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A Cross-Temporal Meta-Analysis of Raven's Progressive Matrices: Age groups and developing versus developed countries

Peera Wongupparaj [a,*], Veena Kumari [a,b], Robin G. Morris [a]

[a] Department of Psychology, Institute of Psychiatry, Psychology, and Neuroscience, King's College London, UK
[b] NIHR Biomedical Research Centre for Mental Health, South London and Maudsley NHS Foundation Trust, London, UK

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ABSTRACT

While many studies have investigated the rise in IQ over time in various countries, the present study attempts to fill the gap in the Flynn effect literature by considering data with various sample sizes, and different study designs, age groups and types of country. A Cross-Temporal Meta-Analysis (CTMA) technique was used to examine the relationship between mean IQ scores from the Raven's Progressive Matrices (RPM) and years of publication, moderated by age group and types of country over a period of 64 years (1950–2014). In all, 202,468 participants were included from 48 countries. We conclude that there is an obvious link between mean IQ scores and years of publication. Importantly, interaction analyses indicate that both age group and types of country moderate this relationship.

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1. Introduction

The term 'Flynn effect' has been coined to designate increases in intelligence scores observed historically in the general population, this phenomenon widely investigated in studies spanning many decades and countries (i.e., Flynn, 1987;

* Corresponding author at: Department of Psychology, P078, Institute of Psychiatry, Psychology and Neuroscience, King's College London, De Crespigny Park, London SE5 8AF, UK. Tel.: +44 207 848 5716.
E-mail address: Peera.wongupparaj@kcl.ac.uk (P. Wongupparaj).

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Flynn & Rossi-Casé, 2012; Lynn & Hampson, 1986; Lynn & Harvey, 2008). Although a rise in intelligence scores has been found in the large majority of studies, varying from as small as 1.65 points in Estonia over 72 years to 21.35 points over 34 years in Argentina (Williams, 2013), IQ gains found in specific groups or country comparisons have still been insufficiently investigated.

In general, the majority of studies have employed large cohort techniques to study this phenomenon (Pietschnig, Voracek, & Formann, 2010), their sampling mostly relying on specific criteria, for example, selecting according to age range or certain demographic features, including educational or occupational categories (e.g. school children, college and university students, seniors, conscripts, engineers or twin groups) (Lynn, 2009; Sundet, Barlaug, & Torjussen, 2004a, 2004b; Teasdale & Owen, 2008; Tuddenham, 1948). Therefore, it would be beneficial if the resulting groupings, sample sizes, study designs, or even type of country (developed and developing) are taken into account and analyzed using formal meta-analysis. This attempt may potentially produce a clearer account of the Flynn effect (Rodgers, 1999). Furthermore, a variety of intelligence tests have been used in different countries to study the Flynn effect including, for example, the Wechsler procedures (e.g. China; Liu & Lynn, 2013; Liu, Yang, Li, Chen, & Lynn, 2012), the General Aptitude Test (GATB) (e.g. Holland; Woodley & Meisenberg, 2013), the Coloured Progressive Matrices (CPM) (e.g. Australia and the UK; Cotton et al., 2005; Lynn, 2009) and the Standard Progressive Matrices (SPM) (Saudi Arabia; Batterjee, Khaleefa, Ali, & Lynn, 2013). Accordingly, in order to compare intelligence scores among groups with different demographic features or countries or cultures, the intelligence test should be the same or comparable types of tests used. In this respect, the Raven's Progressive Matrices (RPM), which have three versions, Coloured, Advanced, and Standard Progressive Matrices, may make the best candidate in terms of frequent international use (Van de Vijver, 1997) and construct validity across age, gender, and country (Rushton, Skuy, & Bons, 2003, 2004, Rushton, Skuy, & Fridjhon, 2003). Furthermore, the RPM has been widely used for a long time since the first version of test in 1938, such that it has produced robust data over a sufficiently long time period to conduct a meta-analysis investigating the Flynn effect.

To our knowledge, only a few studies have investigated the Flynn effect in different countries using a cohort method and meta-analyses (Pietschnig et al., 2010; te Nijenhuis, Murphy, & van Eeden, 2011; te Nijenhuis & van der Flier, 2013). In particular, with meta-analyses, less clear results have been found. For example, Brouwers, Van de Vijer, and Van Hemert (2009) conducted meta-analysis on the RPM using published studies dating from 1987 to 2003. Here, the correlation between RPM mean scores and year of publication was negligible, i.e. the Flynn effect was not observed for this sizable dataset (798 samples across 45 countries; $r = 0.07$). Nevertheless, within the sample, the Flynn effect was found in some counties and to varying extents, for instance, with more substantial correlation coefficients found in Iran than in Australia (0.97 *vs* 0.57) and in Poland than in the United States (0.77 *vs* 0.45).

To further investigate the Flynn effect using meta-analysis, this study presents a Cross-Temporal Meta-Analysis (CTMA) of studies that reported data on RPM, CPM, SPM, and APM, comprising samples of children, adults, and older adults from various study designs (quasi-experiment and survey research), yielding 734 independent samples and 202,468 total participants from 48 countries, studied over a period of 64 years (1950–2014). The study also investigated whether age group and types of county, in particular developed versus developing countries, would act as moderators in terms of intergenerational rise in IQ.

2. Method

2.1. Research instruments

The Raven's Progressive Matrices (RPM), a measure of non-verbal intelligence test that can be used individually or in groups and is widely used in clinical, educational and community settings, was chosen for this study. It is essentially a family of tests that includes three main standardized intelligent test procedures, namely: (a) Coloured Progressive Matrices (CPM); (b) Advanced Progressive Matrices (APM); and (c) Standard Progressive Matrices (SPM).

2.2. Data source and literature search

To investigate the Flynn effect, a cited published article search was conducted using the leading scientific databases ScienceDirect, PubMed, and SpringerLink. The search aim was to obtain all published articles citing the three instruments between 1950 and 2014.

The search terms were “Raven's Progressive Matrices”, “RPM”, “Coloured Progressive Matrices”, “CPM”, “Advanced Progressive Matrices”, “APM”, “Standard Progressive Matrices”, and “SPM”. Over a thousand studies containing targeted data were reviewed and their essential details and characteristics were recorded. This included sample size, year of publication, authors, types of research (experimental versus survey research), country-based participant and types of countries (developed versus developing). The study also recorded the sample mean age, sex ratio (if available) and mean scores and standard deviations for the CPM, APM, and/or SPM (see Table 1). Additionally, occupation was recorded: For the APM dataset, the major occupation is student, accounting for 77.3%, followed by mixed volunteer 6.3%, military 4.1%, and company employee 1.7%; for the CPM, the largest data is again mainly from student (83.9%), followed by mixed volunteer (11.1%), and farmer (0.5%); and for SPM, the major career is student (60.3%), followed by mixed volunteer (7.3%), prisoner (1.1%), and public servant (0.8%).

2.3. Decision rules

Studies were included in the meta-analysis if they reported the mean and/or standard deviation raw scores of the CPM sets A and B, APM set II, and/or SPM sets A to E, and if they employed standard versions of CPM sets A and B, APM set II, and/or SPM sets A to E (excluded were short-form, odd-or even-item versions and modified versions).

Additionally, if studies involved a test–retest method, only mean and/or standard deviation scores for pre-test were recorded and if several articles investigated the same sample or used the same dataset, these statistical parameters (means and standard deviations) were treated as a single data point. Studies were excluded if they investigated clinical research participants (with mental or physical disability) with the