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Assessment of cognition in an adolescent Indigenous population

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Abstract

The assessment of cognition in Indigenous populations is often complicated by cultural and language differences and unfamiliarity with the assessment process. Cognitive tasks are being developed that reduce the impact of these factors. These processes need to be evaluated in different cultural and ethnic groups to determine whether they are appropriate. Such an assessment was recently used in two studies of cognition of 237 Indigenous Australian adolescents (age: $M = 16.06 \pm 2.16$ years). The tasks were completed appropriately, with response times and error rates increasing for difficult tasks. Duration and error rates decreased for the round-based tasks, in line with performance in non-Indigenous samples. There were no gender effects. Age associations occurred in some tasks, but significant correlations were only of a small magnitude. Although the battery appeared to be completed appropriately in this study, more work needs to be conducted examining the influence of demographic factors to ensure that control data can be most appropriately matched in future studies.

Key words: *Adolescence, cognitive assessment, cognitive processes, cross-cultural psychology, Indigenous.*

Cognitive assessment across distinct cultural and ethnic groups is often complicated by methodological shortcomings in the assessment tools used, limited understanding of culturally specific factors that may impact on the assessment, and the use of language-based assessment tools that are inappropriate for the target population (see Ardila, 2005 for a discussion). These weaknesses may lead to misclassification of impairment and distortion of research findings. In cognitive neuroscience these concerns are pronounced because assessment tasks have typically been developed in a Western Anglo-Saxon framework, and normative data have been established in the same manner. The inappropriate application of Western assessments and test administration can lead to harmful consequences through errors of interpretation (Lezak, Howieson, Loring, Hannay, & Fischer, 2004), and researchers need to consider the wider cultural and ethnographic context of their research.

Two approaches are commonly used to increase the applicability of cognitive assessment tasks to culturally diverse populations (Parker & Philp, 2004). The first approach is to adapt existing assessment tools so that they are more appropriate for the given population (Ardila, 2005; Parker & Philp, 2004). This may involve adjusting cut-offs that classify impairment as is commonly used in the assessment of intelligence (Shuttleworth-Edwards et al., 2004), or translating the tools so that they can be better understood by the target population. Both approaches have inherent shortcomings, with the adjustment of cut-off scores not addressing the cultural relevance of the assessment stimulus and translation, possibly confounding things further if the cognitive tools do not have a direct literal translation. Following translation, substantial work is still required to determine equivalence between the translated and standard tasks. Translation also fails to overcome problems with conceptual understanding, where the language is clear but the concepts being assessed remain confusing or inappropriate (Ardila, 2005).

The preferable way to address the potential confounding effects of culture is to utilise assessment tasks that are not dependent on language, formal

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education or culturally specific stimuli (Parker & Philp, 2004). This increases the likelihood that the tasks will be more readily understood and perceived to be less threatening, which will lead to increased retention rates in longitudinal studies, and a more accurate representation of true ability. This approach still requires the establishment of culturally relevant normative datasets, but the target population have a stronger understanding of the concepts underlying the tasks, which increases the ability of the tasks to accurately reflect the cognitive functions they are seeking to measure.

In recent years these issues have been considered increasingly in the cognitive evaluation of Indigenous Australians, particularly in studies of drug and alcohol abuse and subsequent recovery (Cairney, Maruff, Burns, Currie, & Currie, 2004a,b, 2005; Maruff, Burns, Tyler, Currie, & Currie, 1998). In these groups English literacy and fluency are often poor and many people have limited or no formal education (LoGiudice et al., 2006). Cultural beliefs are often divergent from the dominant Western paradigm (Janca & Bullen, 2003), and there is little understanding of a brain–behaviour relationship. These factors are likely to negatively skew performance against normative data on most standard cognitive tests but this would be reflective of an educational or cultural bias, as opposed to any neuropathology or real cognitive performance detriment. Outcome measures are therefore confounded because it is impossible to distinguish between true cognitive change and the impact of cultural factors.

The CogState computerised cognitive test battery (Cogstate, Melbourne, Victoria, Australia) was designed to address these concerns (Cairney & Maruff, 2007). The battery has been validated in different populations, ranging from children with attention-deficit–hyperactivity disorder (Mollica, Maruff, & Vance, 2004), to the elderly with suspected cognitive impairment (Maruff et al., 2004). In part these tasks were designed to assess cognition in groups for whom conventional neuropsychological assessment tests are inappropriate, and be intuitive so that they are not based heavily on language (Cairney & Maruff, 2007). These tasks have proven effective in the assessment of European populations in which English is not spoken as the first language (Straume-Naesheim, Andersen, Dvorak, & Bahr, 2005) and more recently, among an adult Indigenous population, for whom the tasks proved to be culturally appropriate and applicable in a remote-area where spoken English would be regarded as a second or third language at best (Cairney, Clough, Jaragba, & Maruff, 2007). For these tasks to be used more widely through these populations, effort needs to be made to establish their suitability within the target populations. To this end our group is undergoing a systematic process to determine the validity and reliability of these tasks within Indigenous populations by examining the pattern of performance and influence of demographic factors (Dingwall, Lewis, Maruff, & Cairney, 2009). Once this has been established, concerted effort will be made to develop a normative database so that judgements of impairment can be made against established, culturally relevant normative data.

The present paper has been designed to investigate the pattern of performance among Indigenous adolescent groups through Northern and Central Australia using the CogState battery. The current study will explore the efficacy of the battery in this population and analyse the baseline performance of two separate samples of Indigenous adolescents. Ideally the tasks will be free from any systematic gender or age bias because this will allow the ready application of these tasks across equivalent samples in future studies. To ensure that the task demands are understood, the pattern of performance will be examined and it would be expected that performance will mirror task difficulty, and in tasks of serial acquisition that there will be evidence of progressive improvement in performance. These performance characteristics have been observed in other populations using the same test battery and they are expected to be observed here.

Method

Participants

The baseline cognitive performance data of two groups of adolescent Indigenous Australians enrolled in longitudinal studies of cognition were used in this study. All participants were aged between 11 and 19 years of age. Demographic information is given in Table 1. Study 1 involved 84 adolescents (age: $M = 13.63 \pm 1.35$ years; 36.9% male) who were recruited through a school in a large regional centre in central Australia to be the control arm in a study examining the effects of petrol sniffing and other drug abuse. Study 2 involved 153 adolescents (age: $M = 17.40 \pm 1.08$ years; 57.5% male) who have been enrolled since birth in an ongoing study of general health (Aboriginal Birth Cohort Study; Sayers et al., 2003), conducted in both urban and rural/remote communities throughout the Northern Territory of Australia. All participants of the current study were from a wide range of communities throughout the central (Study 1) and northern (Study 2) regions of Australia. The samples represent diverse cultural and language groups and are known to be multi-lingual but do not speak English as their primary language and have low English literacy. Interpreters were made available as necessary.

Table 1. Subject characteristics and performance on card-based tasks ($M \pm SD$)

	Study 1 ($n = 84$)	Study 2 ($n = 153$)	Whole group ($n = 237$)	Study 1 vs. Study 2
Age	13.63 ± 1.35	17.40 ± 1.08	16.06 ± 2.16	$t(235) = -23.48$, $p < .05$
Age range (years)	11–18	15–19	11–19	
Gender (male, female)	31, 53	88, 65	119, 118	$\chi^2 = 8.41$, $p < .05$
Used a computer before (yes, no)	77, 7	91, 62	168, 69	$\chi^2 = 25.69$, $p < .05$
Detection task:				
Speed (log)	2.55 ± 0.13	2.56 ± 0.15	2.56 ± 0.14	ns
Accuracy (arcsin%)	1.15 ± 0.33	1.26 ± 0.25	1.22 ± 0.28	Browne Forsythe (1, 131.92) = 7.21, $p < .05$
Identification task:				
Speed (log)	2.78 ± 0.09	2.78 ± 0.10	2.78 ± 0.10	ns
Accuracy (arcsin%)	1.10 ± 0.42	1.23 ± 0.24	1.18 ± 0.32	Browne Forsythe (1, 114.59) = 6.77, $p < .05$
Visual Learning task:				
Speed (log)	2.92 ± 0.20	3.02 ± 0.20	2.98 ± 0.21	$F(1, 222) = 4.23$, $p < .05$
Accuracy (arcsin%)	0.53 ± 0.21	0.69 ± 0.20	0.63 ± 0.22	$F(1, 230) = 33.46$, $p < .05$

Apparatus

CogState is a computerised cognitive assessment battery that has a number of subtests that can be tailored to a research situation. Typically it takes approximately 20 min to complete an assessment and the assessments are fully supervised. Responses are provided using the keyboard and the computer mouse and do not require any previous contact with, or proficiency using, a computer. Participants are given a chance to become familiar with each task before responses are recorded. Both studies used common tests from this battery, although Study 1 used an expanded battery that included extended assessments of memory. The stimuli in each subtest are presented repeatedly and the data averaged over those presentations. Primarily the test battery uses card-based stimuli, although a number of tasks use other stimuli onscreen.

CogState Subtests

Card-based tasks. All of these tasks (Figure 1a) were completed by participants in both Study 1 and Study 2.

Detection (Detect). In this task a playing card is presented face down on the screen and the participant is required to press a key on the keyboard as soon as the card turns face-up. The speed (mean reaction time; ms) and accuracy (% correct) are captured over repeated presentations.

Identification (Identify). This task uses the same presentation as the Detect task, but in this task, once the card turns face up, the participant needs to determine the colour of the suit, either red or black, and press corresponding keys on the keyboard to indicate this. The speed (mean reaction time; ms) and accuracy (% correct) are captured over repeated presentations.

Visual Learning (Learn). A series of cards are presented on the screen, one card at a time. The participant is required to attend to the cards as they appear and maintain each card in working memory. The participant is required to indicate whether the card has been seen before or whether it is a new card using defined keys on the keyboard. The speed (mean reaction time; ms) and accuracy (% correct) are captured over repeated presentations.

Non-card based tasks. These tasks were completed only by participants in Study 1.

Groton Maze Chase Test. This task differs from the preceding tasks in that it presents a grid of 10 × 10 tiles onscreen with a target tile highlighted in the top left (Figure 1b). To commence this task the participant must click the target tile with the mouse and chase it around the grid as it moves one tile at a time. The task continues for 30 s and records total errors and the number of correct movements per second.

Groton Maze Learning Test. Using the same tile grid as presented in the Groton Maze Chase Test (GMCT), the participant is required to use the mouse to uncover a circuitous path of 28 correct moves from one corner of the grid to the diagonally opposite corner by sequentially clicking on individual tiles (Figure 1b). Correct responses are indicated with a green tick, and incorrect responses are indicated with a red cross. On the first presentation the path can be found only using trial and error. Once the pathway has been uncovered and completed by the participant, the task is repeated for four more rounds along the same path. Correct moves per

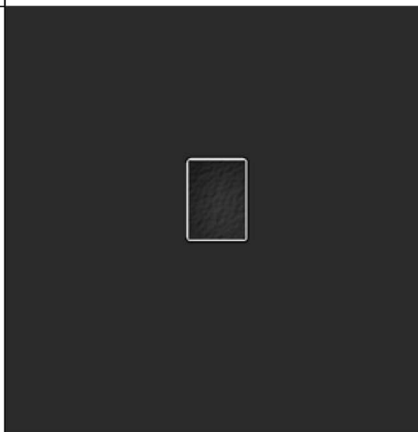
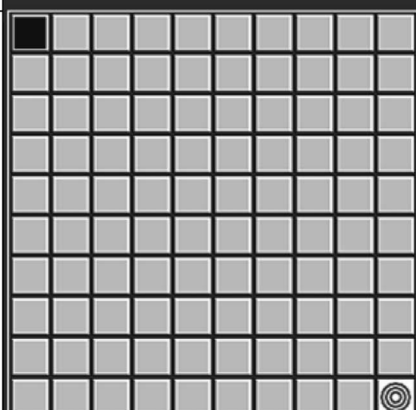
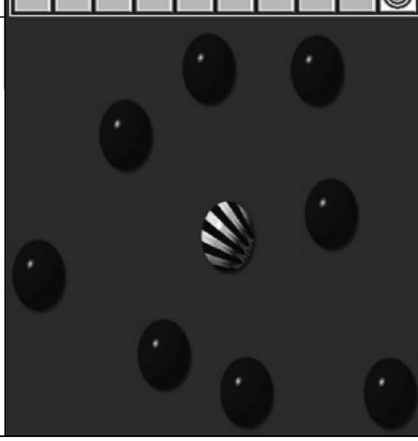
		Tasks	Variables	Domain
A		Detection (Detect) Identification (Identify) Visual Learning (Learn)	Speed (Log RT) Accuracy (Arcsin) Speed (Log RT) Accuracy (Arcsin) Speed (Log RT) Accuracy (Arcsin)	Psychomotor Function/Speed of Processing Visual Attention/Vigilance Visual Learning and Memory
B		Groton Maze Chase Test Groton Maze Learning Test (five rounds) Groton Maze Learning Test–Delayed Recall	Total errors Correct Moves per Second Speed Total errors Correct Moves per Second Speed Correct Moves per Second	Visual Motor Function Executive Function/Spatial Problem Solving Visual Learning and Memory
C		Continuous Paired Associate Learning Test (five rounds)	Speed Total errors Correct Moves per Second	Visual Learning and Memory

Figure 1. Cogstate tasks associated variables and related cognitive domain. RT=reaction time.

second, total errors and speed (duration to completion; ms) are recorded for each round and for overall performance.

Groton Maze Learning Test (delayed recall). Approximately 10 min after completing the five presentations of the Groton Maze Learning Test (GMLT), with other tasks being completed in the interim, the grid is presented one more time with the same hidden pathway as presented on the previous trials. The participant is required to remember the pathway and complete it as quickly and accurately as they can, using the mouse. Correct moves per second and speed (duration to completion; ms) are recorded.

Continuous Paired Associate Learning. This task presents a series of eight blue balls on the screen (Figure 1c). In the acquisition phase, six patterns are presented serially in individual balls, leaving two ‘‘empty’’ distractor balls, so that the participant can learn where each is located. Once this is completed one of the patterns is presented in a central location. The location of that pattern's matching pair has to be recalled, and the matching location clicked with a mouse. The task will not progress until the location of the pattern is correctly recalled, and will continue until the locations of the six patterns are recalled. This task is then repeated for five rounds (locating all six patterns each round) with the patterns in the same location for each round. The speed (duration to completion; s) and the number of errors are recorded for each round and the total task performance.

Because the Continuous Paired Associate Learning (CPAL) and GMLT present the same stimulus over repeated rounds they will collectively be referred to as "round-based tasks".

Procedure

Institutional ethics approval was gained for the two studies prior to commencing the recruitment and data collection. Signed informed consent was gained prior to commencement of the assessments by the participants and their legal guardian. Participants in Study 1 were approached through their school. The purpose of the study was explained to the group and any questions were answered prior to commencement of the study. All participants signed informed consent forms. Over the course of 2 days the sample was assessed in the school computer lab in groups of up to 15 students, with five supervisors overseeing the assessments. Researchers visited individuals from Study 2 in their communities, and invited them to participate in the third complete wave of the long-term Aboriginal Birth Cohort study (Sayers et al., 2003). Participants and, when necessary, guardians, gave informed written consent to participate and they were assessed on the cognitive tests presented here along with an extended health and emotional well-being assessment.

Data analysis

The variables being analysed for each task are presented in Figure 1. Because duration data are typically affected by skew, all speed and duration data underwent $\log_{10}$ transformation to normalise the data. Accuracy data underwent arcsine transformation in accordance with standard analysis practice with the Cogstate battery. Data were screened and extreme cases (defined as values more than three times the interquartile range) were removed from the analysis.

Card-based tasks. To determine equivalence between Study 1 and Study 2, ANOVAs were conducted on the respective performance of each group, with Study number as the independent variable. Following this, data from the two studies were combined and analysis progressed as a series of ANOVAs (or the non-parametric equivalent [Browne Forsythe] where the homogeneity of variance assumption was violated) comparing the performance between genders. Correlations between performance on each of the variables and age (Pearson's r) were conducted to explore any relationship between age and task performance.

Non-card based tasks. For the round-based tasks repeated measures ANOVAs (general linear models) were conducted examining round-based performance with gender as a between-subject factor. The model was then extended using age as a covariate. Main effects for round and gender were examined, as was the interaction between gender and round. Pairwise comparisons were conducted to determine whether performance differed significantly over rounds. Follow-up correlational analysis was conducted using Pearson's r to examine the relationship of age and cognitive performance in the initial and final rounds.

Non-card single presentation tasks. Performance on the GMCT and GMLT–delayed recall (GMLT-R) were analysed using ANOVA or Browne Forsythe tests where appropriate to examine gender differences, and Pearson's r correlations were made between age and the GMCT and GMLT-R variables.

All significance levels for the tests were maintained at $p < .05$. It is understood that the number of statistical comparisons conducted here inflates the risk of Type I error. Because this study is exploratory in nature, we feel that this is justified.

Results

Detection (Detect), Identification (Identify), Visual Learning (Learn)

The data for all card-based tasks in Study 1 and Study 2 are listed in Table 1. They indicate that as the task difficulty increases, the tasks take longer to perform, and accuracy decreases, with the Detect task being the simplest of these three tasks and the Learn task most complex.

Comparison between Study 1 and Study 2. Group comparisons between Studies 1 and 2 show no difference in speed for the Detect and Identify tasks, but those in Study 1 were faster on the Learn task ($p < .05$). Participants from Study 2, however, were more accurate on the Detect ($p < .05$), Identify ($p < .05$) and Learn tasks ($p < .05$). Participants in Study 1 were significantly younger than those in Study 2 ($p < .05$). With the performance data of both groups combined, age showed small positive correlations with accuracy ($r = .27$, $p < .05$) and speed ($r = .24$, $p < .05$) for the Learn task. Age also showed a small positive significant correlation with accuracy on the Identify task ($r = .17$, $p < .05$). Age did not correlate with any of the Detect variables.

Comparison between genders. There were no gender differences that reached significance on the Identify, the Learn or Detect tasks.

Groton Maze Learning Test

On the GMLT there was a progressive improvement in performance as participants completed each round, with increased speed and decreased total errors, and an increase in the correct moves per second (Table 2). The repeated-measures ANOVA indicated that the main effects for speed, total errors and moves per second were significant over rounds ($p < .05$). Subsequent analysis indicated that the progressive round-by-round improvements were significant ($p < .05$) for moves per second. A similar pattern of results was seen for total errors and speed, with reductions in each round being significant, with the exception of Rounds 4–5, where performance plateaued. Gender was introduced as a between-subjects factor but did not reach significance for any of the GMLT variables.

Introducing age as a covariate resulted in the main effects of round for the speed, total errors and moves per second variables failing to reach significance. An examination of correlations between performance on the first and final rounds and age was conducted to determine whether age was related to initial and final performance. This showed that speed and moves per second were not significantly correlated with age in the first round, whereas total errors showed a small significant positive correlation ($r = .24$, $p < .05$). In the final round age was not correlated with total errors but had a small negative correlation with speed ($r = -.25$, $p < .05$) and moves per second ($r = .27$, $p < .05$).

Correlational analysis was conducted examining the relationship between the total performance variables for the GMLT and age. The influence of gender on these variables was also examined. Consistent with the round-based analysis there were no gender differences. Age had a small positive correlation with moves per second averaged over the rounds ($r = .23$, $p < .05$). All other correlations failed to reach significance.

Table 2 lists the performance on the GMCT and GMLT-R, which did not differ significantly between

Table 2. Cognitive performance on the round-based tasks for Study 1 participants ($M \pm SD$)

	Totals	Round 1	Round 2	Round 3	Round 4	Round 5	Analysis
GMCT							
Moves per s	1.52 ± 0.41						
Total errors	2.95 ± 3.87						
GMLT							
Speed (log duration)	2.36 ± 0.01	1.88 ± 0.19	1.69 ± 0.16^b	1.59 ± 0.17^b	1.53 ± 0.14^b	1.5 ± 0.16	$F(3.08, 255.90) = 109.57$, $p < .05$
Moves per s	0.74 ± 0.02	0.41 ± 0.16	0.60 ± 0.21^a	0.76 ± 0.28^a	0.86 ± 0.26^a	0.92 ± 0.31^a	$F(3.46, 287.15) = 93.059$, $p < .05$
Accuracy (no. errors)	83.93 ± 4.07	29.27 ± 18.33	20.78 ± 10.14^b	15.64 ± 10.44^b	12.13 ± 7.89^b	11.21 ± 9.08	$F(2.22, 179.94) = 47.29$, $p < .05$
GMLT-R							
Speed (log duration)	1.52 ± 0.15						
Moves per s	0.89 ± 0.30						
CPAL							
Speed (log duration)	2.13 ± 0.01	1.52 ± 0.16	1.47 ± 0.14^b	1.41 ± 0.13^b	1.37 ± 0.10^b	1.37 ± 0.11	$F(2.99, 242.10) = 32.84$, $p < .05$
Moves per s	0.24 ± 0.00	0.19 ± 0.07	0.21 ± 0.06^a	0.24 ± 0.06^a	0.26 ± 0.06^a	0.26 ± 0.06	$F(3.1, 254.21) = 32.12$, $p < .05$
Accuracy (no. errors)	24.83 ± 2.08	7.43 ± 6.10	6.71 ± 6.44	4.71 ± 5.13^b	3.96 ± 5.25	3.66 ± 5.42	$F(3.46, 280.20) = 10.69$, $p < .05$

Notes. CPAL = Continuous Paired Associate Learning; GMCT = Groton Maze Chase Test; GMLT = Groton Maze Learning Test; GMLT-R = Groton Maze Learning Test–Delayed Recall.
[a]Significantly greater than previous round as indicated by significant *t*-test at $p < .05$; [b]significantly less than previous round as indicated by significant *t*-test at $p < .05$.

male and female subjects and did not correlate with age.

Continuous Paired Associate Learning

Performance on the CPAL task showed a similar round-by-round improvement to that seen in the GMLT (Table 2), with significant main effects and progressive significant improvements ($p < .05$) in performance for speed and moves per second, which asymptoted between Rounds 4 and 5. Although there was a progressive reduction of errors and a significant main effect for total errors ($p < .05$), the analysis indicated that the round-by-round improvement was significant only between Rounds 2 and 3 ($p < .05$), and failed to reach significance for the other rounds. Subsequent analysis conducted with gender as a between-subjects factor indicated that performance was not related to gender. When age was used as a covariate the main effects for speed, total errors and moves per second did not reach significance. Examining the relationship between age and performance on the first and last rounds shows that this correlation was not significant for any of the CPAL variables.

Examining the total performance showed that there were no gender differences on any of the variables and that age did not significantly correlate with the cognitive performance on the CPAL.

Discussion

The cognitive performance data demonstrated that there were no gender effects when adolescent Indigenous Australians completed these tasks. Age interacted with cognitive performance on some of the tasks, although the correlations were small. Performance was reflective of task difficulty, which indicated that the aims of the tasks were understood. On the round-based tasks, participants showed progressive improvements over repeated presentations on the tasks that were significant. These observations are consistent with the pattern of cognitive performance of other more mainstream populations as they complete the same cognitive task, and indicate that cognitive performance was recorded effectively and appropriately. This is encouraging because the sample represented different language groups from remote regions across Australia, where English literacy is poor and experience with this kind of assessment is minimal.

Compared with participants from Study 1, participants from Study 2 were older, more accurate on all card-based tasks and slower to complete the Visual Learning (Learn) task. These group variations in performance can be explained by age, which had small correlations ($r < .3$) with accuracy on the Identification (Identify) task and both speed and accuracy on the Learn task. Given the small observed correlations with age, it is likely that other factors associated with the demographics of the samples or pertinent to the assessment environment will contribute to the observed findings. For example, participants from Study 1 who exhibited poorer performance, were tested in a group environment where there may have been a greater impetus in completing the tasks more quickly and without the same level of care as in an individually supervised assessment, as occurred in Study 2. A separate possibility is that these differences may reflect sample-specific characteristics that vary between Indigenous people from Central and Northern Australia. Much cultural diversity exists between groups from these regions, who speak very different languages and may have conceptual differences that may affect their cognitive performance scores. Little is known about cognitive performance among these populations and the existence of any differences or similarities is unknown. Irrespective of the cause, these differences need to be investigated further.

Interpretation of the impact of age is complicated because it appeared to have an effect on some variables, but this was not of a large magnitude. Age did not affect performance on the non-round and non-card based tasks (GMCT and GMLT-R), but seemed to affect the pattern of improvement on the round-based tasks (GMLT and CPAL). On these tasks main effects were observed, showing round-based progressive improvements over all presentations of the task, but these were no longer significant once age was included as a covariate. When data were collapsed across rounds to provide total task outcome measures, age had a small positive correlation with moves per second but did not correlate with any other variable. To examine these effects in more detail, supplementary analysis was conducted correlating age with Round 1 scores and Round 5 scores, to see if age was associated with initial and final outcomes, or whether the impact of age was only on the pattern of change over time. For the CPAL there was no correlation with age on any of the variables on the first and last rounds of this task, demonstrating that the pattern of acquisition differs depending on age, but that absolute performance at the outset or completion of the task remains unaffected.

The picture for the GMLT is less clear because it appeared that age did exert a small influence on initial and final round performances, correlating with total errors on the first presentation, and speed and moves per second at the final round. It appears that patterns of acquisition are related to age. If age is examined by year (excluding ages 11 and 18 because they included one case each), performance of speed and moves per second at the final round differed by age. Post hoc analysis indicated that for speed, the performance of 12-year-olds was worse than that of 13- and 15-year-olds ($p < .05$), but that no other differences existed. For final-round moves per second the performance of 12-year-olds was significantly worse than that of both 15- and 16-year-olds ($p < .05$), but that other differences between ages were not significant. Despite these differences, the general pattern of performance on the round-based tasks was consistent with those observed in other populations (Pietrzak, Cohen, & Snyder, 2007). This indicated that the tasks demands were understood, that there was an adherence to the task instructions, and showed that age was related to learning over rounds. These findings have two major implications for future work. The first is that it may not be suitable to include the performance of children aged ≤ 12 with older adolescents. The second is that in studies of general cognitive function, such as the current study, an examination of the overall performance on these round-based tasks would be recommended. The analysis of performance by round provides extraneous detail that may distract from the overall analysis. Analysis of the round-by-round changes is likely to be more useful in studies of learning.

These results are encouraging and support existing work that has demonstrated the efficacy of using computerised cognitive assessments in Indigenous adult populations. For example, one study examining cognitive impairment related to alcohol abuse in a group of Indigenous adults demonstrated that chronic alcohol abuse decreased psychomotor speed and accuracy on attention and memory tasks (Cairney et al., 2007). That study was also notable in that it demonstrated the efficacy of the CogState battery in a group that had never used a computer before and had poor English literacy and fluency. Previously our group has also used the Cambridge Neuropsychological Test Automated Battery (CANTAB) assessment battery to effectively show cognitive changes related to substance misuse among Indigenous adults (Cairney et al., 2003; Maruff et al., 1998). The requirement, however, for specialist equipment such as a touch screen and proprietary response buttons, and the length of time required to complete this assessment, make it expensive and impractical when conducting research in remote areas, or with large groups of participants.

The benefits commonly associated with computerised cognitive assessment have been outlined in a number of papers and are also applicable to the current study. These include strengthened metric properties, the ability to generate alternate forms and the ease of conducting standardised assessments (Collie, Maruff, Darby, & McStephen, 2003; Silbert et al., 2004). The CogState battery uses generic stimuli to reduce the reliance on language, which is essential in the assessment of cognition in remote Indigenous communities, where the majority of the current sample reside. In these regions English fluency is often poor (Cairney & Maruff, 2007) and, as a consequence, reliance on language-dependent cognitive tasks is not appropriate because it is not possible to differentiate between cognitive changes related to language from those related to true cognitive deficit. In this regard it meets the preferred option proposed by Parker and Philp (2004) by reducing the influence of cultural factors. Beyond these situational advantages, computerised assessment tools have more pragmatic advantages over conventional testing, with increased standardisation of the assessments and improved collation and data management (Silbert et al., 2004). All timing and accuracy measures are consistent because they are conducted by the program without any input from the research team involved in the assessments. These benefits provide increased confidence that measurements are being conducted accurately, and become particularly important when considering study designs tracking change over time to ensure that test presentation remains consistent.

The present results are encouraging because they show that this battery is useful in the assessment of cognition within an Indigenous adolescent population. The pattern of performance was related to task difficulty, as would be expected with performance on difficult tasks demonstrating more errors and slower performance. There are, however, some questions regarding the effects of demographics on performance that have been beyond the analysis in the present study. Further studies are warranted to gain a more complete understanding of the cognitive performance profile within this population. Beyond the questions being addressed in this study, the temporal stability of cognitive performance on these tasks over time and their equivalence between different Indigenous populations need to be determined. The use of the CogState battery appears to have good utility within a population of Indigenous Australian adolescents and provides a valuable resource in efforts to understand the impact of drugs and alcohol within this population in future studies.

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