J Rehabil Med 2013; 45: 429–433

ORIGINAL REPORT

IS NAVIGATION ABILITY A PROBLEM IN MILD STROKE PATIENTS? INSIGHTS FROM SELF-REPORTED NAVIGATION MEASURES

Ineke J. M. van der Ham, PhD[1], Neeltje Kant, MSc[1,2], Albert Postma, PhD[1,3] and Johanna M. A. Visser-Meily, PhD[4]

From [1]Experimental Psychology, Helmholtz Institute, Utrecht University, Utrecht, [2]Nieuw Unicum, Zandvoort, [3]Department of Neurology, Utrecht University Medical Centre and [4]Rudolf Magnus Institute of Neuroscience and Centre of Excellence for Rehabilitation Medicine, Utrecht University Medical Centre, Utrecht, The Netherlands

Objective: **The aim of this study was to measure the prevalence of navigation problems in patients with mild stroke, using a navigation questionnaire (the Wayfinding Questionnaire; WQ). In addition, the correlations between WQ scores and quality of life measures and neuropsychological test scores were studied.**
Methods: **A sample of 62 patients with mild stroke completed a questionnaire measuring self-reported navigation ability and spatial anxiety. A subset of this sample (*n*=31) also completed a questionnaire on quality of life. Additional relevant neuropsychological data were retrieved from medical files and correlated with WQ and quality of life scores.**
Results: **The results indicate that self-reported navigation impairment occurs in a substantial proportion of patients (29.0%), compared with a large control group (*n*=384) of which 19.9% showed impairment. Moreover, these ratings are closely linked to quality of life and negatively correlated with spatial anxiety. The neuropsychological data show that there is very little correlation between scores on commonly administered tests and navigation ability, which is in line with the results of a previous study.**
Conclusion: **As our data indicate that navigation impairment is common among patients with mild stroke, we recommend a specific focus on navigation ability as part of neuropsychological assessment. This focus is currently lacking. Furthermore, the use of dedicated, experimental navigation tests in cases of explicit problems with navigation should be considered, in order objectively to measure such impairments.**

Key words: stroke; space perception; quality of life; questionnaire.

J Rehabil Med 2013; 45: 429–433

Correspondence address: Ineke J. M. van der Ham, Heidelberglaan 2, NL-3584 CS Utrecht, The Netherlands. E-mail: c.j.m.vanderham@uu.nl

Accepted Dec 19, 2012; Epub ahead of print Apr 24, 2013

INTRODUCTION

Finding one's way around in the world is an important element of human cognition. Such navigation ability comes into play when moving from one location to another, whether from room to room or from home to a different city. Navigation ability is one of the main requirements for autonomy and mobility in daily life. Without it we would have to rely completely on the help of others to reach even nearby locations, such as the local shops.

Many neurocognitive studies concerning navigation ability have been published. For example, publications on the distinctions between allocentric and egocentric processing (1, 2) and between route and survey knowledge (3) have been prominent. In addition, the neurological characteristics of navigation ability have been studied extensively, with the goal of unravelling the neurocognitive architecture of navigation ability (e.g. 4). Such studies entail neuroimaging experiments, but also cognitive tasks in neuropsychological patients.

In fact, there are several recent findings indicating that navigation ability can be selectively impaired in stroke patients. Individual patients may have specific problems with, for instance, map construction or route memory (e.g. 5–7). Likewise, in a recent study on two brain-damaged patients, selective disturbances in navigation ability were reported. Memory of the spatial properties of routes was dissociated from memory of the temporal properties of those routes (8). These findings clearly reflect the complexity of the cognitive structure of navigation ability. Importantly, the patients described in this particular study had distinct self-reported problems with navigation ability, but these problems could not be linked to any cognitive deficit, as observed in an extensive standardized neuropsychological examination. This strongly suggests that, at present, suitable neuropsychological material to assess such navigation problems in detail is lacking. Despite elaborate studies on navigation ability in neurological patients, the matter of neuropsychological testing material has been neglected in the literature so far.

Furthermore, navigation is often not explicitly addressed during neuropsychological examination or anamnestic interviews. Any indication of getting lost frequently can easily be thought of as a more general cognitive problem, such as impaired memory or executive functioning. Patients with mild stroke are of particular importance here. Typically, they live autonomously and are able to take care of themselves. Mobility is vital to how they spend their time, as it improves the ability to interact socially, to perform simple tasks, such as shopping, and to increase physical exercise (9, 10). Stroke patients with a high functional outcome, those who walk and talk, are often

 doi: 10.2340/16501977-1139
 ISSN 1650-1977

discharged home within days. Although it has been widely assumed that these patients have no cognitive impairments, recent studies have proven the contrary (11). These studies are in line with the potential occurrence of navigation problems in this population, as they reported that ischaemic stroke patients with a high functional outcome showed impairment in executive functioning, attention, and memory.

The foregoing illustrates that the scope of navigation problems in patients with mild stroke is largely unknown. It could well be that a substantial number of stroke patients experiences specific navigation problems that have not been explicitly recognized. In turn, the limitations caused by these problems may have dramatic consequences for everyday life and mobility.

In this light, the main research question of the current study concerns the prevalence of specific navigation problems in patients with mild stroke. To answer this question, self-report information (the Wayfinding Questionnaire; WQ) was related to neuropsychological data and a measure of quality of life. It can be argued that recent technological advances allow for the use of virtual reality tools to provide more objective measures of navigation ability in this sample. However, this would not serve the purpose of creating a fast and easy-to-use tool during neuropsychological screening. The questionnaire used here serves this purpose, as it can easily be implemented during regular neuropsychological examinations.

This approach allows us to assess whether navigation ability may have been wrongfully neglected in neuropsychological assessment and rehabilitation treatment. If a strong link exists between navigation ability and quality of life, this would stress the need for attention to this cognitive domain even further. A secondary question is how effective existing standardized tests are in objectively measuring navigation ability. Therefore, the available neuropsychological test results were considered in order to investigate further the extent to which navigation ability is reflected by these standardized tests, or whether the employment of other, more specific, instruments is required.

METHODS

Participants and procedure

Participants were stroke survivors who had visited either the outpatient rehabilitation clinic or the neurology department of the Utrecht University Medical Center. Inclusion criteria were: (*i*) a first or recurrent stroke; (*ii*) age 18 years or older; (*iii*) living autonomously; (*iv*) able to walk without support; and (*v*) activities of daily living (ADL) independent (Barthel Index > 16). Participants were excluded if they had insufficient command of Dutch or if they had another disabling condition or had communication impairments, both indicated by a score of <6 on the shortened version of the Aphasia Scale of the Dutch Aphasia Foundation (SAN).

Stroke survivors were asked by their rehabilitation physician whether they were willing to participate in the study. They completed several questionnaires and returned them in a self-addressed envelope within 2 weeks after recruitment. This study was performed with approval of the local medical ethics committee.

Measures

Demographic characteristics concerning age, sex, marital status, and education were collected. Education level is based on the classification system of Verhage (12), with scores ranging from 1 (lowest level: primary level education) to 7 (highest level: finished university level education). Data on stroke characteristics, including type of stroke, hemisphere involved, and time after stroke, were obtained from medical files.

Many different cognitive components are involved in successful wayfinding (for review see (13)), which can be impaired selectively. Based on this theoretical framing, an extensive questionnaire was constructed entailing a wide range of questions in subscales reflecting these components (unpublished data). From this questionnaire a set of questions was selected for the current study, based on their relevance for the current sample. The subscales in the WQ are navigation, mental transformation, distance estimation, and sense of direction (translation included in the Appendix I). In addition to these scales reflecting ability, a subscale concerning spatial anxiety was also added. This subscale indicates the level of anxiety experienced when navigating on one's own, for instance in a new city during vacation. Apart from the cognitive ability to navigate, anxiety level could also have a considerable impact on mobility, as it has been found to be closely linked to navigational strategies (14). The WQ consisted of 22 questions. As age was found to have no effect on the scores on these scales ($p > 0.10$), a sample of 384 healthy control participants (mean age 38.4, standard deviation (SD) 17.0, range 18–85 years) was used as a reference group for the interpretation of the scores.

The short-form of the Stroke Specific Quality of Life Questionnaire (SSQoL) reflects self-reported health-related quality of life, based on two subscales of physical and psychosocial quality of life, with 6 questions each. Psychometric properties of both the subscales and the total scale are sufficient (15).

For all patients, neuropsychological test results were extracted from their medical files. A *post hoc* approach was used here, in which all available test scores were consulted for each patient. Specific attention was paid to tests measuring spatial perception, attention, and memory. Spatial perception was measured with the Judgment of Line Orientation (JLO) test (16) (giving converted percentiles) and the Rey-Osterrieth Complex Figure copy (17) test (giving converted percentiles). Attention was examined by means of the Trail Making Test (TMT) part A and B (18). Part A of the TMT reflects psychomotor speed and part B is a measure of divided attention, both are expressed in percentiles. Memory was measured with the Rey Auditory Verbal Learning Test (RAVLT), both immediate and delay (19), of which the scores reflect deciles. The delayed Rey-Osterrieth Complex Figure test was used as a measure of memory, also expressed in percentiles. The tests were not performed by all patients.

RESULTS

Participants

A total of 62 patients (36 males) returned the questionnaire and were included in the data analyses. In Table I the means and SDs of demographic and stroke characteristics are provided.

Wayfinding Questionnaire

In Table II the mean scores on all subscales of both questionnaires are provided. WQ scores were compared with the mean scores of the control group of 384 healthy participants, also provided in Table II. All scores deviating more than 1.65 SD from the means of the control group were marked as impaired, as they reflect performance in the upper or lower 5% of the distribution of control participant scores (20). In total, 18 patients (29.0%) showed impaired scores on at least one of the subscales, compared with 16.9% of the control group. 24.2% of the patients showed impairment on the navigation subscale (15% of the control group); 9.7% was impaired on mental transformation (4.7% of the control group); 9.7% on

Table I. *Characteristics of the patients (*n *= 62)*

Demographic characteristics	
Sex, women, *n* (%)	26 (41.9)
Age, years, mean (SD)	58.2 (15.0)
Education level, mean (SD)	5.3 (1.3)
Stroke characteristics	
Type of stroke, *n* (%)	
Ischaemic stroke	40 (64.5)
Haemorrhagic stroke	9 (14.5)
Other	2 (3.2)
Unspecified	11 (17.7)
Stroke location, *n* (%)	
Left hemisphere	27 (43.5)
Right hemisphere	28 (45.2)
Bilateral	2 (3.2)
Time after stroke (months) (n=32) mean (SD)	40.0 (56.0)
Disability measures	
BI score (n=32), mean (SD)	19.8 (0.8)
MMSE, (n=30), mean (SD)	
Score 30	8 (25.8)
Score >23	30 (100)
SAN (n=32), mean (SD)	6.9 (0.4)

BI: Barthel Index; MMSE: Mini Mental State Examination; SAN: Aphasia Scale of the Dutch Aphasia Foundation; SD: standard deviation.

spatial anxiety (1.8% of the control group), 1.6% on sense of direction (1% of the control group); 0% on distance estimation (1.8% of the control group). A more specific examination of the data showed that 43 patients (69.4%) showed impaired ratings on individual questions (ranging from impairment on 1–18 questions per patient). Appendix I shows the percentage of patients with impaired scores for each question separately.

Neuropsychological tests

The available scores on the JLO, Rey Complex Figure copy, TMT A and B, RAVLT immediate and delay, and Rey Complex Figure copy and delay are shown in Table III. These scores were correlated with all questionnaire subscales. Only the Rey Complex Figure delay correlated significantly and positively with the Mental Transformation subscale of the WQ. None of the other neuropsychological measures showed significant correlation with a questionnaire subscale.

Health-related quality of life

A correlational analysis, adjusted for multiple comparisons, was performed on the ratings on the WQ and Quality of Life questionnaire to study the correlation between navigation ability/anxiety and quality of life. In Table IV the correlation coefficients for all subscales are provided, along with an indication of significance. All but one correlation (WQ Navigation and SSQoL physical) were significant, and all correlations were positive with the exception of those including spatial anxiety, for which higher scores indicate higher level of anxiety. For all other subscales of the WQ lower scores indicate higher levels of impairment, and for the SSQoL higher scores indicate higher quality.

Table II. *Questionnaire data. Means and standard deviations (SDs) for all subscales of both the Wayfinding Questionnaire (WQ) and the Short Stroke Specific Quality of Life Scale (SSQoL)*

Scale	Patients with mild stroke (n=62) Mean (SD)	Controls (n=384) Mean (SD)
WQ		
Navigation	4.68 (1.61)	4.53 (1.72)
Mental transformation	5.11 (1.48)	5.11 (1.23)
Distance estimation	4.10 (1.60)	4.11 (1.23)
Spatial anxiety	3.03 (1.62)	3.03 (1.19)
Sense of direction	4.53 (1.68)	4.52 (1.03)
SSQoL (n=32)		
Physical	3.97 (0.85)	
Psychosocial	3.40 (1.03)	
Total	3.68 (0.89)	

Higher scores on the WQ (range 1–7) indicate better ratings, except for special anxiety, where higher scores indicate higher anxiety. Higher scores on the SSQoL (range 1–5) indicate better ratings of quality of life.

DISCUSSION

This study aimed to investigate the prevalence of specific navigation problems in a population of patients with mild stroke. Self-report information was combined with available neuropsychological test data and a measure of quality of life, enabling the examination of whether navigation ability may have been wrongfully overlooked in neuropsychological assessment and rehabilitation treatment. The results indicate that, in our sample, 29% of the patients were impaired on navigation ability according to their self-reported scores. This means that a substantial proportion of patients reports notable problems in navigation, many more than was found in healthy control subjects. Moreover, the impairment appears to be spread over the different subscales, with the exception of the distance estimation subscale. This illustrates that the complexity of navigation is also reflected in navigation impairment. There is no unitary pattern of this impairment, as the precise characteristics vary between individuals.

Table III. *Neuropsychological screening data, with number of patients (n), mean and standard deviation (SD), and indication of all correlations with* p *< 0.05 with any of the subscales*

Task	*n*	Mean (SD)	Correlation (p<0.05) with subscale
JULO	29	23.9 (6.2)	–
Rey Complex Figure copy	31	31.5 (5.6)	–
Rey Complex Figure delay	22	21.7 (40.0)	WQ MT
RAVLT immediate recall	52	6.5 (12.6)	–
RAVLT delayed recall	52	6.7 (10.3)	–
TMT A	41	37.3 (29.1)	–
TMT B	41	40.2 (35.5)	–

All values expressed in percentiles, except for RAVLT, which is expressed in deciles. JULO: Judgement of Line Orientation; RAVLT: Rey Auditory Verbal Learning Test; TMT: Trail Making Test.

Table IV. *Correlational analyses of all subscales of both questionnaires. Values reflect correlation coefficients*

	WQN	WQMT	WQDE	WQSA	WQSD	SSQoL ph	SSQoL ps
WQMT	0.71**						
WQDE	0.65**	0.78**					
WQSA	–0.33**	–0.43**	–0.40**				
WQSD	0.64**	0.72**	0.76**	–0.58**			
SSQoL ph	0.33	0.56**	0.57**	–0.44*	0.60**		
SSQoL ps	0.38*	0.55**	0.56**	–0.52**	0.63**	0.78**	
SSQoL tot	0.38*	0.59**	0.60**	–0.51**	0.65**	0.93**	0.95**

*$p<0.05$, **$p<0.01$, ***$p<0.00$.

Higher scores on the WQ (range 1–7) indicate better ratings, except for SA, where higher scores indicate higher anxiety. Higher scores on the SSQoL (range 1–5) indicate better ratings of quality of life.

WQ: Wayfinding Questionnaire; N: navigation; MET: mental transformation; DE: distance estimation; SA: spatial anxiety; SD: sense of direction; SSQoL: Short Stroke Specific Quality of Life Scale; ph: physical; ps: psychosocial.

In addition to the finding that navigation impairment is a prevalent problem, the impact of this impairment on daily life was considered. Based on the effects of navigation on mobility it could well be that health-related quality of life benefits from high navigation ability and low spatial anxiety. The correlational analysis including both questionnaires showed strong correlations between almost all subscales. Navigation ability subscales correlated positively with the quality of life measures, indicating that, indeed, quality of life is closely linked to that ability. Furthermore, spatial anxiety correlated negatively with navigation ability and with quality of life. This suggests that, by increasing navigation ability in individuals, it might be possible to reduce their spatial anxiety, and by doing so also improve their quality of life. In addition to quality of life improvement it is likely that other relevant characteristics, such as participation in community ambulation, could also benefit from better navigation ability, as it has been shown that this is affected by cognition (21).

Available neuropsychological test scores were included to address the secondary research question: can standard neuropsychological tests predict the amount of navigation problems? This was confirmed to a large extent, as there was only one significant correlation with a WQ subscale present. The Rey Complex Figure delay correlated significantly with mental transformation. This can be explained by the mental reconstruction required to draw the figure from memory in this task (22), which is conceptually linked with mental transformation. This outcome underlines the limited predictive value of standardized (spatial) neuropsychological tests with regard to navigation ability and even with quality of life.

It should be noted that we used the subjective reports as the criterion for ecological validity in this study. While we thus have a direct estimate of the number of daily life problems and the impact of these problems as experienced by the patients, this method is not without limitations. Scores depend on the accuracy of the insight patients have into their own performance. However, the questionnaire can be used as a short screening tool, which can be followed up by more objective testing in, for instance, virtual reality environments, if questionnaire scores give reason to suspect navigation impairment in a patient. Such virtual environments are of particular interest for stroke patients, as they provide a safe and controlled experimental set-up, with ecologically valid measures (23).

Another limitation is that we included a relatively small sample of stroke patients. Future experiments should be performed to establish the correlation between these self-reported measures and objective measures of navigation. Also, available neuropsychological test results were limited for some patients in the sample. Nonetheless, given how little attention this matter has received in literature and clinical treatment, it is of importance to bring this issue forward.

In conclusion, navigation problems may have a higher prevalence than previously thought. In particular this may apply to patients with mild stroke, who are generally assumed to have no major cognitive impairments. Moreover, self-reported navigation ability might be linked to quality of life and to spatial anxiety. This certainly deserves more attention in future research; could quality of life be increased and spatial anxiety be reduced by improving patients' navigation ability? In addition, relevant and commonly used neuropsychological tests have been shown to have very limited predictive value for navigation ability, which could well explain why the matter has been largely neglected in clinical practice. We recommend that patients are questioned specifically about potential navigation problems and that new cognitive tests to accurately and objectively measure the prevalence and extent of these problems should be developed. The current results call for further research on the diagnostics and treatment of navigation problems in stroke patients, a topic which may have been overlooked due to the limitations of available neuropsychological material.

ACKNOWLEDGEMENTS

The authors would like to thank Sander Bosch for his work on the development of a previous version of the WQ, as presented in his unpublished Bachelor thesis. This research was made possible by the Meerwaarde grant (840.11.006) provided by NWO (Netherlands Organisation of Scientific Research).

REFERENCES

1. Klatzky RL. Allocentric and egocentric spatial representations: definitions, distinctions, and interconnections. Lect Notes Comput Sci 1998; 1404: 1–17.
2. Burgess N. Spatial memory: how egocentric and allocentric com-

bine. Trends Cogn Sci 2006; 10: 551–557.
3. Mellet E, Bricogne S, Tzourio-Mazoyer N, Ghaëm O, Petit L, Zago L, et al. Neural correlates of topographic mental exploration: the impact of route versus survey perspective learning. NeuroImage 2000; 12: 588–600.
4. Maguire E. The retrosplenial contribution to human navigation: a review of lesion and neuroimaging findings. Scand J Psychol 2001; 42: 225–238.
5. Ciaramelli E. The role of ventromedial prefrontal cortex in navigation: a case of impaired wayfinding and rehabilitation. Neuropsychologia 2008; 46: 2099–2105.
6. Iaria G, Bogod N, Fox CJ, Barton JJS. Developmental topographical disorientation: case one. Neuropsychologia 2009; 47: 30–40.
7. Incoccia C, Magnotti L, Iaria G, Piccardi L, Guariglia C. Topographical disorientation in a patient who never developed navigational skills: the (re)habilitation treatment. Neuropsychol Rehabil 2009; 19: 291–314.
8. Van der Ham IJM, van Zandvoort MJE, Meilinger T, Bosch SE, Kant N, Postma A. Spatial and temporal aspects of navigation in two neurological patients. Neuroreport 2010; 21: 685–689.
9. Edwards DF, Hahn M, Baum C, Dromerick AW. The impact of mild stroke on meaningful activity and life satisfaction. J Stroke Cerebrovasc 2006; 15: 151–157.
10. Rochette A, Desrosiers J, Bravo G, St-Cyr/Tribble D, Bourget A. Changes in participation after a mild stroke: quantitative and qualitative perspectives. Top Stroke Rehabil 2007; 14: 59–68.
11. Planton M, Peiffer S, Albucher JF Barbeau J, Tardy J, Pastor AC, et al. Neuropsychological outcome after a first symptomatic ischaemic stroke with 'good recovery'. Eur J Neurol 2012; 19: 212–219.
12. Verhage F. [Intelligence and age: study with Dutch people from age 12 to77.] Dissertation. Assen: Van Gorcum; 1964 (in Dutch).
13. Wolbers T, Hegarty M. What determines our navigational abilities? Trends Cogn Sci 2010; 14: 138–146.
14. Lawton CA. Gender differences in way-finding strategies: relationship to spatial ability and spatial anxiety. Sex roles 1994; 30: 765–779.
15. Post M, Boosman H, Passier P, Van Zandvoort M, Rinkel G, Visser-Meily A. Development and validation of a short version of the Stroke Specific Quality of Life Scale. J Neurol Neurosurg Ps 2011; 82: 283–286.
16. Benton AL, Sivan AB, Hamsher KS, Varney NR, Spreen O. Contributions to neuropsychological assessment: a clinical manual, 2nd ed. New York: Oxford University Press; 1994.
17. Osterrieth PA. Filetest de copie d'une figure complex: Contribution a l'etude de la perception et de la memoire. Arch Psychologie 1994; 30: 286–356.
18. Reitan R. Trail Making Test: Manual for administration, scoring and interpretation. Bloomington: Indiana University; 1956.
19. Rey A. L'Examen Clinique en Psychologie. Paris, France: Press Universitaire de France; 1958.
20. Kessels RPC, de Haan EHF, Kappelle LJ, Postma A. Selective impairments in spatial memory after ischaemic stroke. J Clin Exp Neuropsychol 2002; 24: 115–129.
21. Robinson C, Shumway-Cook A, Matsuda P, Ciol M. Understanding physical factors associated with participation in community ambulation following stroke. Disabil Rehabil 2011; 91: 1865–1876.
22. Caffarra P, Vezzadini G, Dieci F, Zonato F, Venneri A. Rey-Osterrieth complex figure: normative values in an Italian population sample. Neurol Sci 2002; 22: 443–447.
23. Schultheis MT, Himelstein JMA, Rizzo AA. Virtual reality and neuropsychology: upgrading the current tools. J Head Trauma Rehab 2002; 17: 378–394.

APPENDIX I. Wayfinding Questionnaire (translated from Dutch)

Navigation (N)
1. I can effortlessly walk back a route I have never walked before, the same way I walked up. (8.1%)

Mental Transformation (MT)
2. If I see a landmark (building, monument, intersection) multiple times, I know exactly from which side I have seen that landmark before. (8.1%)
3. In an unknown city I can easily see where I need to go when I read a map on an information board. (14.5%)

Distance Estimation (DE)
4. Without a map, I can estimate the distance of a route I have walked well, when I walk it for the first time. (14.5%)
5. I can estimate well how long it will take me to walk a route in an unknown city when I see the route on a map (with a legend and scale). (14.5%)
6. I can always orient myself quickly and correctly when I am in an unknown environment. (9.7%)
7. I always want to know exactly where I am (meaning, I am always trying to orient myself in an unknown environment). (4.8%)

Spatial Anxiety (SA)
8. I am afraid to lose my way somewhere. (17.7%)
9. I am afraid to get lost in an unknown city. (21.0%)
10. In an unknown city, I prefer to walk in a group rather than by myself. (14.5%)
11. When I get lost, I get nervous. (16.1%)
12. How uncomfortable are you in the following situations:
 a. Deciding where to go when you are just exiting a train, bus, or subway station. (12.9%)
 b. Finding your way in an unknown building (for example a hospital). (21.0%)
 c. Finding your way to a meeting in an unknown city or part of a city. (8.1%)
13. I find it frightening to go to a destination I have not been before. (29.0%)

Sense of Direction (SD)
14. I can usually recall a new route after I have walked it once. (9.7%)
15. I am good at estimating distances (for example, from myself to a building I can see). (11.3%)
16. I can orient myself well. (6.5%)
17. I am good at understanding and following route descriptions. (16.1%)
18. I am good at giving route descriptions (meaning, explaining a known route to someone). (8.1%)
19. When I exit a store, I do not need to orient myself again to determine where I have to go. (0%)
20. I enjoy taking new routes (for example short cuts) to known destinations. (25.8%)
21. I have a good sense of direction. (9.7%)
22. I can easily find the shortest route to a known destination. (14.5%)

The response possibilities ranged from 1 (not at all applicable to me) to 7 (fully applicable to me). Subheadings were not present in the version sent out to the patients. The percentage of patients with scores below cut-off in parentheses after each question (> 1.65 standard deviation from control scores).