Self-estimation of Performance Time Versus actual Performance Time in Older Adults with Suspected Mild Cognitive Impairment: A Clinical Perspective

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ABSTRACT

Background: Estimation of the passage of time has received marginal attention in contemporaneous psychiatric assessment and diagnosis. There is disagreement regarding the ability of older adults with dementia, particularly of the Alzheimer's type, to estimate time passage, and there is lack of data concerning the ability of older adults in the early stages of cognitive impairment to estimate the passage of time.

Objective: We investigated the hypothesis that individuals with mild dementia perform worse compared to those with no cognitive impairment, and that those with mild cognitive impairment (MCI) assume an intermediate position in terms of their ability to accurately estimate time passage. Another objective was to study demographic and clinical (cognitive, functional, psychiatric) predictors of self-estimation of performance time versus actual performance time.

Method: In the context of a comprehensive psychogeriatric evaluation, three performance time measures were established: actual performance time, subjective estimation of performance time, and accuracy of estimation of performance time.

Results: 102 consecutive persons with suspected MCI were assessed. Final cognitive diagnoses were: dementia 49 (48%), MCI 36 (35%), no cognitive impairment (NCI) 17 (17%). Whereas there were significant group differences (dementia, MCI, NCI) on all cognitive measures and on functional impairment, there were no significant group differences on the three time measures. With the exception of age, estimation of performance time was not associated with any of the other demographic and clinical variables.

Conclusion: Self-estimation of performance time versus actual performance time was not found impaired either in the dementia group or in the MCI group when compared to participants without cognitive impairment.

INTRODUCTION

Descriptive psychopathology makes an important distinction between chronological, clock time (objective, quantifiable) and personal time (subjective) (1). Both might be affected in psychiatric disorders, such as psychoses (2, 3), depression (4) and organic conditions (1). Altered chronological clock time may involve disorientation to time of day, day of the week, month and year, as well as the inability to evaluate correctly the passage or the duration of time. Whereas disorientation to time constitutes a cardinal feature of psychiatric examination, estimation of the passage of time has received marginal attention in contemporaneous psychiatric assessment and diagnosis.

Time perception is considered an unclear cognitive construct (5), for which several mechanisms are potentially responsible (6-9). It is thought that the ability to estimate the passage of time is related to cognitive processes and to the interaction between cognitive and biological mechanisms (10). Memory and attentional-

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executive function seem to be crucial determinants (5). Impairments in time estimation have been found in different types of pathology such as dementia of the Alzheimer's type (5, 10-12), amnesic patients (11), frontal-damaged and alcoholic Korsakoff (13) and brain damaged patients (14). As for dementia, whereas most studies reported impaired time estimation in individuals with Alzheimer's disease (5, 10-12), Levy and Dreier (15) showed that temporal skills, such as intuitive time (i.e., the ability to estimate time interval duration) and socialized time may be relatively preserved in patients with possible Alzheimer's disease. Hence, there is no consensus regarding the level of impairment in time estimation associated with the presence of dementia.

To evaluate respondents' assessment of the passage of time, study designs have adopted sophisticated time estimation tasks (e.g., using computerized devices), covering very short (seconds) intervals, and conducted in experimental settings. Their applicability to clinical, real life situations is not clear. In addition, individuals with dementia recruited for these studies were mild to moderate cases of cognitive impairment with a mean Mini-Mental State Examination (MMSE) (16) score of 22.63 (10), 15 (15), 15 to 24 and 7 to 15 in mild to moderate dementia, respectfully (12). Control groups in most studies consisted of healthy participants (5, 10). In only one study (15) the comparison group consisted of psychiatric patients who had MMSE scores in the normal range, thus mimicking a clinical situation.

One group that could provide meaningful information about the ability of older adults with cognitive impairments to assess the passage of time is the group of individuals with mild cognitive impairment (MCI). MCI is used to describe a group of older adults who have cognitive impairments, often involving memory, not of sufficient severity to warrant the diagnosis of dementia (17). It is a commonly encountered condition in geriatric practice (18). MCI patients have been shown to perform intermediately between individuals with normal cognitive functioning and individuals with dementia on a large scale of cognitive tasks (17, 19). To date, the ability of individuals with MCI to evaluate the passage of time has not been evaluated.

The present study aims to investigate differences in self-estimation of performance time versus actual performance time in three groups of individuals that vary in terms of their cognitive functioning: mild dementia, MCI and NCI. All individuals were referred for evaluation of suspected MCI in the context of an outpatient

psycho-geriatric setting. We hypothesized that individuals with mild dementia perform worse compared to those with NCI, and that those diagnosed with MCI assume an intermediate position. Another objective was to study demographic and clinical predictors of self-estimation of performance time versus actual performance time.

METHODS

About 70% of the new referrals to our outpatient psycho-geriatric service include patients with various degrees of cognitive impairment. The remaining are individuals with functional psychiatric disturbances, mainly those with depression or anxiety disorders, treatable on an ambulatory basis. Combinations of cognitive and non-cognitive psychiatric disorders evidently commonly occur. Each new referral with cognitive complaints undergoes a comprehensive multidisciplinary assessment process (geriatric psychiatrist, geriatrician, social worker, nurse). Fully and semi-structured formats to register information pertinent to each specific field are used. Family members/information providers are encouraged to accompany the patient at each evaluative stage. The psychiatrist is always the first to evaluate the person. The structured part of the psychiatrists' cognitive examination consists of the Mini-Mental State Examination (MMSE) (16) and the Clock Drawing Test-Modified and Integrated Approach (CDT-MIA) (20). Instrumental Activities of Daily Living (IADL) are scored with the Lawton and Brody scale (21). Laboratory investigations, including imaging studies, are recommended to exclude potentially treatable causes for cognitive impairment and physical causes for emotional disorders. For those referrals with early stages of cognitive impairment an MCI clinic was established, where subjects with a working diagnosis of suspected MCI (that is, judged clinically at the first encounter as not demented however not cognitively normal), and considered cooperative enough to undertake further assessment, and in which demographics (schooling, fluency in language) and sensory/motor conditions are favorable, are offered a more comprehensive cognitive and psychiatric evaluation. It has been our experience that final cognitive diagnoses in this heterogeneous clinic population result either in confirmed MCI, mild dementia or NCI, which is in accordance with other clinics reports (e.g., 22).

The cognitive states of participants with suspected MCI are further evaluated, within 4 to 6 weeks from

the first psychiatric interview, with the Kingston Standardized Cognitive Assessment-Revised (KSCA-R) (23) and the Cambridge Cognitive-Examination-Revised (CAMCOG-R) (24). CAMCOG-R protocol may serve to generate an MMSE score and its clock drawing task to obtain a score along with CDT-MIA procedure. Psychiatric diagnoses are obtained with a modified version of CAMDEX-R, the Cambridge examination for mental disorders of the elderly-revised (24) as described elsewhere (25).

DSM-IV operational criteria are used for cognitive and psychiatric diagnoses (25, 26). MCI diagnosis is established according to Winblad et al. (27) criteria operationalized in the following order: a. not demented according to DSM-IV criteria; b. self and/or informant report of cognitive decline; c. impairment on objective cognitive tasks (defined as CAMCOG-R total score below the 25th percentile compared to normative values by age-group, sex and educational level (28); d. preserved basic activities of daily living/ minimal impairment in instrumental functions.

In order to study self-estimation of performance time we took advantage of the fact that both KSCA-R and CAMCOG-R query the correct time of day, and CAMCOG-R includes a "passage of time" evaluation, that is, participants' estimation of the actual duration of interview (minutes) from the beginning of Section A to the end of Section B (CAMCOG-R). KSCA-R was administered at the beginning of the interview (duration of administration time is 15 to 20 minutes [23]), followed by the CAMCOG-R (duration of administration time is 25 to 30 minutes [24]). KSCA-R asks for the exact time of day early in the questionnaire (item 9) whereas CAMCOG-R queries the exact time and time passage estimation at the end of the questionnaire (items 204 to 206). In parallel to participants' response, the examiner registers the exact hour and minute. The assessment is conducted in a room without clocks or calendars, and looking at a personal time piece during the assessment is not permitted. The same investigator, a trained geropsychiatrist (JH), performed all cognitive assessments.

For the purpose of the present study we examined the medical files of all subjects fully evaluated at the MCI clinic during the period December 2004 to June 2006. For each participant the following data were registered: demographic (age, gender, years of education), cognitive and psychiatric diagnoses/features, scores on the MMSE (of the second interview), the CDT-MIA (of the second interview), the CAMCOG-R total, the KSCA-R total, the Lawton and Brody IADL scale, and the number of psychotropic medications taken by each subject. Three performance time measures were established: actual performance time (objectively verified), subjective estimation of performance time, and accuracy of estimation of performance time. The last was expressed in absolute value, that is, the absolute differences between actual performance time and estimated performance time (higher scores on this variable represent greater inaccuracy). The study protocol was approved by the local Helsinki committee.

Analysis. We first conducted descriptive analyses, evaluating group (dementia, MCI, NCI), differences on demographic (age, sex, education), cognitive (MMSE, CDT-MIA, CAMCOG-R, KSCA-R), functional (IADL) and psychiatric status (the presence of psychiatric diagnosis/features, of depressive disorders/features, number of psychiatric medication taken). Next, we evaluated group differences on actual performance time, estimated performance time, and absolute accuracy of estimation of performance time, conducting three separate One Way Analysis of Variance (ANOVAs), with the time measures as outcome variables and cognitive diagnosis (dementia, MCI, NCI) as the independent variable. Finally, three separate regression models were constructed with actual performance time, estimated performance time and accuracy of estimation of performance time, as the dependent variables, and the demographic and clinical variables as predictors. In an additional sensitivity analysis, we evaluated the presence of depressive disorder/features diagnosis instead of the more general presence or absence of a psychiatric diagnosis/features in order to see whether a formal diagnosis of depression was related to the outcome variables. We did not evaluate other psychiatric diagnoses (e.g., anxiety disorders) separately because of the limited sample size.

RESULTS

A total of 102 consecutive persons with suspected MCI completed the entire assessment. Final cognitive diagnoses were: dementia – 49 individuals (48%; of which 63% with Alzheimer's type, 8% with vascular dementia, 10% with mixed type, 19% with other type dementia), MCI – 36 individuals (35%) and no cognitive impairment (NCI) – 17 individuals (17%). Psychiatric diagnoses and predominant features were found in 54 individuals (52.9%) of the sample: 22 (44.9%) in the dementia group, 22 (61.1%) in MCI, and 10 (58.8%) in NCI. Dementia

with depressive features prevailed (63.6%) in the dementia group followed by dementia with behavioral disturbances (22.7%) and with delusions (13.6%). In the MCI group, mixed anxiety-depressive disorder (27.2%), major depressive disorder (22.7%) and minor depressive disorder (22.7%) were the prevailing psychiatric diagnoses. The other psychiatric diagnoses in this group were: dysthymic disorder (9%), bipolar disorder (4.5%), post-traumatic stress disorder (4.5%), anxiety disorder not otherwise specified (4.5%) and adjustment disorder (4.5%). In the NCI group, adjustment disorders prevailed (50%) followed by major depressive disorder (30%). The other psychiatric diagnoses in this group were: post-traumatic stress disorder (10%), generalized anxiety disorder (10%), and anxiety disorder not otherwise specified (10%) (one person had two psychiatric diagnoses).

Table 1 shows that there were significant group differences (dementia, MCI, NCI) in age, all cognitive measures used, and functional impairment. However, no between-group differences were observed in gender, years of education, the presence of psychiatric diagnosis/features, presence of depressive disorders/features or number of psychotropic medications taken.

There were no significant between-group differences on actual performance time, estimated performance

time, and accuracy of estimation of performance time in absolute values across the cognitive diagnoses.

None of the variables evaluated in the present study predicted actual performance time (R^2=.06, p=.90) or estimated performance time (R^2=.07, p=.82). With regard to absolute accuracy of estimation time, age was the only significant predictor, with higher age being associated with poorer accuracy (B= .927, SE =.27, p=.005) (R^2=.18, p=.13). Similar findings were obtained in a sensitivity analysis that evaluated depressive disorders/features diagnoses only (instead of overall psychiatric diagnoses) as a potential covariate of the various outcome variables.

DISCUSSION

We investigated self-estimation of performance time versus actual performance time in individuals with dementia, MCI and NCI seen at a specialized outpatient setting. Whereas on all cognitive and functional measures evaluated in the present study, the MCI group demonstrated intermediate performance between individuals with dementia and individuals with normal cognitive functioning, the time measures showed no variability across the three cognitive groups studied. Self-

Table 1. *Demographic, Clinical and Time Measure Characteristics of the Sample*

	Dementia (n=49)	MCI (n=36)	NCI (n=17)	P value
Age	77.45(6.29)	75.28(6.44)	72.71(4.59)	.02
Male (%)	23(46.9)	19(52.8)	7(41.2)	.71
Years of education	11.35(3.43)	12.03(3.00)	13.59(3.28)	.06
MMSE (range 0-30)	24.81(1.79)	27.56(1.71)	28.12(1.36)	<.001
CDT-MIA total (range 0-33)	20.07(4.47)	24.52(2.99)	27.50(2.53)	<.001
CAMCOG-R total (range 0-105)	76.31(7.95)	86.25(5.37)	93.41(5.03)	<.001
KSCA-R total (range 0-125)	87.24(8.03)	98.82(5.47)	105.62(5.51)	<.001
IADL scale (range 0-8)	5.44(1.89)	6.39(1.88)	7.06(1.24)	.003
Presence of psychiatric diagnosis/features (%)	22(44.9)	22(61.1)	10(58.8)	.29
Presence of depressive disorder/features (%)	14(28.6)	19(52.8)	8(47.1)	.06
Number of psychotropic medications	.71(.81)	1.13(1.04)	.76(.90)	.09
Actual performance time (minutes)	43.95(6.72)	43.72(13.04)	39.33(5.02)	.23
Estimation of performance time (minutes)	42.00(15.96)	40.00(18.24)	46.66(16.67)	.45
Accuracy of estimation in absolute value (minutes)	12.75(8.74)	14.33(16.82)	11.60(13.57)	.76

MCI – mild cognitive impairment; NCI-no cognitive impairment; MMSE – Mini-Mental State Examination; CDT-MIA – Clock Drawing Test Modified and Integrated Approach; CAMCOG-R – Cambridge Cognitive Examination-Revised; KSCA-R – Kingston Standardized Cognitive Assessment-Revised; IADL – Instrumental Activities of Daily Living

estimation of performance time versus actual performance time (in absolute values) was not impaired in the dementia group or in the MCI group when compared to participants with normal cognitive functioning. Hence, estimation of performance time is largely preserved even among those with mild dementia. Furthermore, estimation of performance time is not associated with other demographic, psychiatric or functional variables, with the exception of age. These findings are in accordance with Grewal (12), that individuals with mild dementia of the Alzheimer's type (DAT) did not show significant loss of awareness of time relative to individuals with moderate DAT. Findings also are consistent with Levy and Dreier (15) who found no significant differences between individuals with possible Alzheimer's disease and individuals with normal cognitive functioning in the estimation of the passage of time.

There have been conflicting reports about the influence of depression and other pathologic emotions on the accuracy of judgement of time intervals. While some authors reported a detrimental effect of psychiatric diagnosis (29, 30), others found no evidence for the effect of psychiatric diagnosis on the estimation of the passage of time (15, 31). Our findings concur with the latter and demonstrate that there was no difference in estimation of performance time in individuals with psychiatric diagnosis versus individuals with no psychiatric diagnosis. This tendency was maintained even when only subjects with depressive disorders/features, considered to more specifically influence estimation of performance time (29, 30), were examined.

We hypothesize that estimation of performance time in early stages of cognitive impairment such as MCI and mild dementia depends less on the cognitive domains that are known to be impaired in these syndromes, such as memory and executive function, and more on other domains, such as time judgement, internal clock or the automatic processes of socialized and intuitive time, which are relatively spared at the early stages of cognitive impairment (6-9, 15).

This study does not go without limitations. First, the number of participants in the total sample and in each diagnostic group was relatively small, consisting of those who completed the entire evaluation. Hence, a larger sample is needed to affirm negative results. Second, the NCI control group was composed of psycho-geriatric clinic referrals with cognitive complaints. This is not a healthy control group. We may assume that among some participants subjective cognitive complaints,

labeled "subjective cognitive impairment" (32), may be a harbinger of dementia (32, 33). In addition, 52.9% of the sample received a psychiatric diagnosis, mostly depression, that although mild (25) might still influence time estimation if studied with rating scales designed specifically to quantify the severity of depression, rather than relying solely on a formal diagnosis. Third, the etiology of dementia in our sample is heterogeneous. It is possible that dementia etiology is related to estimation of performance time. For example, individuals with vascular dementia ("arteriosclerotic" dementia, Multi-Infarct Dementia) are notoriously claimed to have a relatively preserved personality and judgement compared with individuals with Alzheimer's disease (34). Hence, further research examining groups of homogenous dementia etiology is warranted.

Nevertheless, the present finding demonstrates that time estimation cannot be used to distinguish individuals with normal cognitive functioning from individuals with MCI or individuals with mild dementia. Findings also suggest that the ability to estimate the passage of time is largely preserved even in those individuals with mild dementia. These preserved temporal skills can be used by caregivers and clinicians therapeutically to enhance feelings of competence among patients (15).

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