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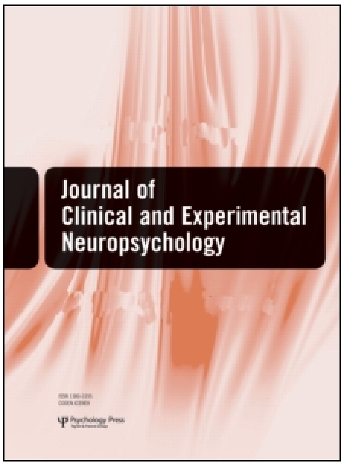

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The Flynn effect and memory function

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The Flynn effect and memory function

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The Flynn effect refers to the steady increase in IQ that appears to date back at least to the inception of modern-day IQ tests. This study examined the possible Flynn effects on clinical memory tests involving the learning and recall of verbal and nonverbal material. Comparisons of the age-related norms on the list learning and design learning tasks from the Adult Memory and Information Processing Battery (AMIPB), published in 1985, and its successor, the BIRT (Brain Injury Rehabilitation Trust) Memory and Information Processing Battery (BMIPB) published in 2007, indicate that there is a significant Flynn effect on tests of memory function. This effect appears to be material specific with statistically significant improvements in all scores on tests involving the learning and recall of visual material in every age range evident over a 22-year period. Verbal memory abilities appear to be relatively stable with no significant differences between the scores in the majority of age ranges. The ramifications for the clinical interpretation of these tests are discussed.

Keywords: Flynn effect; IQ; Memory; Psychometrics; Assessment.

INTRODUCTION

The Flynn effect refers to the steady increase in IQ that appears to date back to the inception of modern-day IQ tests(Flynn, 1984, 1987). Although the Flynn effect is evident on IQ tasks that reflect educational factors, it is most marked on IQ tests with a low cultural loading such as Raven Progressive Matrices (RPM). Flynn reported a steady increase in IQs derived from RPM, over six decades from 1930 based on large military samples from Europe (Flynn, 1987, 2000). Recent analyses of the new Wechsler Adult Intelligence Scale–Fourth Edition (WAIS–IV) suggest a continued and steady increase of approximately 0.3 IQ points in the mean IQ every year (Flynn, 2009). It appears to be IQ tasks that rely on mathematical principles such as pattern progression and abstract problem solving abilities that are most susceptible to the Flynn effect (Lynn, 1990). Interestingly, of all the verbal subtests in the Wechsler Intelligence Scales (Wechsler, 1999) the Flynn effect is most marked on the Similarities subtest, the verbal task that relies most heavily on classification using abstract categories (Hiscock, 2007).

Since all the IQ batteries in mainstream clinical use have norms based on a cross-sectional sample of the population, it has been estimated that the Flynn effect may account for a significant proportion of the apparent age-related decline in some subtests. This has significant implications for clinical neuropsychologists who rely on these test norms to determine atypical patterns of deterioration in function, since age-related decline is most marked on tests that tend to show the greatest Flynn effects (Hiscock, 2007). Whilst adjustments for the Flynn effect can be made for measures of IQ based on the Wechsler intelligence scales and RPM, with a few notable exceptions (Hiscock, 2007), the possible Flynn effects on the majority of other tests of neuropsychological function are unknown. (Connor, Spiro, Obler, & Albert, 2004). As Hiscock points out, “IQ may be the tip of the Flynn-effect iceberg” (Hiscock, 2007, p. 527).

Rönnlund and Nilsson (2009) examined changes on measures of memory and intellect over 15 years in a Swedish population. They found significant gains over time on composite indices of recall and recognition memory. However, whether there are differential Flynn effects on material-specific tests of learning and recall

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remains unknown. The aim of this study was to examine the possible Flynn effects on memory tests involving the learning and recall of both verbal and visual material.

METHOD

The Adult Memory and Information Processing Battery (AMIPB; Coughlan & Hollowes, 1985) was first published in the UK in 1985 and is the most commonly used memory battery amongst clinical neuropsychologists in the UK. The battery was standardized on a sample of 184 British people aged between 18–75 years and presents norms for each of four age ranges—18–30, 31–45, 46–60, and 61–75 years—on tests involving the learning and recall of verbal and visual material. The distributions of gender, social class, and academic achievements and IQ in the normative sample were matched to those within the general UK population.

The BIRT (Brain Injury Rehabilitation Trust) Memory and Information Processing Battery (BMIPB; Oddy, Coughlan, & Crawford, 2007) was published in September 2007. This update to the AMIPB retains many core features of the original battery, but has updated norms. The normative sample for the BMIPB comprised 300 British people aged 16–89 years. Although there are some small differences in cutoffs, the age range of the norms for the BMIPB are broadly consistent with those of the AMIPB: 16–29, 30–44, 45–60, and 61–70 years. Again the normative sample in the BMIPB was selected to closely reflect the distribution of IQ, educational level, and gender within the general population. Anyone with a previous medical history of psychiatric disturbance or a neurological condition that could potentially affect cognitive function was excluded. The normative samples from the AMIPB and the BMIPB are therefore taken to be representative of the wider population.

Whilst the individual test materials (words, design) are different, the core demands of the list learning and design learning tasks in both the AMIPB and the BMIPB are identical.

In the list learning task the participant is read 15 words over five trials and is asked to recall as many as possible following each presentation, giving the list learning score (maximum = 75). A second list of 15 words is then read as a distraction, and the participant is required to recall as many as they can from the second list. The participant is then asked to recall as many words as possible from the original list, without further repetition from the examiner, giving the list recall score (maximum 15).

In the design learning task the participant is asked to study an abstract line drawing, consisting of nine distinct features presented on a grid, for 10 s. See Figure 1 for an example. The participant is then asked to reproduce the design on a blank grid. This is repeated for four further trials, yielding a maximum design learning score of 45. The participant is then shown a new distractor design and is asked to reproduce it on a new grid. The participant is then asked to reproduce the original design without further exposure, yielding the design recall score (maximum = 9).

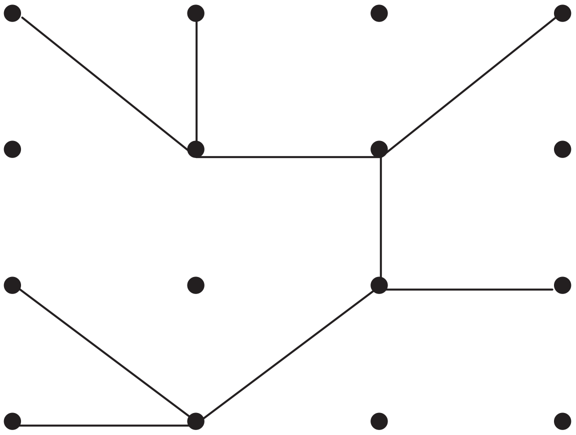

Figure 1. Design learning task. Example of the structure of the stimuli.

The identical task demands and administration procedures for the list learning and design learning tasks of the AMIPB and BMIPB allow for an examination of the Flynn effect in memory functions in the UK population over a 22-year period. The means for the memory scores from the AMIPB and BMIPB were compared in each age range using an independent groups *t* test (calculated from means and standard deviations without knowledge of the individual scores) using a *t* test for means calculator (Dimension Research.com, 2005. Lombard, IL 60148, USA).

RESULTS

Omnibus comparisons of the AMIPB versus BMIPB means for each task were conducted to examine the possibility of Type I errors in the 16 separate *t* tests used to examine differences across the four age ranges, on the four memory tests. The means and standard deviations for the whole sample in the AMIPB (n = 180) and the BMIPB (n = 300) were used for these calculations. These are given in the respective manuals and did not require any statistical pooling of means and standard deviations from the separate age cohort data. The means from the 2007 norms were significantly higher than the 1985 means on the design learning task, $t(478) = 5.16$, $p < .01$, and design recall task, $t(478) = 5.6$, $p < .01$. There were no significant differences between the AMIPB and BMIPB means on the list learning task, $t(478) = 0.7$, $p > .05$, and list recall task, $t(478) = 0.3$, $p > .05$.

The means and standard deviations for the verbal learning and recall tasks from the AMIPB and BMIPB norms are presented in Figures 2 and 3.

There was a significant difference between the AMIPB and BMIPB verbal learning scores in the 30–45-year age range (Figure 2). There were no significant differences between the AMIPB and BMIPB means for the verbal recall scores in the first three age ranges. However scores were significantly higher on the BMIPB for the 61–75-year age range (Figure 3).

The mean and standard deviations for the visual learning and recall tasks from the AMIPB and BMIPB

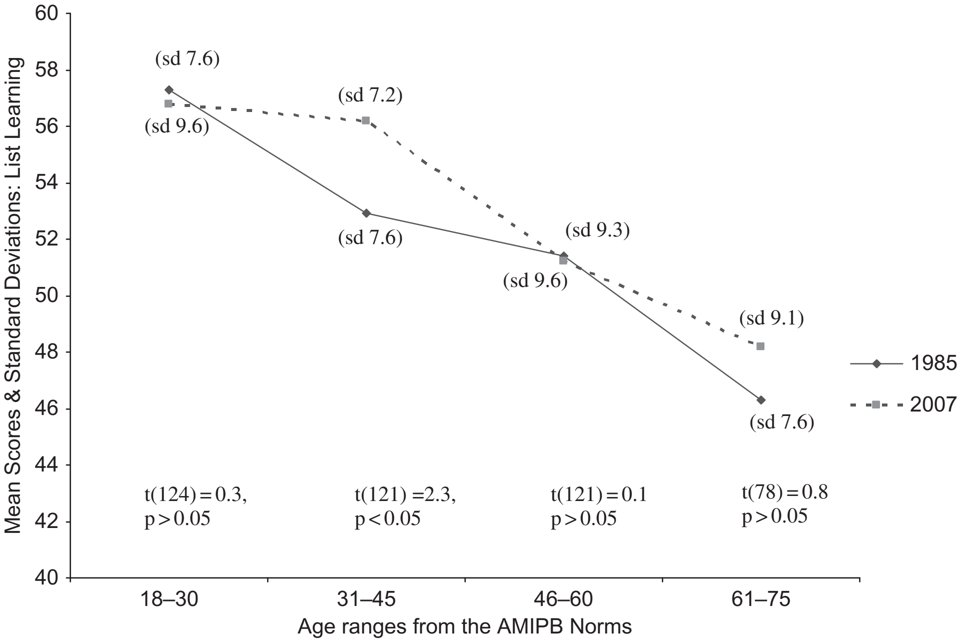

Figure 2. Mean scores by age range on the list learning task on the AMIPB (1985) and the BMIPB (2007). Independent groups (1985 vs. 2007) *t* test for means statistics are presented for each age range. AMIPB = Adult Memory and Information Processing Battery. BMIPB = BIRT (Brain Injury Rehabilitation Trust) Memory and Information Processing Battery.

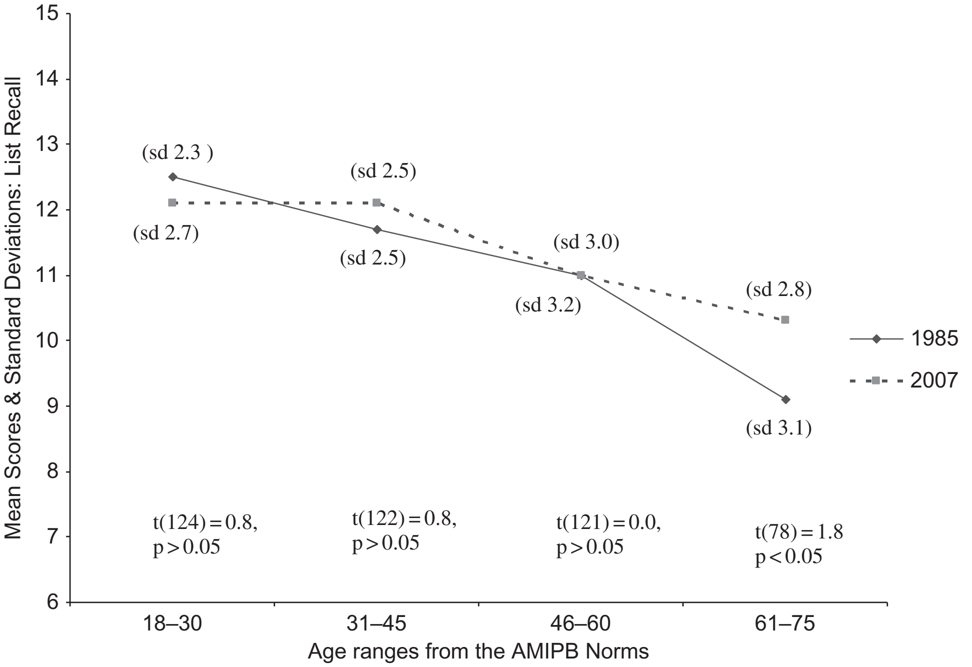

Figure 3. Mean scores by age range on the list recall task on the AMIPB (1985) and the BMIPB (2007). Independent groups (1985 vs. 2007) *t* test for means statistics are presented for each age range. AMIPB = Adult Memory and Information Processing Battery. BMIPB = BIRT (Brain Injury Rehabilitation Trust) Memory and Information Processing Battery.

norms are presented in Figures 4 and 5. There was a significant difference between the AMIPB and BMIPB mean scores on the design learning and recall scores in all age groups. The magnitude of the significant gains on the verbal and visual memory scores are presented in Table 1.

DISCUSSION

Consistent with previous reports (Rönnlund & Nilsson, 2009), we found a significant Flynn effect on tests of memory function. However, this effect appears to be material

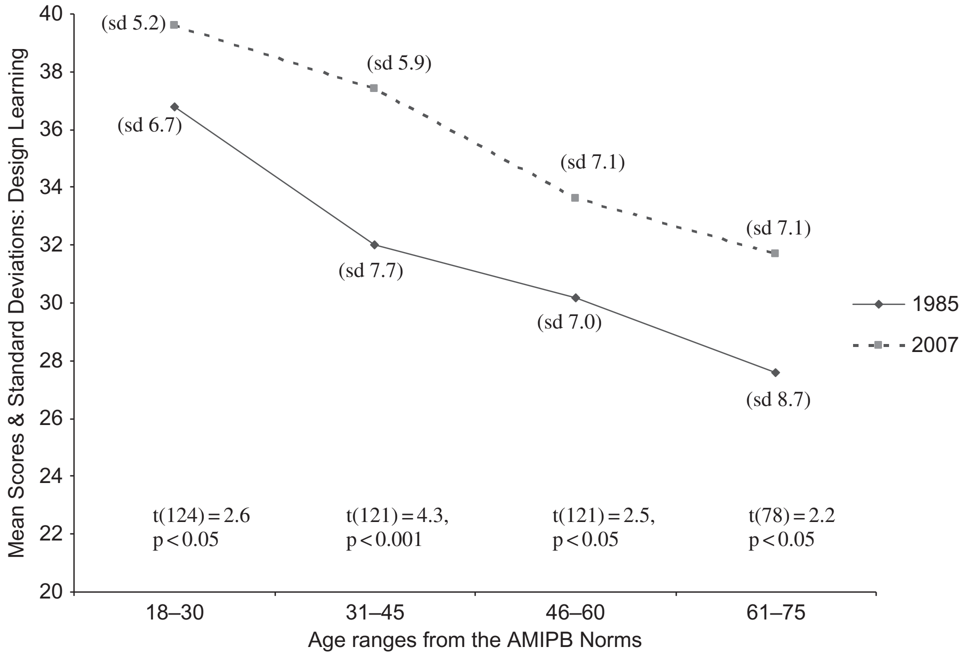

Figure 4. Mean scores by age range on the design learning task on the AMIPB (1985) and the BMIPB (2007). Independent groups (1985 vs. 2007) *t* test for means statistics are presented for each age range. AMIPB = Adult Memory and Information Processing Battery. BMIPB = BIRT (Brain Injury Rehabilitation Trust) Memory and Information Processing Battery.

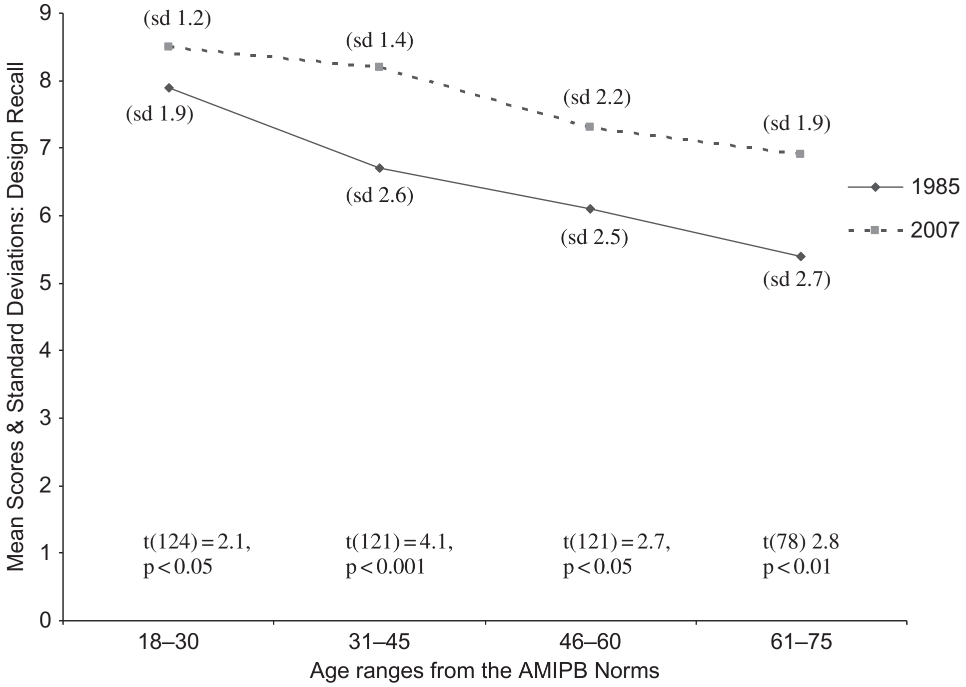

Figure 5. Mean scores by age range on the design recall task on the AMIPB (1985) and the BMIPB (2007). Independent groups (1985 vs. 2007) *t* test for means statistics are presented for each age range. AMIPB = Adult Memory and Information Processing Battery. BMIPB = BIRT (Brain Injury Rehabilitation Trust) Memory and Information Processing Battery.

specific with statistically significant improvements in scores on all tests involving the learning and recall of visual material evident over a 22-year period. Verbal learning and recall appear to be relatively stable with significant improvements in verbal learning only apparent in one age cohort: the 31–45-year olds. The significant increase in verbal recall in the oldest age range may reflect the differences between the AMIPB and BMIPB in the cutoffs employed, with the former battery including people up to the age of 75 in the normative sample.

TABLE 1
Magnitude of the Flynn effect for the verbal and visual memory tests

	Age cohort (years)			
	18–30	*31–45*	*46–60*	*61–75*
List learning	−0.06	0.42^{*}	−0.02	0.19
List recall	−0.17	0.16	0	0.38^{*}
Visual learning	0.41^{*}	0.7^{**}	0.48^{*}	0.47^{*}
Visual recall	0.31^{*}	0.57^{**}	0.48^{*}	0.55^{**}

Note. BMIPB score minus AMIPB score expressed as a percentage of the AMIPB standard deviation for each task. BMIPB = BIRT (Brain Injury Rehabilitation Trust) Memory and Information Processing Battery. AMIPB = Adult Memory and Information Processing Battery.
* $p < .05$.
**$p < .01$.

These findings are based on measurements that have been made at two time points. It is not therefore possible to test the linearity of change over time. Whilst further examination of future restandardization data may elucidate further change, it is possible that these findings from two data sets may reflect potential confounding variables such as lack of equivalence of AMIPB and BMIPB content and demographic differences between the respective normative samples. However, it is notable that our findings are consistent with the IQ literature on the Flynn effect, which has consistently found greatest improvements on tasks with an emphasis on nonverbal cognitive processes and spatial processing (Hiscock, 2007).

Many authors have speculated regarding the factors that may be responsible for the Flynn effect. Greenfield (1998) has suggested that the effect may represent an adaptation to our current digital world, where many of the gadgets we use every day have touch screens and use strong spatial elements in the user interface. However, the technological advances of the past three decades cannot account for the fact that the Flynn effect was evident decades before these innovations became part of our everyday experience. These improvements in spatial processing may have been at the expense of other abilities; scores on tests of Piagetian formal operations appear to demonstrate a reverse Flynn effect over the past 30 years (Shayer & Ginsburg, 2009).

Whilst memory abilities and intellect are often correlated in individuals, they represent distinct cognitive domains that can and do dissociate, a phenomenon most dramatically seen in amnesic patients who maintain premorbid intellectual abilities (Baxendale, 1998). It is possible that the improvements in design learning and recall demonstrated here stem from an underlying improvement in performance IQ skills and spatial reasoning and the application of these abilities in the formulation of more effective strategies for the learning and recall of visual material. Nevertheless this is one of the first studies to demonstrate the Flynn effect on traditional memory tests and as such has implications for the clinical interpretation of scores on visual memory tests, many of which are used in the evaluation of epilepsy surgery patients (Saling, 2009). It is unknown whether the Flynn effect is evident amongst patients with discreet pathologies that affect memory function, such as hippocampal sclerosis. For example, are the memory deficits associated with moderate hippocampal volume loss less severe now than those seen 20 years ago? Or are these patients at an even greater disadvantage as the gap between their impaired abilities and normal function increases? Further study is under way to examine the clinical implications of these findings on the pathological brain. In the meantime, this study suggests that reliance on older norms may result in an overestimate of ability on tests of nonverbal learning and recall. This may present a confound for neuropsychologists concerned with the lateralizing and localizing significance of memory test profiles.

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