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The inclination for conscious motor control after stroke: Validating the Movement-Specific Reinvestment Scale for use in inpatient stroke patients

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Abstract

Purpose: Stroke survivors are inclined to consciously control their movements, a phenomenon termed “reinvestment”. Preliminary evidence suggests reinvestment to impair patients’ motor recovery. To investigate this hypothesis, an instrument is needed that can reliably assess reinvestment post-stroke. Therefore, this study aimed to validate the Movement-Specific Reinvestment Scale within inpatient stroke patients.

Method: 100 inpatient stroke patients (<1 year post-stroke) and 100 healthy peers completed the MSRS, which was translated to Dutch for the study purpose. To assess structural validity, confirmatory factor analysis determined whether the scale measures two latent constructs, as previously reported in healthy adults. Construct validity was determined by testing whether patients had higher reinvestment than controls. Reliability analyses entailed assessment of retest reliability (ICC), internal consistency (Cronbach’s alpha), and minimal detectable change.

Results: Both structural and construct validity of the MSRS were supported. Retest reliability and internal consistency indices were acceptable to good. The minimal detectable change was adequate on group level, but considerable on individual level.

Conclusions: The MSRS is a valid and reliable tool and suitable to assess the relationship between reinvestment and motor recovery in the first months post-stroke. Eventually, this may help therapists to individualise motor learning interventions based on patients’ reinvestment preferences.

1. INTRODUCTION

Many individuals with stroke feel they need to consciously control their movements in order to ensure successful movement execution. This phenomenon is termed 'reinvestment' [1]: attempting to consciously control movements by reinvesting explicit movement-related knowledge. Patients' inclination to reinvest may in part be due to the nature of instructions and feedback they receive during rehabilitation therapy – often directing their attention to *how* they should execute their movements [2,3]. Also, deviant movement patterns due to motor impairments may trigger heightened self-consciousness after stroke [4].

Accumulating evidence suggests that a strong tendency to reinvest may worsen rather than improve the motor abilities of patients with stroke. For instance, healthy adults who rely on conscious motor control demonstrate inferior motor performance and learning [5], and are more susceptible to experience skill-breakdown in dual-task [6] and high-pressure situations [7] compared to people who do not (or to a lesser extent). Also, reinvestment has been associated with an increased risk of falling in healthy elderly [8]. In line with these findings, chronic community-dwelling patients with stroke who are more predisposed to reinvest exhibit greater functional impairments [9]. This has triggered Orrell and co-workers to speculate that heightened reinvestment may impair motor recovery post-stroke. However, as this relationship is merely correlative, the presumed causality still needs to be established (i.e., an alternative explanation would be that patients with more severe motor impairments are more strongly triggered to reinvest, but that this increased reinvestment in itself does not exacerbate these impairments). Gaining insight into the role of reinvestment in motor learning post-stroke may help therapists select appropriate motor learning interventions for individual patients. Specifically, it will help them decide whether they should reduce patients' reliance on conscious motor control – for instance by the use of implicit motor learning strategies like errorless learning [10] or analogy learning [11] – or, alternatively, whether they should tune in to patients' preferences – for instance by encouraging conscious control of movement in patients with a pronounced inclination to reinvest.

To elucidate the putative role of reinvestment in motor rehabilitation after stroke, and to help therapists to reliably gauge reinvestment preferences of stroke patients, we first need a measure that allows reliable assessment of reinvestment already from the start of rehabilitation. One such measure could be the Movement-Specific Reinvestment Scale (MSRS) [12]. The MSRS is a self-report measure that comprises 10 statements about moving in general, with 5 statements referring to the subscale of Movement Self-Consciousness (MS-C; e.g., 'I am concerned about what people think about me when I'm moving'), and the other 5 referring to the Conscious Motor Processing subscale (CMP; e.g., 'I try to think about my movements when I carry them out'). Both a dichotomous (disagree/agree) and 6-point Likert Scale English language version (ranging from 'strongly disagree' to 'strongly agree') have been validated for use in healthy adults, particularly in the context of sports [8,12].

As of yet, it is unclear whether the MSRS is of sufficient psychometric quality to be suitable to measure reinvestment of rehabilitating stroke patients. A recent study [13] has reported (a Dutch translation of) the dichotomous version of the MSRS to have sufficient test-retest reliability (ICC = .85) when administered within a relatively small group (n=45) of chronic community-dwelling individuals with stroke (*M* = 2.7 years since stroke). While promising, several issues warrant further investigation before the MSRS can be applied within a clinical stroke population. First, and most importantly, Kleynen et al. [13] neither investigated the structural and construct validity of the MSRS, nor did they report on the internal consistency of its two subscales. Second, it is unclear whether test-retest values obtained within a chronic stroke population are applicable to individuals involved in clinical rehabilitation. Both motor [14] and cognitive functioning [15] often improve rapidly during the clinical rehabilitation period, possibly resulting in less 'stable' reinvestment tendencies. Finally, considerable measurement error was reported by Kleynen et al. [13] This might be due to their use of dichotomous answer possibilities, as scales with less than 5-answer options seem unfit to detect small clinically significant differences [16].

This study aimed to address the issues outlined above, through comprehensive assessment of the validity and reliability of a 6-point Likert scale version of the MSRS for use in an inpatient stroke population (<1 year post-stroke) and healthy peers. For the purpose of this study, we used a Dutch translation of the original English MSRS [12] Structural validity of the MSRS was assessed by means of confirmatory factor analysis. Its construct validity was tested by assessing whether patients with stroke have significantly higher MSRS scores than healthy peers (as in Orrell et al. [9]). Reliability tests included test-retest reliability, internal consistency, standard error of measurement (SEM) and minimal detectable change.

2. METHODS

2.1. Participants

One-hundred inpatient individuals with stroke and 100 age-matched healthy controls participated in this study. This sample size was based on the assumption that for confirmatory factor analysis a subject-to-variable ratio of 10 is sufficient [17]. Patients were recruited in the Dutch rehabilitation centres Heliomare in Wijk aan Zee and Aardenburg in Doorn. Controls were recruited in the community. Recruitment took place across three measurement periods (November 2013-January 2014, May 2014-July 2014, and September 2014-October 2014).

Patients with stroke were eligible for participation if they (1) had suffered brain injury due to stroke; (2) no longer than 12 months ago; (3) were currently receiving inpatient rehabilitative care; and (4) were able to provide informed consent and understand Dutch instructions, as assessed by their physical therapist or neuropsychologist. No in- or exclusion criteria were formulated with regard to patients' motor functioning. Inclusion criteria for the control group were as follows: (1) no neurological, musculoskeletal, or cognitive impairments; (2) similar age as the stroke group; (3) able to provide informed consent and understand Dutch instructions.

Demographic characteristics of patients were obtained from their medical files and included: age, gender, days since stroke, days spent in the inpatient rehabilitation ward, lesion type (infarction, haemorrhagic), lesion location (left cortex, right cortex, bilateral cortices, stem/cerebellar), and aphasia (yes/no). Age and sex of control participants were registered. All participants signed an informed consent. The protocol was approved by the ethical committee of the Faculty of Human Movement Sciences in Amsterdam.

2.2. Materials

The MSRS English version [12] (appendix 1) was translated for the purpose of this study. This self-report scale includes 10 items. Five items relate to the construct of feeling self-consciousness about moving (Movement Self-Consciousness) whereas the other 5 items relate specifically to conscious motor control (Conscious Motor Processing). Items are scored on a 6-point Likert scale ranging from 1 (strongly disagree) to 6 (strongly agree; as in [18,19]). Sum scores therefore range between 5-30 for each subscale, and between 10-60 for the whole MSRS. The scale can usually be administered within 5 minutes.

2.3. Procedure

The MSRS was translated into Dutch following the recommendations of Guillemin, Bombardier, and Beaton [20]. First, three independent (native Dutch speaking) translators converted the MSRS-EV into a Dutch version and reached consensus on the best translation. Two independent translators (one native English speaker and one native Dutch speaker, both qualified English-Dutch translators) converted the consensus translation back to English. In the final, third round, a group of experts considered all translations made, and decided on the final version. Group members included individuals with knowledge of the concept of reinvestment, individuals who work with stroke patients, and all translators. The final Dutch language version of the MSRS can be found in appendix 2.

Participants completed the newly translated MSRS on two occasions (T1 and T2), with one week in-between (on average 7.1 ± 3.1 days). We considered this test-retest period to be sufficiently short to minimize possible changes in patients' motor and cognitive function between measurements due to natural or therapeutic recovery, and sufficiently long to prevent recall bias. Patients with stroke always completed the scale following a regular physical or occupational therapy session, to ensure that test conditions were similar at T1 and T2. If necessary (e.g., for patients with problematic sight or aphasia), items and answer alternatives were read aloud by a research assistant.

2.4. Data analysis & statistics

All data were analysed with SPSS and AMOS software (version 21; IBM, Chicago, United States). Missing values were dealt with by imputing the median score on the respective item (2 items – or 0.1% of cases - in both groups). Outliers were removed from further analyses when the difference in total MSRS score between T1 and T2 exceeded the mean group difference by 3 z-scores or more *and* if additional reasons for removal were already noted when the scale was administered (e.g., suspicion of difficulty with comprehending instructions).

2.4.1. Structural validity

To investigate structural validity of the MSRS, confirmatory factor analysis was performed using structural equation modeling in AMOS. Confirmatory factor analysis tests whether the data fit the hypothesized two-factor model of the MSRS (i.e., that the scale contains the CMP and MS-C factors, as reported in healthy adults [12]). The data of T1 of all participants (both patients and controls) served as input for this analysis. The procedure entailed analysis of the variance-covariance matrix with maximum likelihood estimation* [21]. Items were constrained to load on the factors they should load on (either on the CMP or MS-C subscale; appendix 1). As scores on the CMP subscale should be moderately correlated to scores on the MS-C subscale [12], these factors were allowed to co-vary. Pairs of error terms within each factor were allowed to co-vary only if this improved fit of the model.

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* This procedure was justified, as skewness and kurtosis of each item was well below the recommended [21] values ($M_{skew} = .62 < 2$, $M_{kurt} = .25 < 7$).

As recommended [22] the structure of the final model, standardized item-factor loadings, and several model fit tests were reported. Model fit tests were the chi-square statistic - both raw (X^2) and divided by its degrees of freedom (X^2/df; both should be close to zero for good fit [23]), goodness-of-fit and comparative fit indices (GFI and CFI; values > .90 indicate acceptable fit, and > .95 good fit [24]), standardized root mean squared residual (SRMR; values ≤.08 indicate good fit [23]), and the root mean square error of approximation (RMSEA; values < .05 indicate good fit, .05-.08 acceptable fit, and >.08 marginal to poor fit [25]).

Subsequently, measurement invariance of the overall final model was determined, to assess whether factor structure was similar for the patient and control group [26]. To this end, model fit was assessed when item-factor loadings were free to differ between patient and control groups (unconstrained testing), when item-factor loadings were equated across groups (so-called weak/metric invariance testing), and when both the item-factor loadings and the intercepts of the model were equated across groups (so-called strong invariance [26]). When model fit is statistically similar in all these three analyses – as indicated by non-significant X^2 values and a difference in CFI of .1 or less [27] – the factor structure is similar for patients with stroke and controls.

2.4.2. Construct Validity

Construct validity was assessed by testing whether the MSRS could differentiate healthy controls from individuals with stroke [28]. Bonferroni corrected independent-samples t-tests were used to test the hypothesis that individuals with stroke had higher CMP and MS-C scores than healthy controls. Data collected at T1 served as input for this comparison. Significance level was set at $p = .05$.

2.4.3. Reliability

Reliability indices and measurement error were calculated for both groups separately. Internal consistency of the CMP and MS-C subscales (at T1) was assessed with Cronbach's alpha. Test-retest reliability for the total score, and for scores on the CMP and MS-C subscales was assessed with a 2-way, random effect, consistency, single measures ICC[†]. Both ICC and Cronbach's alpha values should be higher than .70 for sufficient reliability. Finally, measurement error was assessed by calculation of the standard error of measurement ($SEM = SD_{measurement1+2}\sqrt{1\text{-}ICC}$; [30]) and by calculating the minimal detectable change on the group and on the individual level ($MDC_{group} = SEM \times 1.96 \times \sqrt{2}/\sqrt{n}$; $MDC_{individual} = SEM \times 1.96 \times \sqrt{2}$; [30,31]).

[††] All three variables were normally distributed in the patient group, but somewhat positively skewed in the control group ($M_{skew} = 0.9$). As ICC is highly robust to slight deviations from normality [29] we chose to use the original (non-transformed) data for this analysis.

3. RESULTS

One-hundred patients with stroke and one-hundred healthy peers were included. Of these 98 patients and 97 healthy controls were included in the validity and internal consistency analyses, whereas 97 patients and 91 healthy peers were included in the retest-reliability analysis (see figure 1 for details on the inclusion process). Group characteristics are presented in table 1.

*****Figure 1 near here*****

***** Table 1 near here *****

3.1. Validity

3.1.1. Structural validity

A total number of 195 (98 patients + 97 controls) participants were included in the analysis. The final overall model of the CFA is presented in figure 2. Model fit was best when several pairs of error terms within the MS-C subscale were co-varied (figure 2). Considerable covariance was observed between the CMP and MS-C factors (.78). Standardized item-factor loadings were all in the expected direction (i.e., positive), and of substantial magnitude (>.5). Most importantly, model fit indices were acceptable to good ($X^2(31) = 50.6$, $p = .015$; $X^2/\text{df} = 1.63$; GFI = .95; CFI = .98; SRMR = .045; RMSEA = .057, [90% CI = .026-0.085]). Subsequent tests revealed that this model demonstrated both weak ($X^2(8) = 4.6$, $p = .80$; ΔCFI = .007) and strong measurement invariance ($X^2(11) = 15.9$, $p = .14$; ΔCFI = .01). Thus, factor analysis confirmed the hypothesized two-factor structure of the MSRS, both for the patient and control group.

*****Figure 2 near here*****

3.1.2. Construct validity

Summed reinvestment scores of both groups are presented in table 2. The hypothesis for construct validity was supported by independent-samples t-tests. Stroke patients scored higher on the MSRS than controls, both with regard to the CMP ($t(183.8) = 13.5, p < .001, d = 1.9$, 95% $CI = [8.7\ 12.7]$), and MS-C subscale ($t(172.9) = 10.3, p < .001, d = 1.5$, 95% $CI = [6.0\ 9.8]$). Additional t-tests showed that CMP scores were higher than MS-C scores, both for patients ($t(97) = 10.6, p < .001, d = 2.2$, 95% $CI = [5.1\ 7.4]$) and controls ($t(96) = 6.5, p < .001, d = 1.3$, 95% $CI = [2.4\ 4.5]$).

*****Table 2 near here*****

3.2. Reliability

Table 3 lists all reliability measures. For the control group, internal consistency was satisfactory. For patients, Cronbach's alpha of the CMP-subscale was somewhat below the threshold of .70, but still of substantial magnitude[‡]. Test-retest indices showed a similar pattern of results, with the CMP-subscale scoring slightly below cut-off in the patient group (.70). Observation of the range of scores on this subscale revealed that limited variance may partially account for this: on T1, all patients scored above 5 on the CMP subscale.

The SEM and minimal detectable change were greater for patients than for controls. Specifically, on an individual level the minimal detectable change for the total MSRS score was almost twice as large in patients (12.5) as in controls (6.9). As the total score can range between 10 and 60, it therefore seems that individual changes in MSRS score of 25% or more

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[‡] Additional analysis of the inter-item correlation matrix revealed that item 1 ("I remember the times when my movements have failed me") correlated poorly with items 3 ($r = .16$) and 9 ($r = .11$), and demonstrated weak item-total correlation (i.e., $r < .3$). However, it was decided not to remove this item, considering that confirmatory factor analysis showed item 1 to have satisfactory factor loading (.61), and since removal of this item would only slightly improve Cronbach's alpha of the CMP subscale ($\alpha = .67$).

can be reliably detected in patients with stroke. On group level, however, the minimal detectable change for the total scale and the two subscales was adequate in both groups (i.e., ≤ 1.2).

*****Table 3 near here*****

4. DISCUSSION

It has been proposed that the tendency to consciously control motor actions by 'reinvesting' attentional resources delays motor recovery after stroke [7,9]. As a first step to investigate this hypothesis, this study validated (a Dutch language version of) the Movement-Specific Reinvestment Scale for use in an inpatient stroke population and healthy age-matched peers. Structural validity was supported by factor analysis, which confirmed the two-factor structure obtained by earlier studies within healthy adults [8,12]. In addition, construct validity was verified, as the MSRS successfully differentiated inpatient stroke patients from healthy peers. Furthermore, test-retest reliability and internal consistency were adequate in both groups. Taken together, the MSRS seems a valid and reliable instrument to measure reinvestment tendencies of inpatient patients with stroke and healthy age-matched controls.

This study was the first to assess the validity of the MSRS to measure reinvestment tendencies after stroke. Similar to earlier studies [8,12], when administered to stroke patients, the MSRS encompasses two latent factors, with 5 items relating to one's tendency to engage in conscious motor control (CMP subscale) and 5 measuring the degree to which one feels self-conscious about one's style of moving (MS-C subscale). Tests of construct validity showed that patients with stroke scored higher than controls on both these subscales, reproducing findings with the English MSRS within a chronic stroke population [9]. Further support for the validity of the MSRS's two-factor structure stems from the finding that patients with stroke scored higher on the CMP subscale than on the MS-C subscale, replicating earlier findings with chronic stroke patients [9,13] and patients with Parkinson's disease [32]. It is doubtful that both subscales are of equal clinical relevance, though. Theoretically, one would expect the CMP subscale to be of more relevance than the MS-C subscale, as the former directly concerns one's motor control preferences, whereas the latter merely gauges whether one feels awkward about one's style of moving. Indeed, there is some evidence to support this hypothesis. For instance, higher CMP scores have been found to be uniquely associated with more severe motor impairments in people with stroke [9], with an increased risk of falling in healthy elderly [8], with duration of Parkinson's disease [32], and with more self-reported knee pain in healthy adults [18]. Since no such associations have been reported for individuals' MS-C scores, researchers and rehabilitation therapists may be especially interested in patients' scores on the CMP subscale. Further exploration of the unique associations between MS-C and CMP scores and motor behaviour after stroke is needed.

For the patient group, test-retest reliability indices of the total scale and MS-C subscale were comparable to those reported by Kleynen et al. [13] It seems that in this study the CMP subscale is somewhat less reliable, however. This might be due to the fact that this inpatient stroke population generally is in a less 'stable' situation than the chronic stroke population studied by Kleynen and colleagues. In addition, as noted earlier, low variance in scores on the CMP subscale may have attenuated test-retest reliability. Finally, the use of a 6-point Likert scale (instead of a dichotomous one) may have compromised reliability, as it may have been somewhat more difficult to complete. For the stroke group, internal consistency values of both subscales were similar to those of English and French versions of the MSRS when tested in healthy adults [12,33]. With regard to the control group, both retest reliability and internal consistency were satisfactory to good, replicating findings obtained within young healthy adults [12].

Next to validity and reliability, the utility of the MSRS depends on its measurement error. In this study, although the minimal detectable change of the total scale (12.5 points or 25% of total scale range) was slightly better than the measurement error reported by Kleynen et al. [13] (3 points or 27% of total scale range), it was still relatively large. However, the minimal detectable change was considerably better when assessed on a group level (1.2 points for the total scale, and 0.8 for each subscale). This suggests that the MSRS is suitable to compare reinvestment tendencies across different groups, but is less suitable for tracking individual changes in reinvestment after stroke. In other words, the MSRS may be especially useful for scientific purposes, but needs further refinement for clinical applications. It is unclear how measurement error for the control group compares to earlier work, as this is the first study to report on the minimal detectable change in reinvestment score within healthy (elderly) individuals. Nonetheless, the minimal detectable change for this group seemed adequate both on a group and individual level.

A strength of the present study is that the study population was representative for the general stroke population that is admitted for clinical rehabilitation in a rehabilitation center in the Netherlands. All inpatient people with stroke were screened for participation (n=116). About 86% of these participated, among whom a considerable number of aphasic patients (13%). Of note, a limitation is that we assessed the validity and reliability of the MSRS within a Dutch stroke population. Nonetheless, our results likely also hold true for other stroke populations, as the scale was translated in accordance with cross-cultural validation guidelines

[20]. A more poignant limitation of the MSRS is that it seems less useful for patients with severe aphasia and/or substantial cognitive impairments, as they made up the majority of patients who were excluded from participation. Also, a practical limitation of the MSRS is that questions and answer possibilities need to be read aloud for many patients (e.g., 33% in our study), mostly due to problems with vision (e.g. neglect) or aphasia. Relatedly, a limitation of the present study is that we did not specifically assess cognitive and motor abilities of patients. As our in- and exclusion criteria were quite lenient, it is likely that there was large heterogeneity in terms of cognitive and motor functioning in the patient population. Even so, the MSRS was found to be reliable.

Finally, although technically beyond the scope of this study, our data allowed an interesting side-speculation. That is, two observations from our data may nuance the idea that patients' increased tendency to reinvest is the result of the predominance of explicit motor learning strategies [2,3] within current rehabilitation practice [9]. First, a considerable number of patients (± 25%) were tested within the first two weeks since the start of rehabilitation. Second, no significant association was observed between the time spent in rehabilitation at T1 and reinvestment score ($r < .3$, $p > .1$), suggesting that reinvestment does not change substantially throughout rehabilitation. Based on this, we speculate that reinvestment is not necessarily a strategy patients gradually acquire in the course of rehabilitation. Instead, patients with stroke may already have become highly prone to reinvest even before rehabilitation commences, and remain so throughout the rehabilitation period. Whether this impedes patients' motor recovery (as argued by Orrell et al. [9]) remains an open question. In this regard, the results of Stillman and co-workers are worth mentioning [34]. They reported that healthy (young and old) people who are more predisposed to be mindful (or: " to stay attentive and receptive to events and experiences taking place in the present and thus disengage from habitual actions and thought tendencies", p. 141) have a reduced implicit motor learning ability. Considering the apparent similarities between the concepts of reinvestment (or more specifically: conscious motor processing) and mindfulness, one may speculate that many stroke patients with a strong disposition to reinvest are less able to learn motor skills implicitly. This would be also in line with reports that people with higher reinvestment tendencies are more likely to engage in *explicit* motor learning [35]. Future research should explore this hypothesis, by further mapping the relation between motor recovery and dispositional reinvestment post-stroke.

We conclude that the MSRS is a valid and reliable tool to measure reinvestment after stroke. The clinical usefulness of this tool for individual patients remains to be determined though. In order to establish this, future studies need to assess (1) whether reinvestment indeed impairs motor functioning post-stroke, and (2) whether the MSRS is accurate enough to measure clinically meaningful changes in reinvestment over time in individual patients.

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DECLARATION OF INTEREST STATEMENT

None declared.

Appendix 1: English Movement-Specific Reinvestment Scale (Masters et al., 2005)

DIRECTIONS: Below are a number of statements about your movements in general. Circle the answer that <u>best</u> describes how you feel for each question.

English Movement Specific Reinvestment Scale

1. I remember the times when my movements have failed me

strongly disagree	moderately disagree	weakly disagree	weakly agree	moderately agree	strongly agree

2. If I see my reflection in a shop window, I will examine my movements

strongly disagree	moderately disagree	weakly disagree	weakly agree	moderately agree	strongly agree

3. I reflect about my movement a lot

strongly disagree	moderately disagree	weakly disagree	weakly agree	moderately agree	strongly agree

4. I try to think about my movements when I carry them out

strongly disagree	moderately disagree	weakly disagree	weakly agree	moderately agree	strongly agree

5. I am self-conscious about the way I look when I am moving

strongly disagree	moderately disagree	weakly disagree	weakly agree	moderately agree	strongly agree

6. I sometimes have the feeling that I am watching myself move

strongly disagree	moderately disagree	weakly disagree	weakly agree	moderately agree	strongly agree

7. I am aware of the way my body works when I am carrying out a movement

strongly disagree	moderately disagree	weakly disagree	weakly agree	moderately agree	strongly agree

8. I am concerned about my style of moving

strongly disagree	moderately disagree	weakly disagree	weakly agree	moderately agree	strongly agree

9. I try to figure out why my actions failed

strongly disagree	moderately disagree	weakly disagree	weakly agree	moderately agree	strongly agree

10. I am concerned about what people think about me when I am moving

strongly disagree	moderately disagree	weakly disagree	weakly agree	moderately agree	strongly agree

NB: Items 2, 5, 6, 8, and 10 refer to the subscale Movement Self-Consciousness (MS-C). Items, 1, 3, 4, 7, and 9 refer to the subscale Conscious Motor Processing (CMP).

Appendix 2: Movement-Specific Reinvestment Scale – Dutch language version (MSRS-DLV)

Naam: **Datum:**

INSTRUCTIE: Hieronder staan een aantal uitspraken over uw bewegen in het algemeen. Lees deze goed door en omcirkel het antwoord dat het beste bij u past.

1. **Ik kan me herinneren wanneer het me niet lukte mijn beweging uit te voeren**

1	2	3	4	5	6
helemaal mee oneens	redelijk mee oneens	een beetje mee oneens	een beetje mee eens	redelijk mee eens	helemaal mee eens

2. **Als ik mijn spiegelbeeld zie, bekijk ik mijn bewegingen**

1	2	3	4	5	6
helemaal mee oneens	redelijk mee oneens	een beetje mee oneens	een beetje mee eens	redelijk mee eens	helemaal mee eens

3. **Ik denk veel na over mijn bewegingen**

1	2	3	4	5	6
helemaal mee oneens	redelijk mee oneens	een beetje mee oneens	een beetje mee eens	redelijk mee eens	helemaal mee eens

4. **Ik probeer na te denken over mijn bewegingen als ik ze uitvoer**

1	2	3	4	5	6
helemaal mee oneens	redelijk mee oneens	een beetje mee oneens	een beetje mee eens	redelijk mee eens	helemaal mee eens

5. **Ik voel me ongemakkelijk over hoe ik eruit zie tijdens het bewegen**

1	2	3	4	5	6
helemaal mee oneens	redelijk mee oneens	een beetje mee oneens	een beetje mee eens	redelijk mee eens	helemaal mee eens

Movement-Specific Reinvestment Scale – Dutch language version (MSRS-DLV)

6. Ik heb het gevoel dat ik mezelf bekijk tijdens het bewegen

1	2	3	4	5	6
helemaal mee oneens	redelijk mee oneens	een beetje mee oneens	een beetje mee eens	redelijk mee eens	helemaal mee eens

7. Ik ben me bewust van de manier waarop mijn lichaam werkt als ik een beweging uitvoer

1	2	3	4	5	6
helemaal mee oneens	redelijk mee oneens	een beetje mee oneens	een beetje mee eens	redelijk mee eens	helemaal mee eens

8. Ik maak me zorgen over mijn manier van bewegen

1	2	3	4	5	6
helemaal mee oneens	redelijk mee oneens	een beetje mee oneens	een beetje mee eens	redelijk mee eens	helemaal mee eens

9. Ik probeer uit te zoeken waarom mijn bewegingen mislukken

1	2	3	4	5	6
helemaal mee oneens	redelijk mee oneens	een beetje mee oneens	een beetje mee eens	redelijk mee eens	helemaal mee eens

10. Ik maak me zorgen over wat anderen van mij denken als ik beweeg

1	2	3	4	5	6
helemaal mee oneens	redelijk mee oneens	een beetje mee oneens	een beetje mee eens	redelijk mee eens	helemaal mee eens

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TABLES

Table 1. Group Characteristics

*Defined at T1; NB: N/A = not applicable

Demographic variable	**Stroke**	**Control**
n	98	97
Age (SD)	57.9 (11.4)	59.7 (10.0)
Male/Female	58/40	52/45
Stroke type		*N/A*
Hemorrhagic	25	
Infarct	73	
Stroke location		*N/A*
Right	52	
Left	26	
Bilateral	5	
Stem/Cerebellar	12	
Unspecified	3	
Days since stroke* (range)	63 (11-266)	*N/A*
Days in rehabilitation* (range)	44 (3-259)	*N/A*
Aphasia (Yes/No)	13/85	*N/A*

Table 2. Summed reinvestment scores (± SE) for both groups at T1 and T2. Scores are presented separately for the total scale (MSRS-DLV) and for each subscale (CMP and MS-C). Of note, differences between T1 and T2 can be somewhat distorted as 1 stroke patient and 6 healthy controls only completed the MSRS-DLV at T1. NB: CMP = Conscious Motor Processing; MS-C = Movement Self-Consciousness; MSRS = Movement-Specific Reinvestment Scale;

Group	MSRS-DLV score	T1	T2
Stroke			
	Total Scale	40.8 ± 1.0	38.6 ± 1.1
	CMP	23.5 ± 0.5	22.4 ± 0.5
	MS-C	17.2 ± 0.6	16.1 ± 0.7
Control			
	Total Scale	22.2 ± 1.0	19.8 ± 0.9
	CMP	12.6 ± 0.6	11.4 ± 0.6
	MS-C	9.4 ± 0.4	8.4 ± 0.4

Table 3. Reliability measures for both groups.

NB: CMP = Conscious Motor Processing; MS-C = Movement Self-Consciousness; ICC = Intraclass Correlation Coefficient; MDC = minimal detectable change; SEM = standard error of the measurement;

		Stroke	**Control**
ICC (95% CI)			
	Total Scale	0.80 (0.71-0.86)	0.92 (0.89-0.95)
	CMP	0.67 (0.54-0.76)	0.91 (0.86-0.94)
	MS-C	0.79 (0.71-0.86)	0.84 (0.77-0.89)
Internal Consistency (α)			
	CMP	0.66	0.77
	MS-C	0.74	0.69
SEM			
	Total Scale	4.5	2.5
	CMP	2.9	1.8
	MS-C	2.9	1.5
MDC (individual level)			
	Total Scale	12.5	6.9
	CMP	8.0	5.0
	MS-C	8.0	4.2
MDC (group level)			
	Total Scale	1.2	0.7
	CMP	0.8	0.5
	MS-C	0.8	0.4

FIGURES

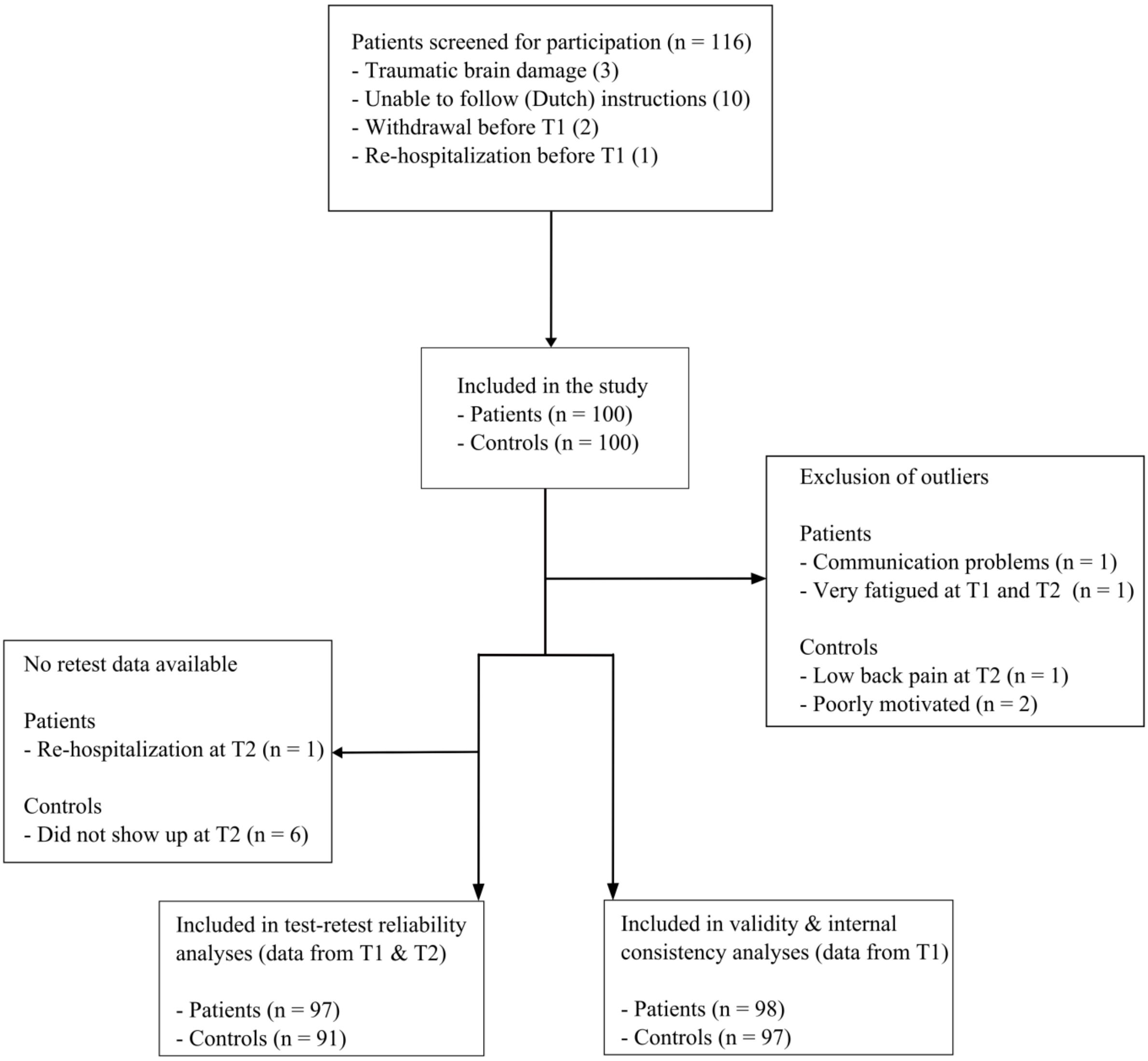

Figure 1. Flowchart of inclusion of stroke patients and healthy controls

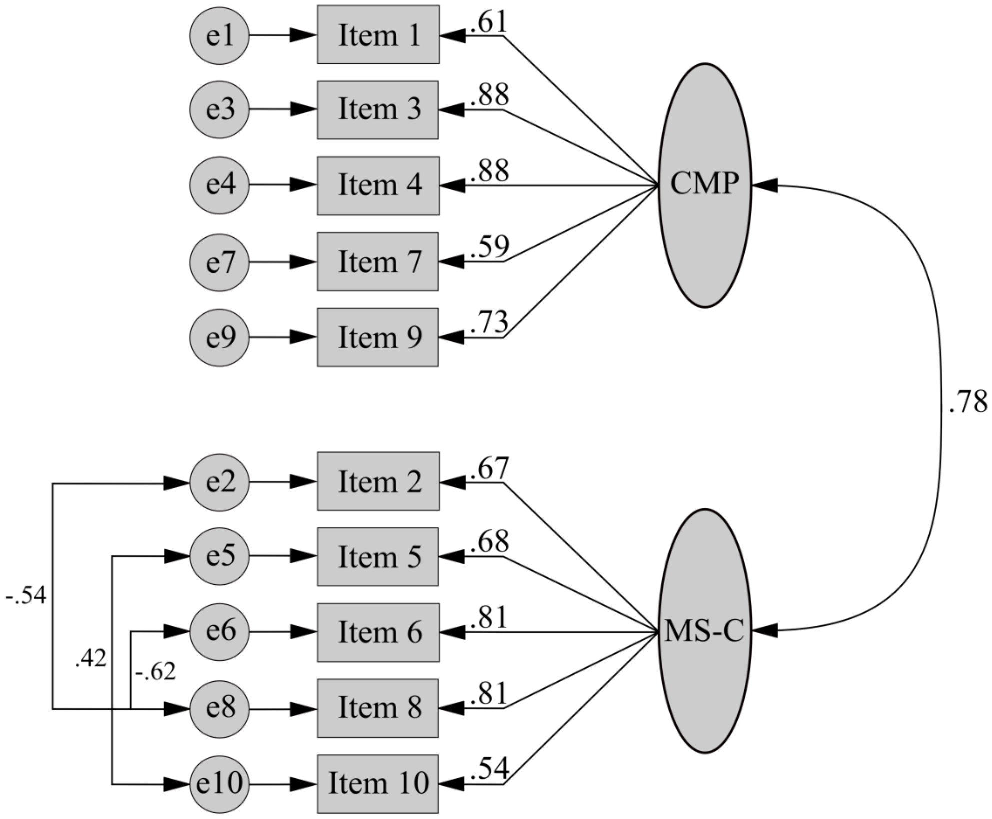

Figure 2. Final overall model yielded by the CFA. Shown (above the arrows) are the standardized factor loadings of each item and the amount of covariance between the factors CMP and MS-C. Allowing covariance between the error terms of three pairs of items (items 5–10, items 2–8, and items 6–8) yielded the best fitting model. Item numbers refer to the items on the questionnaire (see appendices). NB: CMP = Conscious Motor Processing subscale; MS-C = Movement Self-Consciousness subscale; e = residual error.