an actual poor cognitive functioning (de Haan et al., 2018). In addition, the study of Kempen (1994) showed a significantly poorer performance by low-near vision participants with a Jaeger near vision of J5 or worse compared to a control group with normal near vision of J1 and the published norm group of each test on two out of the three vision-dependent neuropsychological tests of visual processing[1]. According to this study

[1] In the study of Kempen (1994) significantly poorer performance was found on the Benton's facial recognition and Visual form discrimination. No significant effect was found on the Judgement of line orientation.

(Kempen et al., 1994), visual impairment can result in unexpectedly low scores on processing-related vision-dependent neuropsychological tests. These findings imply that poor vision and possibly other visual impairments may also have an impact on the test results of other neuropsychological tests that involve vision by using visual test material. Feasibility studies examine the feasibility and acceptability of interventions and methods of use and are therefore useful to explore the applicability of neuropsychological tests in low vision patients or HH patients (Aschbrenner et al., 2022). Mixed methods designs are increasingly being used in feasibility studies, to optimize what can be learned from the feasibility study (Aschbrenner et al., 2022; Sarika et al., 2019; Vin et al., 2015). Mixed methods integrate quantitative and qualitative data and this gives them the potential to develop a comprehensive and nuanced understanding of feasibility (Aschbrenner et al., 2022; de Boer, 2006). In a mixed methods design, a qualitative interview can be used to give meaning to quantitative data; to explore how the intervention or methods were experienced (Blasi et al., 2022; Bowen et al., 2009; Hazelton et al., 2021). Furthermore, case studies are a research method especially suitable for collecting concrete contextual and comprehensive knowledge about a specific topic or person (Flyvbjerg, 2011; Lacey et al., 2015; Larson, 2015; Woelders et al., 2018).

The aim of the current project is to investigate the feasibility and validity of the neuropsychological test battery that is used to measure the reading ability, cognitive performance and questionnaire-domains in people with HH due to acquired brain injury. For this purpose, three research questions have been formulated that will be investigated by means of a case study. The case is a participant of the effectivity study into two reading training interventions in HH patients. First, the question “Can the researchers obtain the intended information from the neurocognitive test battery, i.e., do the test results retain validity if they are administered to people with HH?” will be investigated. Because visual impairment may have an impact on vision-dependent neuropsychological test results, the hypothesis is that the participant with HH scores lower than expected based on the norm groups of the vision-dependent neuropsychological tests (Kempen et al., 1994). The second question is: “Is the duration of the neuropsychological examination (NPE) as expected?”. HH patients are less able to perceive visual information due to the HVFD and often experience more severe fatigue than NV people (de Haan et al., 2016; de Haan et al., 2018; Schakel et al., 2019). Therefore, the hypothesis is that the participant with HH has difficulty to complete the NPE within the duration of 2 to 2.5 hours , that is standard for normal vision (NV) people (based on the test duration as described in the test manuals). The third question is: “How is the NPE experienced by the participant with HH?” The experience of the participant can be used to

adjust the NPE, so that it is better suited to people with HH. In addition, the subjective experiences may reveal other factors that have an effect on the feasibility of the NPE.

Methods

Design and procedure

For this feasibility study a mixed method case study design is used (Figure 1). Answering the research questions requires both a quantitative (NPE) and qualitative (semi-structured interview) approach. The quantitative results of the NPE measures the occurrence of deviating test results, but do not yet give meaning to the test results. By conducting a qualitative semi-structured interview, meaning can be given to the quantitative data through processing of the participant's experience with the NPE. In addition, the qualitative semi-structured interview may reveal other factors that can be used to adequately tailor the test battery to clinical practice. The NPE and the semi-structured interview are conducted by a researcher of the University of Groningen. During all assessments, protocols are used to ensure the reliability of the measurements. This study was approved by the Medical Ethical Committee of the University Medical Center Groningen and informed consent of the participant was obtained.

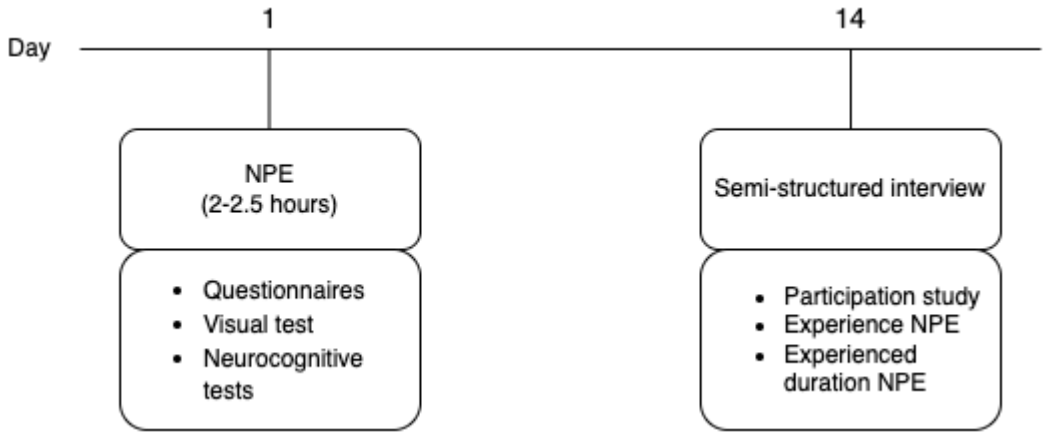

Figure 1.

Research design with corresponding measures and time span between measurements.

Case Description

Inclusion and exclusion criteria

The participant is eligible for the case study when the participant is aged 18 years or older, has a either right- or left-sided HVFD or at least quadrantanopia, there are at least three

months between the onset of HVFD and the first measurement, the participant has difficulties with reading, that are caused by the HVFD, the near visual acuity of the participant is ≥ 0.5 with the participant's own current correction, the participant's MMSE score is ≥ 24 and the participant has formulated a treatment goal regarding reading. The participant will be excluded from participation when there is either an additional visual field defect (at least cluster) in ipsilesional visual hemi-field, pre-existing dyslexia, illiteracy, low literacy or other pre-morbid reading problems, no clear neurological cause of HVFD or presence of comorbid neglect.

History

The participant is a 56-year-old Dutch female with an education level of 6 according to the Verhage classification and suffered [redacted] (Bouma et al., 2012; Verhage., 1964) [redacted] An MRI scan was made in 2021 [redacted] the HH remained. The participant experienced several symptoms: [redacted] Even after adjustment of the contact lenses and rehabilitation therapy for HH the symptoms remain when reading and walking. [redacted] An additional visual field measurement in the spring of 2021 with the Humphrey visual field 24-2 (HVF 24-2) revealed a left-sided HH with macular splitting visual field loss. During neuropsychological assessment the participant wore glasses if applicable.

Materials and measures

NPE

The NPE consists of questionnaires, a visual tests and neurocognitive tests with an expected duration of 2 to 2.5 hours (based on the test duration as described in the test manuals) (Figure 1). The questionnaires are used to assess the feasibility of the questionnaire's administration procedure in HH patients. The results of the questionnaires are not used for the purpose of this project. The visual test was used to exclude an restrictive near vision of the participant at the time of NPE. Finally, neurocognitive test performances were

assessed to investigate the validity of the neurocognitive tests in people with HH. The validity of the NPE is questioned by analyzing the validity of each test individually. Although, a distinction was made between vision-dependent neuropsychological tests and vision-independent neuropsychological tests.

Questionnaires. Three consecutive questionnaires were read to and filled in with the participant. The 32-item 0-measurement version of the Hemianopia Reading Questionnaire (HRQ) is a subjective assessment of reading skills, attitude towards reading, reading activities, motivation and confidence in the training (Appendix A). The appreciation for reading is assessed based on one's own reading attitude and reading skills. The HRQ is a newly developed instrument whose psychometric qualities are currently being investigated (Scheper, 2021). The Fatigue Severity Scale (FSS) is a 9-item questionnaire that measures the severity of fatigue symptoms in everyday situations (Ozyemisci-Taskiran et al., 2019). The scores are rated on a 7-point scale, where a higher score indicates more fatigue. The National Eye Institute Visual Function Questionnaire 25 item (NEI-VFQ-25) is designed to measures the self-reported vision-related quality of life (QoL) (Cole et al., 2000). These items are rated on a 6-point scale, where a higher score indicates that more difficulty was experienced performing an activity.

Visual test. The Early Treatment of Diabetic Retinopathy lettercard (ETDRS charts) is administered to measure the participant's near vision with glasses or lenses if applicable (Trauzettel-Klosinski et al., 2012). The outcome measure of the ETDRS charts is the number of correctly read letters.

Neurocognitive tests. To assess the participant's cognitive performance, several neuropsychological tests were administered (Table 1).

Table 1

Neuropsychological tests with corresponding measurement pretensions and outcome measures

Neuropsychological test	Measure pretension	Outcome measure	Visual component
Mini Mental State Examination (MMSE)[a]	Overall cognitive functioning	Number of correct answers	Yes

Reading Speed Texts (IReST)[b]	Objective reading level; reading speed and reading errors	Words per minute	Yes
Subtask 'read paragraphs' of the Comprehensive Aphasia Testbattery (CAT)[c]	Reading comprehension	Number of correct answers	Yes
Subtask Digit Span of the Wechsler Adult Intelligence Scale IV (WAIS-IV)[d]	Verbal working memory, attention and executive functioning	Number of correct digit spans	No
Verbal Fluency Test (VFT)[e]	Verbal working memory, attention and executive functioning	Number of named words	No
Subtask 'story' of the Rivermead Behavioral Memory Test (RBMT)[f]	Verbal short term memory and long term memory of coherent information	Number of remembered elements	No
Subtask 5 of the Token Test[g]	Exclude (severe) aphasia	Number of correct actions	Yes
Free drawing test[h]	Exclude neglect; spontaneous visual and constructive skills	Symmetry and omissions of the drawing	Yes
Line bisection[i]	Exclude neglect; unilateral neglect	Number of omissions	Yes
Clock drawing test[j]	Exclude neglect; attention, visual semantic memory, working memory, visuospatial skills and executive functioning	Correct number of scoring criteria	Yes
Bells Test[k]	Exclude neglect; lateralized attention and	Differences in omissions between the	Yes

	spatial cognition	left and right column	
Bourdon-Wiersema Test[l]	Sustained attention	Average time per line	Yes

Note. Corresponding references: [a]Knipping, (2018). [b]Trauzettel-Klosinksi et al., (2012). [c]Springer et al., (2010). [d]Wechsler, (2000). [e]Lezak et al., (2012). [f]Wilson et al., (1991). [g]van Dongen et al., (1976). [h]Plummer et al., (2003). [i]Schenkenberg et al., (1980). [j]Elzen et al., (2004).[k]Plummer et al., (2003). [l]Bourdon et al., (1977).

Semi-structured interview

Within fourteen days of the NPE, a qualitative semi-structured telephone interview was conducted, in which the participant's experience with the specific questionnaires, visual task, reading and cognitive tasks was questioned. Besides the questions on participation into the effectivity study of two reading training interventions in people with HH, the experienced duration of the NPE and the overall experience with the NPE was questioned (Figure 1). The semi-structured interview is based on a study by Dowrick (2013) (Appendix B).

Data analysis

Cut-off scores or norm groups were used for the calculation of neurocognitive test performance. The Digit span, VFT and Bourdon-Wiersma were converted to percentile scores and labeled using norm groups. Test results were rated as deviant or very low when the score is lower than in 95% of the norm population (≥ 2 standard deviations), which corresponds to a percentile score of 2 or lower (Kochan et al., 2010). Cut-off scores were used for the MMSE, CAT, Token test, Line bisection, Clock drawing and Bells test. The Free drawing test is qualitative assessed. If the object was asymmetric or had omissions or distortions on one side of the drawing, this was indicated for neglect. The ETDRS charts was considered to be normal at a near vision of >=0.5.

The results of the semi-structured interview were processed qualitatively through transcribing and coding. The semi-structured interviews were partly transcribed manually and partly by using happy scribe (Scribe, n.d.). The transcribed semi-structured interviews were completely encoded in the Atlas ti program (Poleschuk & Riopelle, 2022). Codes were added to the transcribed interviews by means of open coding. Subsequently, codes were merged and renamed using axial coding, from which the code tree was subsequently created. Finally, selective coding was applied to make the mutual structure between the codes visible.

Results

NPE

The NPE took two hours and reveals deviant test results on some neuropsychological tests (Table 2).

Table 2

Raw and edited test scores of the NPE and corresponding labels

Test	Raw score	Edited score	Label
MMSE[a]	[redacted]		Normal
ETDRS			
Letter size	[redacted]		Normal
IReST[b]			
Time (seconds)	[redacted]		
Total correct words	[redacted]		
Word per minute	[redacted]		Deviant
Reading errors	[redacted]		
CAT: subtask 'read paragraphs'[c]	[redacted]		Normal
Digit span[d]			
Forward	[redacted]	Percentile 40	Average
Backward	[redacted]	Percentile 30-50	Average
VFT[e]			
Word fluency: animals	[redacted]	Percentile 20-50	Average
Word fluency: professions	[redacted]	Percentile <1	Very low
Letter fluency: D, A, T	[redacted]	Percentile <1	Very low
RBMT-story[f]			
Immediate recall	[redacted]		Average
Delayed recall	[redacted]		Average
Token test[g]			
Total correct actions	[redacted]		No indication for aphasia
Number of color errors	[redacted]		
Number of shape errors	[redacted]		
Number of action errors	[redacted]		
Free drawing			
Symmetric	[redacted]		No indication for neglect
Omissions or distortions	[redacted]		
Line bisection[h]			
Mean deviation	[redacted]		
Mean deviation left	[redacted]		
Mean deviation middle	[redacted]		
Mean deviations right	[redacted]		
Number of omissions	[redacted]		No indication for neglect
Clock drawing test[i]	[redacted]		No indication for neglect
Bells test[j]			
Start	[redacted]		
Strategy	[redacted]		

Total number of bells			
Errors column 1 to 3			
Errors column 5 to 7			
Omission differences between left and right columns			No indication for neglect
Total errors			
Bourdon-Wiersma[k]			
Total time			
Average time per line		Percentile <10	Low
Total number of errors			

Note. Norms of Bouma et al., (2012) are used for interpretation.

Norm groups: [b]Reading level of children, 9-12 years Trauzettel-Klosinksi et al., (2012). [e]Women, high education level, 55-60 years, van der Elst et al., (2006). [k]Women and men, 50-59 years, Grewelf, (1953). [f]Man and women with brain injury, 14-69 years, Wilson et al., (1991). [d]Women, high education level, 50-59 years, Wechsler, (2000). Cut-off scores: [a]MMSE: Knipping, (2018). [c]CAT: *Springer et al., (2010)*. [g]Token test: *van Dongen et al., (1976)*. [h]Line bisection: *Schenkenberg et al., (1980)*. [i]Clock drawing test: Elzen et al., (2004). [j]Bells test: Gauthier et al., (1989).

Semi-structured interview

The codes that are created during the open coding, are merged and renamed during axial coding, from which the code tree is subsequently created. The codes of the code tree are linked to each other during selective coding by means of a network analysis (Figure 2). The network analysis focuses on the experience with the NPE and shows that the clusters ‘experienced difficulty with the NPE’, ‘physical factor’ and ‘social emotional factor’ play a role in the experience with the NPE. The cluster ‘social emotional factor’ shows that the importance of reading in daily life is a motivation for the participant to participate in the study. The cluster ‘physical factor’ shows that the experienced duration of the NPE may be influenced by the severity of the fatigue symptoms and the medical condition of the participant. Additionally, the cluster ‘experience with the NPE’ reveals that the two factors time pressure and concentration influence the perceived difficulty of the cognitive tests in the participant.

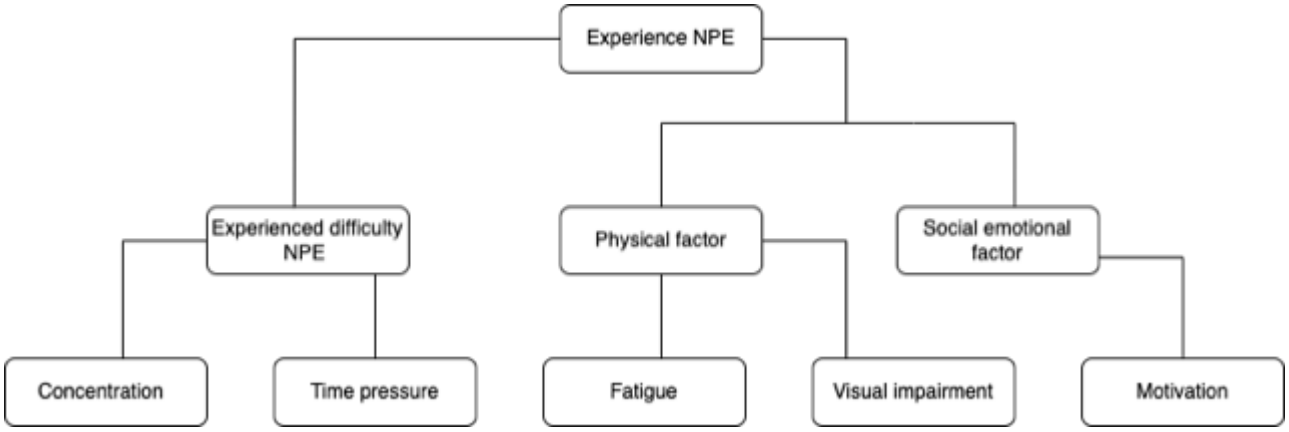

Figure 2.

The network analysis shows the questioned elements (codes) that are important in the evaluation of feasibility of the NPE. The way in which the elements relate to each other is shown schematically.

Physical and social emotional factors

NPE focuses on measuring cognitive performance. However, in practice, motivation, physical and mental fitness can affect cognitive test performance (Hill et al., 2018; Matias-Guiu et al., 2022). In order to be able to interpret the test results of the NPE properly, it is important to question these factors. The semi-structured interview shows that the participant is highly motivated to participate in the study into the effectiveness of two reading training interventions in HH patients and therefore for the NPE, because reading is an important part of her life:

[redacted]

Note: For the purpose of this paper the quotes are translated into English.

As an indication of the physical and mental fitness, the participant was asked how the duration of the NPE was experienced. The semi-structured interview shows that the participant experienced the length and duration of the NPE as excellent. In addition, the NPE in general was perceived as good and the participant experienced the contact with the researcher as pleasant.

[redacted]

Experienced difficulty with the NPE

The participant generally experienced the NPE as easy, but in some tests it was more difficult. In tests with a time limit, for example the VFT, the participant reported time pressure:

[redacted]

The participant experienced the reading of the questionnaires by the researcher as pleasant. However, the participant would have liked to fill in the questionnaires herself, so that she did not have to mention the answer options verbatim.

[redacted]

A final finding from the semi-structured interview is that it was unclear to the participant which tests are reading tests and cognitive tests: a reading test is confused for a cognitive test.

Discussion and conclusion

This project investigated whether the NPE of use is sufficiently feasible and valid for HH patients. To this end, the validity of the NPE for people with HH was assessed. Additionally, is was examined whether the duration of the NPE remained within the expected 2 to 2.5 hours and how the NPE was experienced by the participant with HH.

Validity of the NPE

ETDRS. The ETDRS shows that the near vision of the participant is normal. The study by Macnamara and colleagues (2021) shows the importance of researchers to take into account the effect of limited vision on cognitive test performance. It is therefore advisable to incorporate simple screening tasks, such as the ETDRS charts, into the NPE and to assess near vision prior to cognitive measurement (Kempen et al., 1994; Macnamara et al., 2021). The ETDRS, is seen as adding value in increasing the validity of the NPE, by excluding restrictive near vision of the participant (Macnamara et al., 2021). For this reason, it is considered unlikely that deviating neuropsychological test scores can be explained by restrictive near vision.

Vision-dependent neuropsychological tests and questionnaires

Questionnaires; HRQ, FSS, VFQ. The test result of the IReST test shows that the participant has achieved a deviating reading speed. This suggests that there is impaired reading performance, as is often seen in HH patients and quadrant anopsia (Warren, 2009). In the current study design, an attempt was made to take into account the reading problems by reading the questionnaires to the participant. An advantage of this method is that the researcher has control over the speed with which the text is read aloud. In this way, an average reading speed can be maintained and the progress of the NPE is not slowed down the reading speed of the participant. Another advantage of reading the questionnaires aloud is that the participant is likely to need less cognitive load and less effort to establish visual perception to complete the questionnaire (Schakel et al., 2017). Requirements for reading questionnaires are that the participant must be able to hear well, the researcher speaks loud enough, articulates clearly and the participant must be able to understand and speak the language well. A possible adverse effect of this method is that there is less privacy when reading aloud and jointly completing a questionnaire (Mneimneh, 2012). Answering the questions to the researcher can be experienced as painful or shameful for the participant and may increase the chance of socially desirable responses (Braun et al., 2001; Mneimneh, 2012). Social desirable answers may negatively affect the validity of the questionnaires. In a healthy target group, independent reading and completing of questionnaires is preferred, in order to prevent socially desirable responses and miscommunication. However, in the target group HH, the need to limit fatigue effects and keep the duration of the NPE within the standard duration so that neuropsychological tests remain feasible in HH patients, make this method preferable.

MMSE. The participant obtained a normal test result on the MMSE. In the study of de Haan and colleagues (2018), no indication was found that low visual acuity (of 0.2 or lower)

negatively affects the test results of the MMSE in a healthy group of participants (N= 238) aged 50-80 years, where visual acuity is simulated by means of simulation glasses. This is in contrast to the study of Beker and colleagues (2019), where normative data was generated for 15 neuropsychological tests in 235 healthy centenarians while taking sensory limitations into account. This study shows that in 60% of the participants vision was mentioned as a reason for test incompletion. The results of Beker and colleagues (2019) suggests that vision may have a negative impact on the test results of the MMSE in healthy centenarians with sensory limitation, such as impaired vision. Since the participant in this case study obtained almost a full score on the MMSE and it is unclear to what extend studies on low near vision can be generalized to HH patients (de Haan et al., 2018), there is no indication that the MMSE is insufficiently valid for HH patients.

When deviating test scores on the MMSE frequently occur in follow-up research into the effectivity study of two reading training interventions in HH patients, this could be an indication that the visual impairment has a negative impact on the MMSE test performance. Then, it may be considered to calculate the MMblind score (de Haan et al., 2018; Pye et al., 2017). The MMblind is a shortened version of the MMSE, which can be calculated after the MMSE has been assessed, by excluding the scores of the visual items (naming objects, editing a sheet of paper, reading a sentence aloud, writing down a sentence and drawing a figure). In this way, a visual impairment cannot have an effect on the test result (de Haan et al., 2018). For the calculation of the MMblind score, norm groups developed by Busse and collegues (2002) can be used. To investigate the validity of the MMSE, the MMblind score of each participant could be calculated in the follow-up research. An important note is that the MMblind tasks are found to be easier, so that a higher score can be expected on the MMblind in advance, which does not have to indicate a negative effect of visual impairment. However, if the difference between de MMSE score and MMblind score is found to be significantly larger in HH patients than in a healthy control group, this could be an indication that the HH has influenced the MMSE score due to the HVFD. Conversely, smaller non-significant differences could be an indication that the HH has no effect on the MMSE score and suggest no negative impact of the HVFD on the MMSE test performance in HH patients.

IReST, The participant achieved a deviant reading speed on the IReST, as is often seen in HH patients (Warren, 2009). The IReST is a widely used test to measure reading performance in NV people and in people with various visual impairments (Mathews et al., 2017; Pondorfer et al., 2020; Swenor et al., 2017; Trauzettel-Klosinski et al., 2012). Literature shows that the IReST is highly predictive in everyday reading and therefore suitable for

evaluating the effects of visual impairments and measuring the effectiveness of interventions (Rubin., 2013; Trauzettel-Klosinski et al., 2012). The IReST is suitable in the assessment of reading speed in neurological reading disorders such as HH (Trauzettel-Klosinski et al., 2012) and is therefore considered to be valid to measure reading performance in HH patients.

Subtask 'read paragraphs' of the CAT. The participant obtained a normal score on the CAT, which indicates that the reading comprehension is of normal performance. According to Howard and colleagues (2010) the CAT is psychometrically well-constructed and clinically feasible. In addition the assessment of the CAT reading paragraphs is quick and contains short paragraphs, minimizing the participants cognitive effort and potential fatigue effects. Since this test is used in the current project to measure affected reading comprehension due to the HH, it is desirable that the HH interferes with the test result and measures possible limitations in reading comprehension i.e. this test is valid for HH patients.

Token test. The participants performance on the token test shows no indication for (severe) aphasia. To differentiate between a cortical language processing disorder i.e. aphasia and a peripheral visual loss, Smith (1985) discusses the importance to assess the patients vision (visual field defect and visual acuity) and to assess the language processing abilities by means of aphasia examination which is not biased by visual impairment. Such an examination would contribute to more valid assessments with regard to language processing in HH patients (Smith, 1985). Regarding the first point, the current project already measured the patients vision by using the ETDRS charts. Regarding the second point, Smith (1985) recommended to use objects rather than pictures and if pictures are used they should be large, simple and distinctive, so that it simplifies the visual discrimination task for the HH patient. The token test uses objects, tokens, which are seen as relatively large, simple and distinctive. In addition, prior to the test, the participant is asked to name the color and shape of the tokens (van Dongen et al., 1976). From this it can be determined if the discriminating ability for the shape and color of the participant is sufficient. Because the discriminating ability of the participant is tested and an insufficient near vison is excluded with the ETDRS charts, the probability of interference of the HVFD on the test performance is considered small. This was confirmed by Boller and colleague (1966) who found the token test as a good discriminating tool between aphasic and non-aphasic cerebrally damaged patients.

Free drawing test. The participant's performance revealed no indications for neglect on the Free drawing test. Literature supports the differentiating ability of the Free drawing test between neglect and HH. Where incomplete drawings of test objects with omissions or distortions are characteristic for neglect patients, HH patients appear to have no difficulty in

making a drawing of a test object from memory and complete symmetrical drawings (Fallrath., et al 2015; Plummer et al., 2003; Ting et al., 2011; Zihl et al., 2009). Therefore the Free drawing test is considered to be valid to exclude neglect in HH patients.

Clock drawing. The participant achieved a normal score on the clock drawing test. This result contradicts with literature about the effect of a visual impairment on test performance of the Clock drawing test. The study by Beker and colleagues (2019) shows that 60% of centenarians with sensory limitation mentioned vison as a reason for incompletion of the clock drawing test. In addition, Pye and colleagues (2017) compared the standard written clock drawing test with the vision-independent clock drawing test in 74 visually impaired people compared to 76 NV people. The results show that visually impaired people performed significantly poorer on the standard clock drawing test compared to NV people (Pye et al., 2017). However, the participant in this case study achieved a full score, which indicates no effect of the visual impairment on the test performance of the clock drawing test. Research of de Haan and colleagues (2018) discus that it is unclear to what extent studies on low near vision can be generalized to other eye conditions, such as an HVFD. A possible explanation is that the impact of a visual impairment on the test performance can be target group specific. Literature shows that unilateral neglect patients often fail to draw the contralesional side of the clock, or draw them incompletely, and misplace numbers or generate numbers (McDowell et al., 2006; Suter., 2007). In addition, neglect patients with damage in the right hemisphere often draw smaller clocks compared to people without neglect that have damage to the right hemisphere and compared to healthy people (Chen et al., 2012). None of these remarkable different clocks were observed in the test performance of the participant in this case study. Consequently, the HH does not seem to have a limiting effect on the test performance of the Clock drawing and therefore the clock drawing test can be considered as a valid instrument to exclude neglect in HH patients.

Bells test and line bisection. Based on the participant's test performance on the line bisection and the bells test, there was no indication for neglect. Research shows that neglect patients show more omissions on the Bells test and the line bisection compared to HH patients (Saj et al., 2012; Schenkenberg et al., 1980; Soukup et al., 1994; Zeltzer et al., 2011). Differences in test performance on the Bells test and line bisection between neglect patients and HH patients may be explained by a lack of compensation skills (through head and eye movements) and disease insight that is characteristic of neglect patients, but not of HH patients (Bouma et al., 2012; Kerkhoff et al., 2021; Muller-Oehring et al., 2003; Plummer et al., 2003). Literature shows that the HH patients perform better on both the Bells test and the

Line bisection compared to neclect patients. Considering these findings, the tests are valid instruments to exclude neglect in HH patients.

Bourdon-Wiersma. The participant achieved a low score on the Bourdon-Wiersma test. The Bourdon-Wiersma test manual describes the importance of recognizing visual complaints (Bourdon et al., 1977). This suggests that a visual impairment may interfere with valid test performances. Research shows that reading performance in HH patients deteriorates when the size of a print reduces (Smith., 1985). The Bourdon-Wiersema test contains many small visual stimuli, which may cause people with HH to experience more difficulty perceiving the visual test material. In addition, the duration of the Bourdon-Wiersma test is long, which may require a lot of cognitive effort from the participant. Due to the intensity of the test and the high effort necessary to establish visual perception, the Bourdon-Wiersma is seen as a high effort task leading to potential more severe fatigue effects in visually impaired patients. The question then is whether the Bourdon-Wiersma measures more severe fatigue, the high effort to perceive the visual test material or an actual deviating test performance on sustained attention. The participant achieved a low score on the Bourdon-Wiersma and should therefore be interpreted with caution for the reasons mentioned. The Bourdon-Wiersma could possibly be a less valid instrument for HH patients. However, to measure sustained attention, a long duration of a test is inevitable. It may be possible to look for an auditory task on the domain sustained attention, which requires less processing of visual test material. Thereby minimizing the possible interfering effect of the high effort to perceive the test materials on the test performance. For example, the paced auditory serial addition test (PASAT) might be considered (Bouma et al., 2012). No studies are found in the literature on the effects of visual impairment on the Bourdon-Wiersma. For the purpose of this study, it could therefore first be examined if repeated deviating test results on the Bourdon-Wiersma arises in HH patients. Since the Bourdon-Wiersma test might be less valid in HH patients, it is advisable to position the test at the end of the test battery (as is already done in the current NPE), so that potential more severe fatigue effects in HH patients affect the other neuropsychological tests in the NPE as little as possible (Matias-Guiu et al., 2022).

Vision-independent neuropsychological tests

VFT, Digit span and RBMT. The participant achieved a very low score on the category professions of the word fluency and letter fluency of the VFT. In addition, an average score on the word fluency category animals of the VFT and the subtask Digit Span (forward and backward) of the WAIS-IV is obtained. In addition, an average score is obtained on the subtask ‘story’ (immediate recall and delayed recall) of the RBMT. Literature shows

that a deviating score on the VFT can be difficult to interpret, because deviating score may be explained by disorders in executive functions, language functions, semantic memory, speed of information processing or a combination of these domains (Bouma et al., 2012). Deviating test results on the VFT therefore occur in different types of neurological and psychiatric disorders (Bouma et al., 2012). For this reason, the very low performance on VFT should be interpreted with caution and the semi-structured interview can be of added value when looking for an interpretation of the deviating test score. The semi-structured interview shows that the participant attributes the very low score, on the category of professions of the word fluency and the letter fluency, to the experienced time pressure. Due to the time pressure, the words did not occur to her, while the participant claimed to know more words. The test scores on the VFT in the case study may therefore not be a reliable measurement. However, the reason cited for the low score has nothing to do with the visual impairment. That a visual impairment does not seem to negatively affect the test result of the VFT is supported by the research of Beker and colleagues (2019). 0% of the centenarians with sensory limitation mentioned vision as a reason for test incompletion of the letter and animal fluency (Beker et al., 2019). These results suggest that a visual impairment may not affect the test performance of the VFT. Additionally, in the case study no deviating results are found on the Digit span and the RBMT. In the research of Beker and colleagues (2019) mentioned 0% of the centenarians with sensory limitation vision as a reason for incompletion of the Digit span and the RBMT. These findings suggest that a visual impairment may not have a negative effect on the test performance of the Digit span and the RBMT, which is in line with the test performance of the participant in this case study. Moreover, the study of Pye and colleagues (2017) found no group differences on vision-independent tests (VFT, category fluency test, RAVLT) in visually impaired people compared with NV people. This study concluded that visually impaired people benefit from vision-independent cognitive tests (Pye et al., 2017). Since no negative effect of a visual impairment on vision-independent neuropsychological tests is found in the literature, the VFT, Digit span and RBMT are considered to be valid for HH patients.

Taken together the hypothesis that the participant scores lower than expected (based on the norm groups of these tests) on the vision-dependent neuropsychological tests due to the HH can be rejected. No indications where found that the vision-dependent neuropsychological test of the NPE are invalid for people with HH. Although, the validity of the Bourdon-Wiersma might be decreased in HH patients and should be interpreted with caution in the follow-up research into the effectivity study for two reading training interventions in HH

patients. Additionally, the administration procedure of the questionnaires is found to be a suitable manner of administration in HH patients. However, it is important to be attentive for miscommunication and a higher change of social desirable response. Moreover, no negative impact of visual impairment is found on vision-independent neuropsychologically tests of the NPE, which makes them considered to be valid for HH patients.

Duration of the NPE

The duration of the entire NPE remained well within the expected standard duration of 2 – 2.5 hours (based on the test duration as described in the test manuals) and no deviations were found in this case study with regard to the duration of the NPE. Based on the semi-structured interview, it appears that the participant has not experienced any difficulties with the duration of the NPE. This result does not correspond to the expectation that people with HH need more time for the NPE as a result of the visual impairment and experienced severely fatigue symptoms (de Haan et al., 2016; de Haan et al., 2018; Schakel et al., 2019). Although the participant in the case study did not experience any problems with the duration of the interview, it should be noted that this reflects the result of only one person. Research of de Haan (2018) found that a visual impairment can affect the length of time it takes people with a visual impairment to complete a vison-dependent task. For example, the study found that participants with a simulated visual acuity of 0.2 (moderate visual impairment) need an average of 1.5 times longer to complete the TMT than people with normal visual acuity. In addition, it also appeared that participants with a simulated visual impairment needed significantly more time for part A of the Balloons Test. Nevertheless, the performance remained good and well within the permitted time of 3 minutes. Part B of the Balloons Test was not affected by the simulated visual impairment (de Haan et al., 2018). The results of de Haan and colleagues (2018) show that a visual impairment can affect the test performance and duration of a number, but not necessary all, neuropsychological tests with a visual component. In some cases, the test performance is not affected, but the visual impairment does appear to have an effect on the length of time it takes to complete the task. Although de Haan and colleagues (2018) discuss that it is unclear if these results can be generalized to people with HH, it does suggest that such an effect in HH patients may be possible. However, the result of the case study shows that not every participant has to experience problems with the duration of the study or fatigue problems during the NPE. For this reason, the hypothesis that the participant experiences difficulty with the duration of the NPE (or some vision-dependent tests) and will take longer than expected based on the standard duration of 2 to 2.5 hours is rejected. Based on the literature, it is seen as plausible that some of the participants

may experience more difficulties with the duration of the NPE, or with a number of vision-dependent (neuro)psychological tests due to the visual impairment, reading problems and severe fatigue that occur frequently in the target group HH (de Haan., 2016; de Haan et al, 2016; de Haan et al., 2018; Hazelton et al., 2021; Ong et al., 2012; Schakel et al., 2017; Schakel et al., 2019; Schuett et al., 2009; Weinberg et al., 1979). One advice is to take into account the fatigue complaints, by asking and reporting the fatigue of the participant several times during the NPE, and to include more breaks than usual, if this is desirable.

The participant's experience with the NPE

The semi-structured interview shows that the participant experienced the NPE as good. However, it is recommended to take into account the most frequently mentioned causes of fatigue in visually impaired people, such as cognitive load, the intensity and amount of activities, the high effort necessary to establish visual perception and difficulty with light intensity (Schakel et al., 2017). By reducing fatigue effect as much as possible, test results can be better interpreted (Matias-Guiu et al., 2022). It could be investigated if the FSS contains questions that can have a predictive value about the degree of fatigue of the participant during the NPE. As an example, it could be investigated if question 3 of the FSS is related to the fatigue severity experienced during the NPE, since this question relates to how quickly someone becomes tired. In addition, it could be investigated whether questions 1, 7 and 8 of the FSS are related to neurocognitive test performance[2]. These questions seem to relate to the limitations that fatigue causes on everyday functioning and motivation, and therefore possibly also relates to the limitations on neurocognitive test performance (Hill et al., 2018; Matias-Guiu et al., 2022).

To take into account the light sensitivity in HH patients (de Haan et al., 2016), it may be asked at the beginning of the NPE if the participant can clearly see the test stimuli, or whether adjustment of the light is desirable. Hence, the test location must also have a room where the light intensity can be regulated. In addition, the semi-structured interview attempts to take into account the intensity and amount of the activities by questioning the difficulty of the questionnaires, reading tests, cognitive tests and the duration of the NPE. The semi-structured interview shows that the participant did not experience any problems with the difficulty of the tests and the duration of the NPE. However, the experience of one participant is insufficiently representative of the target group HH. After taking the NPE from several participants, it can

[2] The questions addressed by the FSS are as follows: 1.When I'm tired, I'm less motivated, 3. I get tired easily. 7. Fatigue hinders me from performing certain tasks and responsibilities, 8. Of the complaints that bother me the most, fatigue is one of the three worst

be indicated if the difficulty of the tests and the duration of the NPE are sufficiently feasible for the target group HH.

The methodological set-up has already attempted to take into account the high effort to establish visual perception by reading the questionnaires to the participant. The participant experienced the reading of the questionnaires as pleasant. A suggestion that the participant gave was to have the questionnaires completed by the participant herself. It seems easier for the participant to see the answer options next to the question instead of having to describe it verbatim to the researcher. An adjustment could be to not only to read the questionnaires to the participants, but also to let them read along with the questionnaires and to point out the answer options. In that case, the answer options no longer only have to be mentioned verbatim and the researcher still has control over the administration of the questionnaires.

Finally, the participant indicated that she was comfortable writing down the answers of VFT instead of having to mention them verbatim, in order to prevent slamming into this task. Slamming at this task is a recognized phenomenon, which also occurs in the healthy target group and is therefore neither specific for people with a visual impairment nor for HH patients (Bouma et al., 2012; Lezak et al., 2012). Writing down the answer options means a deviation from the standard test procedure. This is only desirable if there are valid reasons and does not include the experienced time pressure. This phenomenon is already taken into account in the manual of the VFT, because help is offered if the participant does not mention anything for 15-20 seconds. A few examples are then mentioned by the researcher to help the participant get back on track (Lezak et al., 2012). Because it is not the visual impairment that negatively affects the test performance, it is not advisable to deviate from the standard test procedure for the purpose of this study.

Feasibility and validity of the NPE

In summary, the quantitative test results of the vision-independent neuropsychological tests of the NPE do not appear to indicate a negative impact of a visual impairment on the test performance (Beker et al., 2019; Pye et al., 2017). Deviating test results on these tests can probably be explained by impaired cognitive performance (or other influencing factors such as time pressure) and not by the visual impairment. The assumption that a visual impairment negatively affect the test performance on vision-dependent neuropsychological tests seems to be correct (Beker et al., 2019; de Haan et al., 2018; Kempen et al., 1994; Macnamara et al., 2021; Pye et al., 2017; Smith., 1985). Although, the latter seems to be dependent on specific conditions and characteristics in patient groups. For example, HH patients have ways to compensate. Due to the nature of the condition, they seem to be able to compensate more

effectively than low near vision patients or neglect patients (Beker et al., 2019; Bouma et al., 2012; Kerkhoff et al., 2021; Muller-Oehring et al., 2003; Plummer et al., 2003; Pye et al., 2017). However, HH patients may also experience limitations in vision-dependent neuropsychological tests, due to their limitations with regards to light sensitivity, fatigue and reading (de Haan., 2016; de Haan et al, 2016; de Haan et al., 2018; Hazelton et al., 2021; Ong et al., 2012; Schakel et al., 2017; Schakel et al., 2019; Schuett et al., 2009; Weinberg et al., 1979). It is important to take this into account in the methodological design of the NPE. In the current methodological design of the research into the effectiveness of the two reading training interventions, this is already sufficiently taken into account. Therefore, based on this project, there is no reason to assume that the NPE used is insufficiently valid or feasible for HH patients. However, some suggestions are made to increase the validity and feasibility of the NPE and some recommendations are made for further research in HH patients in this field. The results of this project may contribute to the quality of the research into the effectiveness of reading training interventions in people with HH.

Limitations

The storage of personal experience is done by episodic memory (Wessels et al., 2017). Episodic memory is not acquired through prolonged practice, nor through much repetition, making it vulnerable to misremembering and forgetting. The rate at which information is forgotten is highest in the first few hours after an experience occurred (Wessels et al., 2017). In this project the personal experience is questioned through the semi-structured interview within 14 days after the NPE. The relatively long time between the NPE and the semi-structured interview may have caused limitations in the data collection process of the semi-structured interview. The participant may have been able to give less detailed information, because the information was no longer properly stored in her memory. However, the NPE has found no indications for limited memory, as an average score was observed on both the subtask ‘story’ of the RBMT (immediate recall and delayed recall) and the Digit span of the WAIS-IV (backward and forward). Therefore, the information obtained from this case study is considered to be of sufficient quality. Nevertheless, for a comprehensive analysis of the research experience, it is desirable to obtain as much information as possible from the participant. To achieve this, the semi-structured interview should preferably be conducted as soon as possible after the NPE.

Another small addition to the semi-structured interview to get more information about the NPE could be an adjustment to the interview questions. The semi-structured interview shows that the participant confused a cognitive tests with a reading test. Adding the

corresponding specific test to the questions about the experience of the reading tests, cognitive tests, visual tests and questionnaires could provide more specific information about the experience of these tests in practice. It is advisable to briefly explain the specific tests to the participant, so that the participant knows what tests it is about and can give an appropriate answer to the question asked. In addition, consideration could be given to structurally adding the questions: "What did you find difficult or easy about the reading tasks, cognitive tasks, visual tasks?" to the semi-structured interview in order to obtain more in-depth information about the perceived difficulty of the tests mentioned.

Based on the case study and scientific literature, this project investigated whether the NPE is feasible to measure questionnaire domains, cognitive performance and reading ability in people with HH. Follow-up research with a larger sample size could show whether test performances in HH patients significantly deviate compared to other visual impairments or a healthy control group. Significance cannot be determined with a case study. However, the case study did provide qualitative data and recommendations for further research, which can be used in follow-up research.

Implications

The findings of this project have revealed some suggestions and recommendations that can further increase the feasibility and validity of the NPE. First, the MMblind score can be calculated after the MMSE test is assessed, to investigate the effect of the visual test components in the MMSE in HH patients. Second, the Bourdon-Wiersma should be interpreted with caution, because this test might have a reduced validity in HH patients. Due to the possible more severe effects for this test in HH patients, this test should be continued to be positioned at the end of the NPE. Third, the design of the NPE should take into account the specific characteristics of HH patients, such as light sensitivity, fatigue and reading problems. Light sensitivity; by questioning whether the participant can see the test material well and taking the NPE in a room in which the light sensitivity can be regulated. Fatigue; by questioning and reporting the fatigue and taking more breaks during the NPE if this is desirable. Reading problems; by continuing to read the questionnaires aloud, letting the participant read along and pointing out the answer options. Finally, in order to investigate the effect of fatigue on the neuropsychological test performance in HH patients, it can be further investigated whether questions from the FSS can have a predictive value for the degree of fatigue experienced during the NPE. These findings can be applied in follow-up studies to increase the feasibility of neuropsychological assessment in people with HH.

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Appendix A

On request from examiner.

Appendix B

Semi-structured interview after NPE

Leestraining bij Hemianopsie

Pilotfase

Semigestructureerd interview

Telefonisch afnemen na voormeting

Versie 16-2-2021

Gebaseerd op Dowrick, C., Chew-Graham, C., Lovell, K., Lamb, J., Aseem, S., Beatty, S., Bower, P., Burroughs, H., Clarke, P., Edwards, S., Gabbay, M., Gravenhorst, K., Hammond, J., Hibbert, D., Kovandžić, M., Lloyd-Williams, M., Waheed, W., & Gask, L. (2013). Increasing equity of access to high-quality mental health services in primary care: a mixed-methods study. *Programme Grants for Applied Research*, *1*(2), https://doi.org/10.3310/pgfar01020

Bel de deelnemer OF dit gebeurt na nameting via videobellen

Voorstellen, waarom je belt, context.

[Doel interview]

We willen graag feedback ontvangen over de ervaringen met dit onderzoek. We willen weten wat en wel niet goed ervaren wordt en waarom. Om deze reden bellen we u in totaal twee keer voor een kort telefonisch interview. Dit is de eerste keer, de tweede keer is na de nameting. De nameting is het onderzoek met een onderzoeker van de universiteit nadat u de training heeft afgerond.

[Te bespreken]

Ik zou vandaag graag aan u willen vragen hoe u over dit onderzoek te horen kreeg, waarom u heeft besloten deel te nemen en hoe u de voormeting heeft ervaren.

[Ontdekking]

Hoe heeft u voor het eerst van het onderzoek gehoord?

Heeft u voldoende informatie ontvangen om u te helpen bij uw keuze?

[Toezegging]

Wat heeft u doen besluiten om mee te doen aan het onderzoek?

Had u bedenkingen om deel te nemen? (Hoe werden die overwonnen?)

Was er iets in het bijzonder dat uw deelname vergemakkelijkte?

Heeft iemand u geholpen bij het maken van de keuze?

[VBO]

Hoe was het om de gezichtsveldmeting te ondergaan?

Voelde u zich gefrustreerd tijdens deze meting? Zo ja; in hoeverre?

[Voormeting]

U heeft een onderzoek gehad met [naam onderzoeker] van de universiteit Groningen op [datum]. Hoe vond u dat onderzoek?

Waren de leestaken moeilijk of makkelijk?

Waren de cognitieve taken moeilijk of makkelijk?

Wat vond u van de vragenlijsten?

Wat vond u van de lengte van het onderzoek?

Zijn er nog andere dingen die u over het onderzoek kwijt wil?

[Afsluiting]

[Probeer een samenvatting te geven van wat de cliënt verteld heeft.]

Zijn er nog dingen die u verder kwijt wil over de keuze voor deelname of het eerste onderzoek?

Dan waren dit de vragen die ik voor nu voor u had. Uw antwoorden worden verwerkt samen met de antwoorden van de andere deelnemers. In het najaar verwerken we al deze feedback en kunnen we waar nodig aanpassingen doen voor het vervolg van het onderzoek.

U gaat in de komende [aantal] weken [optie behorend bij arm] volgen.

Hartelijk dank voor uw tijd. We spreken elkaar weer voor het tweede telefonisch interview, ongeveer [noemen].

Uitleggen hoe dan afspraak etc