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The Cross-Cultural Dementia Screening (CCD): A new neuropsychological screening instrument for dementia in elderly immigrants

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ABSTRACT

Objective: Currently, approximately 3.9% of the European population are non-EU citizens, and a large part of these people are from "non-Western" societies, such as Turkey and Morocco. For various reasons, the incidence of dementia in this group is expected to increase. However, cognitive testing is challenging due to language barriers and low education and/or illiteracy. The newly developed Cross-Cultural Dementia Screening (CCD) can be administered without an interpreter. It contains three subtests that assess memory, mental speed, and executive function. We hypothesized the CCD to be a culture-fair test that could discriminate between demented patients and cognitively healthy controls. *Method*: To test this hypothesis, 54 patients who had probable dementia were recruited via memory clinics. Controls (*N* = 1625) were recruited via their general practitioners. All patients and controls were aged 55 years and older and of six different self-defined ethnicities (Dutch, Turkish, Moroccan-Arabic, Moroccan-Berber, Surinamese-Creole, and Surinamese-Hindustani). Exclusion criteria included current or previous conditions that affect cognitive functioning. *Results*: There were performance differences between the ethnic groups, but these disappeared after correcting for age and education differences between the groups, which supports our central hypothesis that the CCD is a culture-fair test. Receiver-operating characteristic (ROC) and logistic regression analyses showed that the CCD has high predictive validity for dementia (sensitivity: 85%; specificity: 89%). *Discussion*: The CCD is a sensitive and culture-fair neuropsychological instrument for dementia screening in low-educated immigrant populations.

Currently, approximately 3.9% of the European population are non-EU citizens, and a large part of these people are from "non-Western" societies, such as Turkey and Morocco (19.6 million people; Eurostat, 2015). In the coming decades, this immigrant population will grow older, and the incidence of both mild cognitive impairment and dementia will increase accordingly. Accurate information about the prevalence of dementia is not available for most of the minority groups in European countries.

The diagnosis of dementia in elderly immigrants can be challenging for a number of reasons. Most of the elderly immigrants from ethnic minorities have a limited knowledge of the host country's language, and many are low educated or even illiterate. Due to these barriers, either cognitive testing is not possible, or the degree of cognitive impairment is overestimated due to the minorities' poor results on conventional cognitive screening instruments (Ardila, 2005; Manly & Espino, 2004;

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ⓘ Supplemental table for this article can be accessed here.

O'Bryant & O'Jile, 2004). For instance, on the Mini Mental State Examination (MMSE), scores that are as low as 14 points (that is, 10 points under the normal cutoff score of 24 points) may still be normal for illiterates (Ardila et al., 2010). Cultural factors may further influence these minorities' perception of cognitive symptoms that accompany dementia, their likelihood of visiting a memory clinic, and the communication between these patients and their general practitioners (GPs) and/or specialists (Mukadam, Cooper, & Livingston, 2011). Memory clinics across Europe are currently not well prepared for the elderly immigrant population, mainly because there are hardly any culturally appropriate cognitive screening tests available (Nielsen et al., 2011).

We developed a new neuropsychological dementia screening test, the Cross-Cultural Dementia screening (CCD; Goudsmit, Parlevliet, van Campen, & Schmand, 2014). In this paper, we present data on the standardization and validation of the CCD (i.e., the diagnostic accuracy) in both cognitively healthy participants and demented patients.

Method

Features of the CCD

The CCD was developed in 2005 in a general hospital (Medical Centre Slotervaart) in Amsterdam. The CCD consists of three subtests that measure memory, mental speed, and executive function.

Memory is assessed by the Objects test, which is a memory test that uses colored pictures of everyday objects, such as household items, tools, food, and clothing. The participant has to recognize 30 target items that are among an increasing number of distractors (92, in total). This test has two parts: a learning trial with immediate recognition (Part A) and a delayed recognition trial (Part B). The score of the Objects test represents the number of correctly recognized targets (maximum: 30) plus the number of correctly rejected distractors (maximum: 92). The maximum total score for immediate and delayed recognition is 122 each.

Mental speed and inhibition are assessed by the Sun–Moon test, which is a series of suns and moons that the participant has to name as fast as possible in his or her mother tongue (Part A). For an example, see Figure 1. In the second part of the test (Part B), the participant is asked to say "sun" when a moon is shown and "moon" when a sun is shown, which evokes a Stroop effect (Stroop, 1935). The scores of Parts A and B include the time to completion in seconds plus the added penalty seconds for mistakes; accordingly, both speed and accuracy are taken into account.

Mental speed and divided attention are assessed by the Dots test, which is based on the Trail Making Test (Reitan & Wolfson, 1985). Instead of letters and numbers, this task uses stimuli that resemble domino pieces. In the first part of the test (Part A), dominoes that have one to nine dots have to be connected in the right order as fast as possible by drawing a line in pencil. In the second part (Part B), the participant must connect black and white dominoes to one another, in both an alternating and an ascending order from one to nine, as fast as possible (i.e., 1 white–1 black–2 white–2 black, etc.; see Figure 2). The scores include the time in seconds on both Part A and Part B. Mistakes are also scored, but they are only used for the qualitative analysis.

The CCD does not require general factual knowledge or reading and writing skills. The test provides multiple examples in order to ensure that the participant understands the instructions. The test can be administered without the experimenter needing to speak in the participants' language. Test instructions are given by the computer by the digitally recorded standard instructions in the participants' language. Currently, the CCD is available
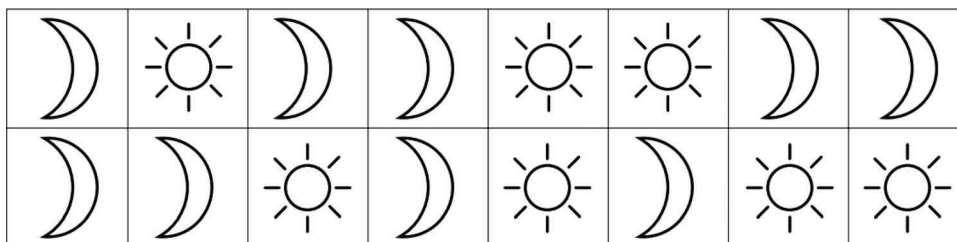

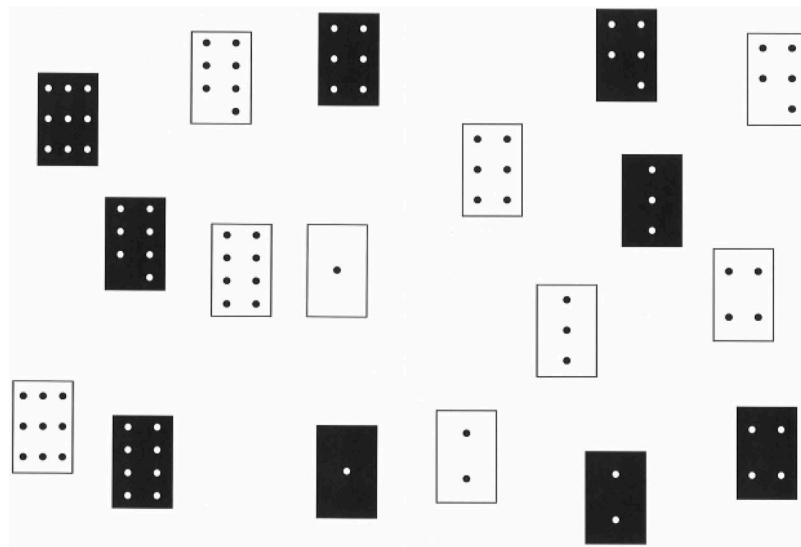Figure 1. Example of a stimulus material from the Sun–Moon test.

Figure 2. Example of a stimulus material from the Dots test (Part B).

in six languages: Dutch; Turkish; Moroccan-Arabic and Tarifit (two languages that are commonly spoken by Moroccans in the Netherlands); and Sranantongo and Sarnámi-Hindustani (the most spoken of the Surinamese languages by the Creoles and the Hindustani, respectively). The test instructions were translated by professional translators and were judged for suitability by bilingual and bicultural administrators. Furthermore, the test requires no or minimal verbal response from the participant; only behavioral responses, such as pointing to the correct alternative, are required. Note: The Sun–Moon test is the only exception to the nonverbal procedure because the administrator needs to know the words for sun and moon in the participants' language in order to score the task. The administration time is approximately 20 minutes.

Experiment 1: Standardization

Method

Participants

Participants were recruited to the SYMBOL-study of the Academic Medical Centre in Amsterdam (AMC), the Netherlands. SYMBOL stands for Systematic Memory Testing Beholding Other Languages (Parlevliet et al., 2014). Inclusion occurred from May 2010 to May 2013. Participants were approached through their GPs, who were located in seven cities in the Netherlands, which all have a large immigrant

population. Informed consent was obtained from all of the participants. The study was approved by the AMC institutional review board.

All of the patients of the participating GPs who met the inclusion criteria (being of Dutch, Turkish, Moroccan, or Surinamese descent and being aged 55 years or older) were invited to participate in the study via a letter that was sent by their GP and the research team. Afterwards, they received a telephone call from a bilingual and bicultural interviewer who provided them with further explanation about the study. If the participant was interested, an appointment was made at the GP's practice or at a local (senior) center, or they were visited at home.

All of the eligible participants were screened for exclusion criteria, which were reported by the participant, a family member, and/or the GP. These included current or a history of neurological diseases, such as brain tumors, epilepsy, severe strokes with permanent disabilities, brain injury with a loss of consciousness for more than an hour and hospitalization, memory complaints that are worse than normal for one's age, obvious cognitive impairment (as judged by the examiner), psychosis at the time of assessment, or a history of psychosis or bipolar disorder. In addition, a few participants ($n = 14$) were excluded due to problems with the test administration (i.e., severe visual problems or a lack of cooperation).

All of the participants completed the CCD and a structured questionnaire. The questionnaire (if

necessary, taken orally for illiterate participants) contained questions on demographic characteristics, medical history, self-perceived cognitive functioning (Question 6 of the EuroQoL 5D+C; Brooks, 1996; Krabbe, Stouthard, Essink-Bot, & Bonsel, 1999), and depressive symptoms (using the Geriatric Depression Scale–2 or –15; Arroll, Khin, & Kerse, 2003; Sheikh & Yesavage, 1986).

Bilingual and bicultural interviewers administered the CCD and the questionnaire. All of them were students in psychology or in a related discipline, and they received 9–12 hours of training on the administration and scoring of the CCD.

Procedure

Participants were divided into six groups, based on their self-defined ethnicity: Dutch, Turkish, Moroccan-Arabic, Moroccan-Berber, Surinamese-Creole, and Surinamese-Hindustani. Their demographic characteristics are shown in Table 1. Their mean age was 65.1 years (SD = 7.4 years), and 45% were males. Education was scored according to the International Standard Classification of Education of UNESCO (ISCED, 2012).

The ethnic groups differed in regard to age, $F(5, 1619) = 16.38$, $p < .001$, sex, $\chi^2(5) = 59.2$, $p < .001$, and education, Kruskal–Wallis, $\chi^2(5) = 688.5$, $p < .001$. Turkish and Moroccan participants were relatively younger and had less education than the native Dutch and Surinamese participants. Missing data on sex and education were replaced by the same proportion of the sex distribution ($n = 27$) or the median of the education level ($n = 54$) of the same ethnic group. Participants with scores on the CCD that could be defined as outliers were removed ($n = 32–73$, depending on the subtest). These outliers had a score that was less than 112

on immediate recognition of the Objects test, greater than 200 (s) on Part A of the Sun–Moon test, greater than 250 (s) on Part B of the Sun–Moon test, greater than 350 (s) on Part A of the Dots test, and/or greater than 600 (s) on Part B of the Dots test. Statistical analyses were conducted using the IBM SPSS Statistics Version 20.0 for Windows.

Results

The means and standard deviations for the CCD subtest scores for each of the ethnic groups are shown in Table 2.

To examine the effect of ethnicity on the CCD results, we performed an analysis of covariance (ANCOVA, or multivariate analysis of covariance, MANCOVA) with the CCD subtest scores as the dependent variables, the ethnic group as the independent variable, and age and education as the covariates. If the data were not normally distributed, they were either transformed or subjected to a nonparametric analysis.

The average immediate recognition score on the Objects test (Part A) was 121 out of the 122 objects. The average score for delayed recognition (Part B) was 116 out of the 122 objects. Thus, almost all of the participants performed very well on both of the subtests, which made the score distribution highly skewed. Therefore, differences between the ethnic groups were tested based on the Kruskal–Wallis test [Part A: $\chi^2(5) = 143.4$, $p < .001$; Part B: $\chi^2(5) = 51.5$, $p < .001$], which showed significant differences between the groups. Despite the skewed distribution, the MANCOVA was used to estimate the effect sizes. The effects of

Table 1. Demographic background of the participants from six ethnic groups.

Participant characteristics	Turkish (n = 323)	Moroccan-Arabic (n = 173)	Moroccan-Berber (n = 59)	Surinamese-Creole (n = 346)	Surinamese-Hindustani (n = 249)	Native Dutch (n = 475)	Total (N = 1625)
Sex[a]							
% Male	46	69	45	36	36	48	45
Age (years)							
Mean	63.6	63.5	65.6	64.5	64.2	67.5	65.1
SD	6.0	6.2	6.5	7.8	7.4	8.0	7.4
Range	55–83	55–79	55–77	55–91	55–87	55–95	55–95
Education[b,c]							
Median	1	1	0	5	3	5	4
Range	0–7	0–6	0–5	0–7	0–7	1–7	0–7

Note. N = 1625.
[a]For 27 participants, sex was not registered. [b]For 54 participants, education was not registered. [c]Ordinal scale: range was from 0 (illiterate/no education) to 7 (university). Eight categories: 0: no education; 1: less than 6 classes of elementary school; 2: elementary school; 3: more than elementary school, without specialized further education; 4: secondary education, skills level; 5: secondary education; 6: tertiary education (bachelor); 7: tertiary education (master and higher).

Table 2. Performance on the CCD subtests by the six ethnic groups.

Performance on the CCD	Turkish	Moroccan-Arabic	Moroccan-Berber	Surinamese-Creole	Surinamese-Hindustani	Native Dutch	Total
Objects test							
n	311	165	55	344	239	473	1587
Part A: Immediate Recognition score	120 (2)	120 (2)	120 (2)	121 (2)	121 (2)	121 (1)	121 (2)
Part B: Delayed Recognition score	115 (6)	116 (5)	116 (6)	115 (5)	115 (5)	117 (4)	116 (5)
Sun–Moon test							
n	318	171	55	343	242	463	1592
Part A:							
Time (s)	33 (11)	30 (11)	38 (16)	30 (14)	32 (11)	23 (7)	29 (12)
No of errors	0.3 (1.0)	0.2 (0.6)	0.2 (0.7)	0.3 (1.4)	0.6 (2.3)	0.0 (0.4)	0.3 (1.2)
Penalty seconds per mistake	3.6	5.8	8.4	2.3	4.0	1.4	4.5
Corrected time score (s)	33 (12)	31 (12)	40 (9)	31 (14)	34 (15)	23 (7)	30 (14)
Part B:							
Time (s)	41 (14)	43 (18)	49 (21)	38 (14)	38 (15)	27 (7)	36 (15)
No of errors	1.3 (3.4)	1.0 (2.0)	1.5 (2.6)	0.8 (2.9)	1.3 (3.7)	0.2 (1.1)	0.8 (2.7)
Penalty seconds per mistake	3.5	4.3	8.3	4.6	3.6	3.4	5.5
Corrected time score (s)	46 (21)	48 (22)	64 (40)	42 (21)	44 (24)	28 (9)	41 (25)
Dots test							
n	314	170	55	343	242	469	1593
Part A: Time (s)	50 (38)	56 (48)	73 (60)	34 (27)	41 (34)	19 (12)	37 (35)
n	298	165	52	342	228	467	1552
Part B: Time (s)	134 (73)	150 (96)	166(102)	104 (80)	119 (80)	54 (34)	104 (79)

Note. CCD = Cross-Cultural Dementia Screening. Means; standard deviations in parentheses. Participants with scores that were defined as outliers were removed so number of subjects differs per subtest; see Method section.

ethnicity, age, and education were small. Their explained variance (η^2) was approximately 3%.

The mean corrected time score (i.e., including penalty seconds in the case of errors) for the Sun–Moon test was 30 (s) for Part A (Naming) and 41 (s) for Part B (Interference). There were differences between the ethnic groups for the Sun–Moon test, for both Part A and Part B, $F(10, 3168) = 18.3$, $p < .001$, $\eta^2 = .06$. The native Dutch group was faster than the rest; when excluding this subgroup, differences still remained between the other groups for Part B, $F(8, 2244) = 3.9$, $p < .001$, but the explained variance was very small ($\eta^2 = .01$). The differences between the ethnic groups could partly be explained by differences in word length of the words "sun" and "moon" in the different languages. There were also effects for education, $F(2, 1583) = 64.1$, $p < .001$; and age, $F(2, 1583) = 32.3$, $p < .001$. Higher educated and younger participants performed better, but again, the explained variances were very small ($\eta^2 = .08$ and $\eta^2 = .04$, respectively). Thus, the Sun–Moon test had a small to moderate association with ethnicity, education, and age.

The average time on the Dots test for Part A was 37 s, and on Part B it was 104 s. We log-transformed the scores before performing an ANCOVA for Parts A and B because the values were not normally distributed. There were differences between the ethnic groups for Part A, $F(5, 1583) = 48.7$, $p < .001$, $\eta^2 = .13$, and for Part B, $F(5, 1546) = 68.7$, $p < .001$, $\eta^2 = .18$. The native Dutch group was faster than the rest; when excluding this subgroup, there were no differences between the other groups [Part A: $F(4, 1122) = 0.64$, $p = .64$; Part B: $F(4, 1122) = 1.51$, $p = .20$]. Education also had an impact on the performances of Parts A and B: Higher educated subjects performed better, $F(1, 1583) = 260.9$, $p < .001$, $\eta^2 = .14$; $F(1, 1546) = 211.9$, $p < .001$, $\eta^2 = .12$, respectively. Finally, age also affected the performances of Parts A and B: Younger participants performed better, $F(1, 1583) = 98.9$, $p < .001$, $\eta^2 = .06$; $F(1, 1546) = 115.8$, $p < .001$, $\eta^2 = .07$, respectively.

Level of education correlated with test results (higher educated people attaining better scores), with explained variances between 3% (Objects test) and 14% (Dots test Part B). Moreover, the standard deviations of scores tended to be larger in the lowest education group (see Supplementary table).

Further analysis of cultural differences

We hypothesized that the differences in CCD scores for the different ethnic groups would be caused by the fact that our six ethnic groups were not fully comparable with regard to education and

age. Therefore, the analyses were repeated for three age-matched and education-matched subgroups of participants (59 were Moroccan-Berber, 59 were Moroccan-Arabic, and 59 were Turkish). Matching on age and education with the lowest educated group (the Moroccan-Berber group) proved possible for these three ethnic groups only because both the Surinamese and the native Dutch group were higher educated and older, comparable to the age and education distribution in their populations. For the age-matched and education-matched ethnic groups, there was no longer a significant effect for ethnicity detectable. This outcome, together with the earlier analyses on effect of ethnicity, supported our assumption that most cultural differences on the CCD were in fact caused by differences in population characteristics such as age and education.

Experiment 2: Validity

Method

Patients

Patients with a diagnosis of probable dementia were recruited from memory clinics. Inclusion occurred between January 2009 and March 2013. The diagnosis of dementia was made according to the Dutch consensus guidelines by a geriatrician or neurologist (Knopman et al., 2001; Waldemar et al., 2007). The CCD was not used as a diagnostic tool in order to avoid circularity in the diagnosis (incorporation bias). Informed consent was obtained for all of the patients from their primary caregivers. They received oral and written information about the research project, which was approved by the ethical committee of the hospital.

We included 54 patients (28 were Turkish, 8 were Moroccan-Berber, 6 were Surinamese-Creole, 5 were Moroccan-Arabic, 5 were native Dutch, and 2 were Surinamese- Hindustani). The diagnoses included Alzheimer's disease (43%), the combination of Alzheimer's disease and vascular dementia (19%), vascular dementia (17%), dementia not otherwise specified (16%), fronto-temporal dementia (3%), and Lewy body dementia (2%). Information on the severity of dementia was not systematically scored.

After the routine diagnostic procedures, the CCD was administered by an experienced neuropsychologist or by a trained examiner who had a master's degree in psychology and prior experience with testing demented patients.

Procedure

The patients ($n = 54$) were matched for age, education, gender, and ethnicity to control for these characteristics in the participants ($n = 54$) who were drawn from the standardization sample. The discriminative capacity of the CCD was evaluated with receiver operating characteristics (ROC) curves, which visually reveal sensitivity and specificity in the area under the curve (AUC). Finally, to examine the predictive power of the CCD, a logistic regression analysis was performed with the group (control participant and demented patient) as the dependent variable and with CCD performance, age, education, and the ethnic group as the independent variables.

The patients had little education (ISCED scale median = 1.0; range = 0–5); most of the patients had completed less than elementary school. The mean age was 77 years ($SD = 9$), and 56% were female. The missing values or outliers of the demented patients were replaced by the lowest normal values of the patient group, 250 s for the Sun–Moon test, Part A and/or B ($n = 14$); 554 s for the Dots test, Part A ($n = 21$), and 574 s for the Dots test, Part B ($n = 32$). The missing values or outliers for the control participants were replaced by the lowest normal value in the control group, 518 s for the Dots test, Part B ($n = 3$).

Results

In Table 3, the CCD performance of the control participants and demented patients is shown. Controls performed better than demented patients on all of the subtests (Mann–Whitey U test for the differences in distributions between the groups were all significant at the $p < .001$ level).

The sensitivity and specificity of the CCD subtests are shown in a ROC curve (see Figure 3). Part B of the Objects test shows the best combination of sensitivity and specificity. AUCs varied from .85 (Sun–Moon test, Part A) to .95 (Objects test, Part B).

The optimal results for discriminating the controls from the demented patients were reached with the cutoff points that are reported in Table 4. These cutoff points were determined by combining the maximum scores for both sensitivity and specificity (i.e., Youden index; Youden, 1950).

To determine which subtest had the best predictive value for dementia, we performed a

Table 3. Performance on the CCD subtests by the control participants and the demented patients.

	Group	
	Control	Demented
Performance on the CCD	(n = 54)	(n = 54)
Objects test		
Part A: Immediate Recognition score[a]	120 (4)	107 (11)
Part B: Delayed Recognition score[a]	115 (6)	97 (7)
Sun–Moon test		
Part A: Corrected time score (s)[b]	34 (15)	100 (81)
Part B: Corrected time score (s)[c]	46 (24)	170 (78)
Dots test		
Part A: Time (s)	45 (37)	285 (225)
Part B: Time (s)	157 (126)	438 (179)

Note. CCD = Cross-Cultural Dementia Screening. Means; standard deviations in parentheses.
[a]The number of good-positives plus the number of good-negatives (max.: 122). [b]Corrected time score Part A = time in Part A + (penalty seconds × errors). [c]Corrected time score Part B = time in Part B + (penalty seconds × errors).

Table 4. Optimal cutoff points, sensitivity, and specificity for all of the subtests, based on 54 controls and 54 demented patients.

Performance on the CCD	Cutoff scores	Sensitivity	Specificity
Objects test			
Part A: Immediate Recognition score[a]	<118	.85	.89
Part B: Delayed Recognition score[a]	<109	.92	.91
Sun–Moon test			
Part A: Corrected time score (s)[b]	>39	.81	.85
Part B: Corrected time score (s)[c]	>71	.85	.89
Dots test			
Part A: Time (s)	>115	.67	.98
Part B: Time (s)	>216	.85	.83

[a]The number of good-positives plus the number of good-negatives (max.: 122). [b]Corrected time score A = time in Part A + (penalty seconds × errors). [c]Corrected time score B = time in Part B + (penalty seconds × errors).

forward stepwise conditional logistic regression analysis (N = 108; 54 demented patients and 54 matched controls). Predictors included all of the CCD subtest results, age, and education. In Table 5, the results of the best predictors are shown. Age and education were not significant predictors (p = .17 and p = .57, respectively). The best predictors were the Objects test, Part B (Delayed Recognition) and the Sun–Moon test, Part B (Interference). The other subtests did not add predictive value. A similar solution was reached by combining Objects test Part B with
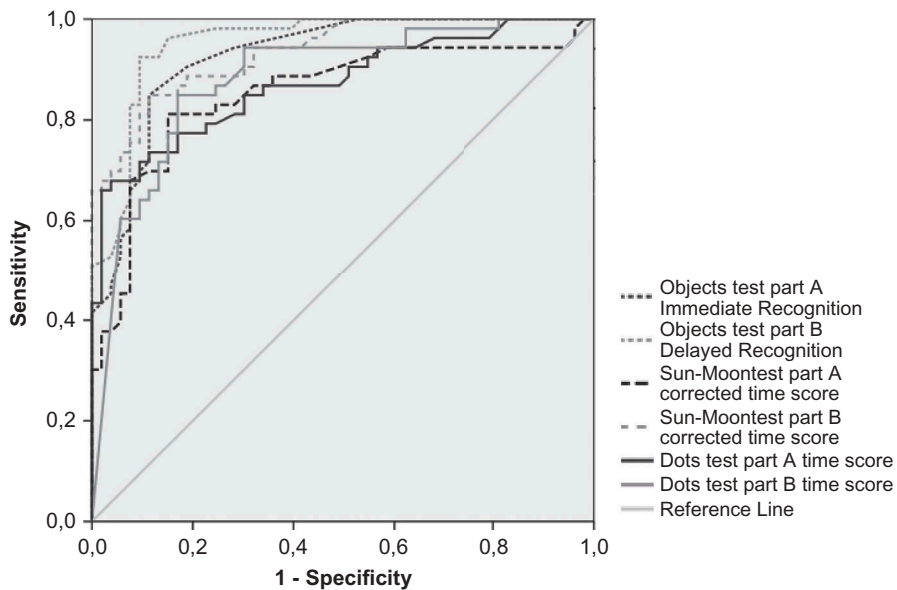

Figure 3. Receiver-operating characteristic (ROC) curves that show the discrimination between the demented patients and controls by the three subtests of the Cross-Cultural Dementia Screening (CCD).

Table 5. Logistic regression analysis results.

							95% CI for Exp (B)	
Predictor	B	SE	Wald	df	p	Exp (B)	Lower	Upper
Objects test, Part B: Delayed Recognition score	−0.190	0.050	14.244	1	.000	0.827	0.749	0.913
Sun–Moon test, Part B: Corrected time score (s)	0.022	0.008	7.277	1	.007	1.022	1.006	1.039
Constant	18.321	5.567	10.831	1	.001			

Note. CI = confidence interval.

Dots test Part B (i.e., without Sun–Moon test Part B), with comparable predictive value. The final model, which combined the scores of the Objects test, Part B and the Sun–Moon test, Part B, correctly classified 89% of the cases, with a sensitivity of 85% and a specificity of 89%.

The results of the logistic regression analysis can be expressed as a logit in the following formula, where p is the estimated probability for dementia:

$$\ln[p/(1-p)] = 18.321 \\ + (-0.190 \times \text{Objects test, Part B}) \\ + (0.022 \times \text{Sun} \\ - \text{Moon test, Part B}).$$

The probability of having dementia decreases with a lower logit. For example, if the logit is –3, the probability of having dementia is less than 5%. If the logit is 0, the probability of dementia is 50%; when the logit is more than 7, the probability is more than 99.9%. Thus, individual scores on the CCD can be transformed to a score for the person's probability of having grave cognitive disturbances due to dementia with this formula, which is a useful option in clinical practice.

General discussion

In this paper, we described the features and psychometric properties of the CCD. The test format, which included standardized instructions in the participant's language, proved to be suitable for elderly immigrants from different ethnic backgrounds. It requires well-trained examiners and is suitable to be administered in specialized centers such as memory clinics. In Experiment 1, we examined the effect of demographic variables on the CCD scores. The memory test (Objects test) was only minimally related to ethnicity. Performance on the Sun–Moon test, however, was influenced by ethnicity, which might be because the length of the words for sun and moon vary in the different languages. For example, the Turkish word for "sun" consists of two syllables ("güneş"), whereas the Surinamese word only has one syllable ("son"). Performance on the Dots test was influenced by the ethnic background of the participants, but this effect disappeared when correcting for age and education differences between the groups. Overall, these results support our hypothesis that the CCD is a culture-fair test. Education and age had a weak association with the Objects test, a weak to

moderate association with the Sun–Moon test, and a moderate to strong association with the Dots test. Education and age effects on neuropsychological test results are common, which is reflected in the norms tables for most of the neuropsychological tests (Lezak, Howieson, Bigler, & Tranel, 2012). Similarly, the CCD manual provides the norms tables for different age and education groups (Goudsmit et al., 2014).

In Experiment 2, we compared control participants and demented patients. The three CCD subtests all showed good sensitivity and specificity for dementia. The predictive validity of the combinations of subtests was good (89% of the cases were correctly classified, with a sensitivity of 85% and a specificity of 89%). The results of the Objects test, Part B (Delayed Recognition) and Sun–Moon test, Part B (Interference) were the strongest predictors for dementia.

Some limitations of this study have to be addressed. First, we only included participants from a limited number of ethnicities due to the available language versions of the CCD. Further study of CCD performance in other ethnic groups, such as the Chinese population, would be interesting (and is in progress). Second, because the exclusion criteria for the control participants were based on self-reports and information from the GP, it is possible that certain control participants were, in fact, cognitively impaired. Although we corrected for this possibility by deleting or replacing improbably low or missing scores, this may have led to lower scores in the control group. Third, the Dots test seemed to be too difficult for a few illiterate control participants and for many of the dementia patients, which could explain why this subtest had no additional predictive value in the logistic regression analysis. Finally, despite all our efforts, we only were able to include a limited number of demented patients, which makes our results less robust. However, the most prevalent types of dementia were represented in the study.

Apart from these limitations, the strengths of the CCD are that it has better psychometric properties than the MMSE (which has a sensitivity of .76 and a specificity of .83; Eefsting, Boersma, Van Tilburg, & Van den Brink, 1997). The predictive validity of the CCD also favorably compares to that of other brief, culture-sensitive screening tests, such as the Fuld Object Memory Evaluation (FOME) and the Rowland Universal Dementia Assessment Scale (RUDAS), and the CCD assesses

more domains than the Common Objects Memory Test (COMT; Kempler, Teng, Taussig, & Dick, 2010; Nielsen et al., 2013; Rideaux, Beaudreau, Fernandez, & O'Hara, 2012). Furthermore, the CCD has the advantage that it may be administered without an interpreter.

In conclusion, the CCD is a promising tool for the screening of cognitive impairment in elderly immigrants, and it has been proven to overcome low education or illiteracy barriers, language barriers, and cultural differences. The CCD is a useful complement to the usual multidisciplinary diagnostic workup in memory clinics.

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