Alzheimer’s Quick Test cognitive screening criteria for West African speakers of Krio

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Abstract

Objectives: to obtain normative data for Alzheimer’s Quick Test (AQT) measures of perceptual and cognitive speed from West African speakers of Krio.

Subjects: normal adults, who were functionally independent, from Sierra Leone (n = 164) aged 25–79 years.

Methods: perceptual and cognitive speed were measured with AQT single- and dual-dimension colour–number (C–N) and colour–animal (C–A) naming tasks. Tests were administered individually in the participants’ communities.

Results: men and women performed similarly (P > 0.05), whereas literate speakers used significantly less time than preliterate peers (P < 0.01). Correlations between age and colour naming were low (P < 0.01) and speed decreased by <0.1 s per year. Dual-dimension naming remained stable across ages. Correlations with years of education were low for dual-dimension naming (P < 0.01) and speed increased ∼0.4 s per added year. Correlations between age and education and AQT naming were non-significant for literate participants. Criterion time cut-offs (seconds) for screening were developed for preliterate and literate speakers of Krio for typical (<+1 SD), slower-than-typical (between +1 and +2 SD) and atypical (>+2 SD) performance.

Conclusion: AQT C–N and C–A naming are time efficient (3–5 min each), objective and reliable and can be administered in Krio to West African adults in Africa, Europe or North America to screen for cognitive impairments and facilitate referral for medical workup.

Keywords: cognitive processing speed, attention/executive, set shifting, screening criteria, elderly

Introduction

With rapid global growth in elderly populations, it is important to find behavioural measures to differentiate normal ageing from cognitive impairments caused by disease processes. This is challenging, as normal performance varies because of hereditary, developmental, educational or environmental factors [1, 2]. There is limited information about normal cognitive ageing [3–7] and none for African adults. This is in spite of the estimates that the African population over the age of 65 years would grow from 17.7 to 37.9 million from 1997 to 2025 [8]. This study provides measures of normal cognitive ageing in West African Krio speakers, obtained with simple, objective and reliable processing-speed tests with broad cultural/linguistic application [9].

Tests of content are typically used to screen for cognitive impairment and decline associated with neurological conditions. However, they introduce cultural, linguistic and/or educational biases, when used outside Western cultures for which they were developed. The common measure, Mini-Mental State Examination (MMSE) [10, 11], shows limitations in differentiating normal function from Alzheimer’s disease (AD) [12, 13]. Thus, MMSE showed specificity of 100% and sensitivity of 84%, whereas Alzheimer’s Quick Test (AQT) colour–form (C–F) naming [9] showed specificity of 97% and sensitivity of 97%. Educated Westerners readily perform the MMSE tasks, but abilities required for subtraction, reading and writing might not be developed in societies where literacy is not generally established. It is, therefore, of importance for the developing societies to identify cognitive-screening measures that are quick, reliable, objective and cross-culturally applicable, and can be administered with minimal training. These considerations prompted the collection of normative data for AQT colour–number (C–N) and colour–animal (C–A) naming [9] from functionally intact West African speakers of Krio.

AQT assesses processing speed (i.e. time to complete a controlled-input task) with rapid naming. Processing-speed
tests are sensitive to small changes in time, and older adults typically use longer time than younger adults [14–16]. Similarly, AQT dual-dimension (C–N and C–A) naming shows significant, but small, time increases with age for American adults below the age of 60 years (1 s per decade) and slightly larger increases after age 60 (1 s per seven years) [5]. Naming times are not affected by gender [9, 17].

The AQT naming tasks are criterion-referenced for normal adults in the US, Sweden and Greece, and cut-offs (seconds) for typical, slower-than-typical and atypical naming speeds are reported [9, 17, 18]. Test–retest reliability is high, and effects of age on naming are similar for American and Swedish speakers [9, 17]. Speakers of Greek require a higher cut-off point (100 s) for atypical C–F naming than American and Swedish speakers (+30 s) [18].

Sustained naming causes redistribution of cerebral blood flow. During AQT C–F naming, normal adults show increased blood flow to temporal–parietal brain regions bilaterally and suppressed flow to frontal regions compared with the rest [9, 17, 19, 20]. C–F naming shows high sensitivity (93.1–98.7%) and specificity (96.6–99.9%) and differentiates Swedish and Greek adults with mild-to-moderate AD from cognitively normal peers [17, 18], and in differentiating AD from dementia with Lewy bodies [21]. AQT dual-dimension naming assesses attention/executive functions mediated by temporal–parietal activation [22—24].

This study was descriptive and objectives were pragmatic. They were as follows: (i) to obtain normative data for AQT C–N and C–A naming from West African speakers of Krio, (ii) to compare naming times and effects of ageing for Krio and American speakers and (iii) to develop culturally/linguistically appropriate criterion cut-offs (seconds) for typical, slower-than-typical and atypical performance.

Materials and administration

A trained examiner, native of Sierra Leone, administered the tests individually in Krio, the lingua franca for trading and social interactions, which blends English, French and Portuguese. Participants completed testing in one session in their community settings, and short trials established adequacy of naming test stimuli.

AQT C–N and C–A each consists of three tests. Test 1 requires naming of 40 squares (e.g. black, blue, red or yellow) and Test 2 naming either 40 numbers (e.g. 2, 4, 5 and 7) or animals (e.g. bird, cat, fish, rat, snake and spider) rendered in black. Tests 1 and 2 measure perceptual speed (i.e. perception + response time). Test 3 requires naming of 40 C–N (e.g. red circle and blue square) or C–A (e.g. yellow fish and black spider) combinations and measures cognitive speed (i.e. perceptual speed + cognitive overhead). Test–retest reliability (r) is high for C–N (0.91) and C–A naming (0.96).

Naming times for each test were measured digitally, beginning at voice onset, and recorded in seconds and in fractions of seconds. Data from 144 American speakers with a mean age of 39.6 years (SD 15.9) were used for comparison. One-way ANOVA indicated no significant differences in age between Krio and American speakers (F = 3.20; P>0.05).

Statistical analyses

Naming times (seconds) were used in the analyses for the total group (n = 164), men (n = 105) and women (n = 59), preliterate (n = 41) and literate (n = 123) speakers and speakers with (n = 45) and without (n = 119) malaria. The analyses (SPSS Version 11.0.2 for Macintosh) produced descriptive statistics, one-way and univariate ANOVA comparisons, correlations (r) and linear regression coefficients (β). Measures of variability (SD) and cumulative frequencies were used to establish criterion cut-off times (seconds).

Results

Background variables

AQT naming times (seconds) for Krio speakers are summarised in Table 1. Single-dimension naming times are about one-third shorter than the dual-dimension times. Means for men and women did not differ significantly for colour, number, animal or C–A naming (F = 0.96–2.37; P>0.05). C–N naming was significantly faster among women than men (F = 6.55; P<0.01).

Mean time differences between (i) preliterate (n = 41) and literate adults (n = 123) and (ii) adults with (n = 45) and without malaria (n = 119) were tested. One-way ANOVA with literacy as a factor (i.e. education above age 15/Grade 8) [25] indicates significantly shorter C–N (M = 55.30, SD 20.37) and C–A (M = 76.14, SD 23.52) times for literate than for preliterate speakers (M = 73.10, SD 17.67; 82.98, SD 14.36) (F = 8.19 and 12.01; P<0.01). Naming times by literate Krio (n = 123) and American speakers (n = 144) were compared. Means (seconds) for Americans were as follows: colour—20.91 (SD 3.31), number—14.26 (SD 2.72), C–N—41.04 (SD 6.75), animal—25.74 (SD 3.75) and C–A—48.29 (SD
and $C–A = 94.97 + (\ldots)$

Men ($\ldots$)

Malaria ($\ldots$)

Education Color $34.28$ $− (\ldots)$

Groups Colour Number Colour–number Animal Colour–animal

Total ($n = 164$) $30.73 (6.09)$ $19.48 (5.72)$ $59.39 (21.06)$ $37.60 (9.20)$ $77.80 (21.72)$

Men ($n = 105$) $30.99 (5.75)$ $19.06 (5.81)$ $62.56^* (21.29)$ $38.25 (9.80)$ $79.22 (20.73)$

Women ($n = 59$) $29.98 (7.10)$ $20.24 (5.54)$ $54.00^* (19.84)$ $36.12 (7.62)$ $74.51 (23.62)$

Preliterate ($n = 41$) $30.71 (5.83)$ $17.59 (3.57)$ $73.10^* (17.67)$ $39.83 (10.65)$ $82.98^* (14.36)$

Literate ($n = 123$) $30.49 (6.50)$ $20.05 (6.18)$ $55.30^* (20.37)$ $37.07 (8.74)$ $76.14^* (23.52)$

Malaria ($n = 45$) $28.76 (7.28)$ $19.38 (6.71)$ $48.04^* (12.84)$ $36.18 (8.18)$ $69.27^* (26.63)$

Free from malaria ($n = 119$) $31.32 (5.69)$ $19.50 (5.32)$ $63.87^* (21.96)$ $38.12 (9.51)$ $80.74^* (18.89)$

7.18). All differences were significant ($P<0.01$) ($F = 43.09$, $21.65, 11.08, 44.30$ and $36.85$). Univariate ANOVA with age and years of education as independent variables tested interaction effects. For $C–N$, age was not significant ($F = 1.32$), whereas education ($F = 2.24; P<0.05$) and the age–education interaction were significant ($F = 0.81; P>0.05$). For $C–A$, the effects for age ($F = 1.52$), education ($F = 1.23$) and interaction ($F = 1.11$) were all non-significant ($P>0.05$).

Mean differences between speakers with ($n = 45$) and without ($n = 119$) malaria were significant ($P<0.05$) for colour, $C–N$ and $C–A$ naming ($F = 5.66, 20.63$ and $9.50$). Adults with malaria completed $12.0$ (SD $2.5$) and adults without malaria completed $9.8$ (SD $3.7$) years of education, which is a significant difference ($F = 11.67; P<0.01$).

**Age and education effects**

In the total group ($n = 164$), correlations ($r$) between age and colour and animal naming were significant ($−0.23$ and $−0.17$; $P<0.05$), whereas correlations with number, $C–N$ and $C–A$ were not ($−0.09$, $−0.15$ and $−0.03$; $P>0.05$). Significant relationships between age and naming times were analysed using linear regression (Table 2). Coefficients for age effects for colour and animal naming indicated increases (slowing of speed) of $0.05$ and $0.08$ s per year. Age accounted for $5\%$ of the variance in colour and $3\%$ in animal naming time.

Correlations ($r$) were significant between education and colour, $C–N$ and $C–A$ naming ($−0.19$, $−0.38$ and $−0.28$; $P<0.05$), whereas correlations with number and animal naming were not ($−0.03$ and $−0.13$; $P>0.05$). Linear regression (Table 2) indicated decreases in time (increased speed) of $0.14$ s for colour, $0.43$ s for $C–N$ and $0.46$ s for $C–A$ naming per added year of education. The relationships were described by the following equations: $C–N = 82.96 + (−2.25$) (education) and $C–A = 94.97 + (−1.67$) (education). Education accounted for $3\%$ of the variance in colour, $14\%$ in $C–N$ and $8\%$ in $C–A$ naming time. In the previous research, education after the age of $15$ years (Grade 8) did not affect AQT dual-dimension naming times [1, 19]. Therefore, correlations ($r$) were calculated between years of education and $C–N$ and $C–A$ naming for literate Krio speakers ($n = 123$). There was no significant correlation for $C–N$ ($r = −0.14; P>0.05$), but there was for $C–A$ naming ($r = −0.29; P<0.01$).

**Criterion cut-offs**

Normative ranges for typical, slower-than-typical and atypical naming times for literate ($n = 123$) and preliterate ($n = 41$) Krio speakers were developed by previously employed methods [9, 17] (Table 3). Times (seconds) shorter than $+1$ SD above the mean indicated typical, longer than $+2$ SD above the mean indicated atypical (potentially pathological) and between $+1$ and $+2$ SD indicated slower-than-typical performance. Cut-off times were adjusted to lend parsimony and ease of reference for screening.

Cut-off criteria for literate Krio speakers were compared with criteria for literate American and Swedish speakers for $C–N$ (typical $<50$ s; slower $51–59$ s; atypical $>60$ s) and $C–A$ naming (typical $<60$ s; slower $61–69$ s; atypical $<70$ s) [9, 17]. This indicated a difference in cut-off criteria of $25–30$ s for $C–N$ and $40–50$ s for $C–A$ naming.

**Table 2. Linear relationships between age and years of education and AQT naming times (seconds) for Krio speakers ($n = 164$)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Naming time</th>
<th>Constant $B_0$</th>
<th>Coefficient $B_1$</th>
<th>$P$</th>
<th>$r$</th>
<th>$r$-squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Colour</td>
<td>$23.97$</td>
<td>$0.15$</td>
<td>&lt;0.01</td>
<td>0.23</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>Animal</td>
<td>$45.10$</td>
<td>$−0.17$</td>
<td>&lt;0.05</td>
<td>0.17</td>
<td>0.03</td>
</tr>
<tr>
<td>Education</td>
<td>Colour</td>
<td>$34.28$</td>
<td>$−0.34$</td>
<td>&lt;0.05</td>
<td>0.19</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td>Colour–number</td>
<td>$82.96$</td>
<td>$−2.25$</td>
<td>&lt;0.01</td>
<td>0.38</td>
<td>0.15</td>
</tr>
<tr>
<td></td>
<td>Colour–animal</td>
<td>$94.97$</td>
<td>$−1.67$</td>
<td>&lt;0.01</td>
<td>0.28</td>
<td>0.08</td>
</tr>
</tbody>
</table>

**Table 3. Criterion cut-offs for typical, slower-than-typical and atypical performance for preliterate and literate adult speakers of Krio**

<table>
<thead>
<tr>
<th>Group</th>
<th>AQT test</th>
<th>Typical</th>
<th>Slower-than-typical</th>
<th>Atypical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preliterate</td>
<td>Colour–number</td>
<td>$&lt;90$ s</td>
<td>$91–109$ s</td>
<td>$&gt;110$ s</td>
</tr>
<tr>
<td></td>
<td>Colour–animal</td>
<td>$&lt;110$ s</td>
<td>$111–129$ s</td>
<td>$&gt;130$ s</td>
</tr>
<tr>
<td>Literate</td>
<td>Colour–number</td>
<td>$&lt;75$ s</td>
<td>$76–94$ s</td>
<td>$&gt;95$ s</td>
</tr>
<tr>
<td></td>
<td>Colour–animal</td>
<td>$&lt;100$ s</td>
<td>$101–124$ s</td>
<td>$&gt;125$ s</td>
</tr>
</tbody>
</table>
Discord

Normative naming times were obtained from Krio speakers for AQT C–N and C–A naming, and criterion cut-offs were developed for potential cognitive screening. C–F naming, explored in clinical research [9, 13, 17–20], was not administered because of rare use of names for geometric forms in West African daily life. The study assumed a macro-perspective where dual-dimension naming times were considered symptomatic of broader attention/executive functions (e.g. attention, working memory and set shifting) [20, 22–24].

Women named the C–N stimuli on average 10 s faster than men, a counterintuitive finding, as men tend to be the traders. More importantly, men and women used similar times for dual-dimension naming, concurring with the findings for American and Swedish speakers [1, 5, 17]. Age did not significantly affect dual-dimension naming either.

Education (literacy) influenced C–N, but not C–A naming speed. This seems appropriate, as colour naming and number naming are part of the curriculum in West African schools, and longer exposure should result in greater cognitive speed. Interactions between age and education were not significant for dual-dimension naming. As a group, Krio speakers were significantly slower at naming both single- and dual-dimension stimuli than American speakers [5]. Even literate Krio speakers used considerably longer time than literate Americans to name stimulus combinations.

Age and education

Associations between age and naming times were low and only reached significance for perceptual speed measures. Age accounted for less variance in colour naming for Krio (5%) than for American speakers (8%) [5]. Associations between years of education and dual-dimension naming were low, but significant, and speed increased by about 2 s for each added year of education. Education accounted for relatively large proportions of the variance in C–N and C–A naming (15 and 8%, respectively).

The association between education and naming time was evident in adults with and without malaria. Adults with malaria, and more advanced education, used on average 10 s less for C–N and 20 s less for C–A naming than malaria-free adults. This supports that achievement of literacy results in greater cognitive flexibility. In the literate group, there was no significant association between education and C–N naming. This concurs with the findings that education past established literacy has little effect on dual-dimension naming among American and Swedish adults [9, 17].

Implications for screening

Criterion cut-offs for AQT naming are identical for American and Swedish speakers [9, 17, 18, 20]. Because Krio shares features of English in content and structure, similarities in naming times would be expected. However, criterion cut-offs for the lower limits of atypical performance for Krio speakers are more than 30 s longer than cut-offs for American speakers [9]. The difference may reflect cultural traditions for rate of speech in West Africa or other uncontrolled factors.

Speed, ease of administration and equity of access are desirable screening-test qualities in societies with limited education. The advantages of using C–N over C–A naming with West African Krio speakers were therefore considered based on variability, biases and expressed preferences. C–N and C–A naming showed similar variability, but the majority preferred C–N to C–A naming. Although C–N or C–A naming may be used alone for screening, best clinical practice suggests administering both the tasks (5–7 min total) until clinical utility data become available. We also suggest repeating administration of dual-dimension tests with atypical naming times (>+2 SD) for consistency and validation.

Results suggest that AQT C–N and C–A can be used for first-line screening of Krio speakers in West Africa, Europe or North America to identify adults, who may require further evaluation for cognitive impairment and/or dementia. The tests are not intended for diagnostic purposes, because they are sensitive to cognitive impairments resulting from a range of neurological and psychiatric disorders. If naming time consistently falls in the atypical range, referral for medical workup is recommended. If naming time falls within the slower-than-average range, periodic screening is recommended to identify if significant reductions in cognitive speed (+15 s or more), which may be indicative of a progressive disorder, have occurred.

Current health priorities in West Africa concern individuals who are HIV positive. Growth in the elderly population will, however, demand attention to detecting cognitive impairments, resulting from dementia or other causes. While prescription medications for AD are unavailable to most West Africans, the cultures have long histories of treating illness, including memory loss, with herbal constituents and compounds, justifying early identification.

Key points

- Normative data for AQT C–N and C–A naming were collected from 164 functionally intact speakers of Krio in Sierra Leone.
- Naming speed was significantly faster for literate than for preliterate speakers.
- Age had no significant effect on dual-dimension naming times.
- Years of education affected dual-dimension naming times in the total group, but not in the group of literate speakers.
- Criterion cut-offs were developed separately for screening literate and preliterate West African speakers of Krio.

Conflicts of interest

None.

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AQT cognitive screening criteria

References


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