Intelligence 40 (2012) 139–144

Contents lists available at SciVerse ScienceDirect

Intelligence

An increase of intelligence measured by the WPPSI in China, 1984–2006

Jianghong Liu [a,b,*], Hua Yang [c], Linda Li [a,b], Tunong Chen [c], Richard Lynn [d]

[a] School of Nursing, University of Pennsylvania, Philadelphia, PA, USA
[b] School of Medicine, University of Pennsylvania, Philadelphia, PA, USA
[c] Nanjing Brain Hospital, 264 Guangzhong Lu, Nanjing, China
[d] University of Ulster, Coleraine, Northern Ireland, BT52 1SA, UK

ARTICLE INFO

Article history:
Received 17 November 2011
Received in revised form 13 January 2012
Accepted 13 January 2012
Available online 4 February 2012

Keywords:
Intelligence
China
Flynn effect

ABSTRACT

Normative data for 5–6 year olds on the Chinese Preschool and Primary Scale of Intelligence (WPPSI) are reported for samples tested in 1984 and 2006. There was a significant increase in Full Scale IQ of 4.53 points over the 22 year period, representing a gain of 2.06 IQ points per decade. There were also significant increases in Verbal IQ of 4.27 points and in Performance IQ of 4.08 points.

1. Introduction

It has been reported in numerous studies from the 1940s that the intelligence of the populations of the economically developed nations has been increasing. The first major study showing this was carried out in the United States by Tuddenham (1948), who reported that the average IQs of men conscripted into the American army in 1943 was 11.5 IQ points higher than those conscripted in 1917, representing a gain of 4.4 IQ points per decade. The second major study was carried out in Scotland and reported that the intelligence of 11 years old children had increased by 2.21 IQ points over the years 1932–1947, representing a gain of 1.47 IQ points per decade (Thomson, 1949). The presence of these increases has been confirmed in many Western countries and has been reviewed by Flynn (1984, 1987) and Flynn and Weiss (2007) after whom they have been designated "the Flynn effect."

There have only been two studies of the Flynn effect in Asia. The first of these were reported for Japan by Lynn and Hampson (1986). Recently, te Nijenhuis, Cho, Murphy, and Lee (in press) have reported large IQ gains averaging 7.7 points per decade in South Korea.

It is only in the last decade that increases in intelligence have been studied in economically developing countries. Only four studies of these have been reported. Daley, Whaley, Sigman, Espinosa, and Neumann (2003) reported a 15 IQ point gain over 14 years for school students on the Coloured Progressive Matrices in Kenya, representing a gain of 10.7 IQ points per decade. Meisenberg, Lawless, Lambert, and Newton (2005) reported an 18 IQ point gain for 20–70 year olds over 35 years on the Coloured Progressive Matrices in Dominica, where it represents a gain of 5.1 IQ points per decade. Colom, Flores-Mendoza, and Abad (2007) reported a 17 IQ point gain for 7–11 year olds in Brazil, over the 72 years (1930–2002) on the Draw-a-Man Test, representing a gain of 0.24 IQ points per decade. Finally, Khaleefa, Sulman, and Lynn (2009) reported WAIS-R Full Scale IQ gain of 4.05 points over the 20 year period (1987–2007) in Sudan, representing a gain of 2.05 IQ points per decade. The objective of this paper is add to the literature on IQ gains in economically developing nations by reporting data for an IQ gain in China.

* Corresponding author at: University of Pennsylvania, 418 Curie Blvd., Room 426, Claire M. Fagin Hall, Philadelphia, PA 19104-6096, USA. Tel.: +1 215 898 8293; fax: +1 215 746 3374.
E-mail addresses: jhliu@nursing.upenn.edu (J. Liu), xiaoyang124@163.com (H. Yang), lindali89@gmail.com (L. Li), ctn03@yahoo.com.cn (T. Chen), lynnr540@aol.com (R. Lynn).

0160-2896/$ – see front matter © 2012 Elsevier Inc. All rights reserved.
doi:10.1016/j.intell.2012.01.008

2. Methods

This study compares the IQs obtained by 5–6 year olds on the Chinese version of the Wechsler Preschool and Primary Scale of Intelligence (WPPSI) in 1984 and 2006. The WPPSI was constructed in the U.S.A. by Wechsler to measure the intelligence of children aged 3 to 7 years old (Wechsler, 1967). The WPPSI consists of 10 subtests, five of which comprise Verbal IQ (Information, Comprehension, Arithmetic, Vocabulary and Similarities) and five comprise Performance IQ (Geometric Design, Animal House, Block Design, Mazes and Picture Completion) (Wechsler, 1967). The verbal subtests are combined to produce to a Verbal IQ (VIQ) and the performance subtests are combined to produce to a Performance IQ (PIQ). All ten subtests are combined to produce a Full Scale IQ (FIQ), which is widely recognized as a good measure of general intelligence defined as an average of all cognitive abilities.

The Chinese WPPSI was standardized in China in 1984 on a representative nationwide sample of 1628 children aged 5–6 years old (Song & Yue-mei, 1987). The test has been shown to have good reliability in Chinese children (Gong & Dai, 1986; Gong & Dai, 1988; Yang, Liu, & Townes, 1994; Zhu, Lu, & Tang, 1984).

In the current study, data for 1195 children aged 5–6 years old on the Chinese WPPSI were obtained in 2005–2007 in the Jintan Child Study. This study consisted of a sample of 1656 children comprising 24.3% of all preschool children in the Jintan City region. The original sample of 1656 children was reduced to a sample of 1195 children to provide a match for age and gender distribution to the 1984 sample. The mean age of both samples was 5.7 years. The Jintan sample, composed of 55.5% boys and 44.5% girls, was drawn from four preschools that reflect the region's geographical, social, and economic profile: the urban city center (Jianshe preschool), the suburbs (Huacheng preschool), and the surrounding rural area (Xuebu and Huashan preschools). Jintan is located in southeast China, approximately 50 miles south of Nanjing and 120 miles north of Shanghai, in the province of Jiangsu. Although the 1984 sample is nationally representative and the 2006 sample is regionally representative, the two samples are still comparable. Not only is the Jintan sample drawn from city, town, and village populations, but the demographics of Jiangsu are similar to those found on the national level (e.g., sex ratio, proportion of population living in urban or rural areas, ethnic majority) (All China Data Center, n.d.). Institutional Review Board approval was obtained from the University of Pennsylvania and the ethical committee for research at Jintan Hospital in China. Further information regarding the subjects, recruitment, and setting are described in Liu, McCauley, Zhao, Zhang, and Pinto-Martin (2010) and in Liu and Lynn (2011).

3. Results

Table 1 gives the mean scaled scores and standard deviations of the 1984 and the 2006 samples on the ten subtests, as well as for the Verbal, Performance, and Full Scale scores. The right hand columns give the differences between the two samples expressed as *ds* (standard deviation units), and t values for the statistical significance of the differences in the scores obtained in the two samples. It will be noted that the 2006 sample obtained significantly higher Verbal, Performance, and Full Scale scores than the 1984 sample, although this advantage was not present in all of the subtests.

Table 1
Mean scaled scores of 1984 and 2006 samples.

Test	1984		2006		d	t
	Mean	SD	Mean	SD		
Information	9.86	3.16	10.64	2.76	0.26	6.97***
Vocabulary	9.88	2.98	10.51	2.65	0.22	5.92***
Math	10.20	3.08	11.01	2.70	0.28	7.41***
Similarities	10.12	3.02	9.79	3.00	−0.11	−2.88**
Comprehension	10.01	3.15	10.78	2.95	0.25	6.66***
Animal-house	9.96	3.04	11.52	2.93	0.52	13.75***
Picture-completion	9.98	3.05	9.97	3.30	−0.003	−0.08*
Maze	10.03	3.12	11.80	3.33	0.55	14.32***
Geometric design	9.89	3.08	10.54	2.62	0.23	6.04***
Block-design	10.25	3.33	8.91	2.97	−0.43	−11.24***
Verbal scaled scores	49.97	11.33	52.72	10.53	0.25	6.64***
Performance scaled scores	50.13	10.63	52.74	9.99	0.25	6.67***
Full scaled scores	100.08	19.44	105.46	17.78	0.29	7.63***

d = the difference between the 2 means divided by the average sd.
t = the value of t as a test of the significance between the two means.
*** p<0.001.
** p<0.01.
* p<0.05.

Table 2 gives the mean IQ scores between the 1984 norm sample and 2006 sample. Comparing the two samples, significant increases of 4.27, 4.08, and 4.53 IQ points can be observed for Verbal, Performance, and Full scale scores, respectively.

Table 3 gives the mean IQs of the boys and girls in the two samples. It will be seen boys obtained slightly higher mean IQs than girls in both samples, and that comparable gains from 1984 to 2006 were obtained by both boys and girls.

For the 2006 sample, correlation matrices of subtests and VIQ, PIQ, and FIQ are provided in Tables 4 and 5. Since it was not included in previously published data, this information could not be presented for the 1984 sample.

4. Discussion

The present study compared 2006 WPPSI-R test scores of a sample of Chinese children aged 5–6 years with those of same-age children obtained in the 1984 Chinese

Table 2
Comparing VIQ and PIQ and FIQ with that of norms.

	1984		2006		d	t
	Mean	SD	Mean	SD		
Verbal IQ	99.85	14.32	104.12	14.85	0.29	7.66***
Perform IQ	100.40	14.67	104.48	14.93	0.28	7.22***
Full scale IQ	99.99	14.07	104.52	14.35	0.32	8.35***

d = the difference between the 2 means divided by the average sd.
t = the value of t as a test of the significance between the two means.
*** p<0.001.

Table 3
IQ of boys and girls in 1984 and 2006 samples.

	1984		2006	
	Boys	Girls	Boys	Girls
Verbal IQ	101	99	105	103
Performance IQ	101	99	105	103
Full scale IQ	101	99	106	103

standardization sample. Three key findings emerged. First, there was a significant increase in the Wechsler FIQ of 4.53 points over the 22 year period (1984–2006), representing a gain of 2.06 IQ points per decade. This is less than the FIQ gains of approximately 3 IQ points per decade on the Wechsler tests for all age groups in the United States over the periods of 1932–1978 and 1972–1995, as reported by Flynn (1984, p.184) and Flynn and Weiss (2007). The IQ gain reported here for Chinese 5–6 year olds is also less than the gain of 5.3 IQ points per decade for the same age group in the United States for the years from 1932 to 1978 reported by Flynn (1984) (his Table 2). However, this gain of 5.3 IQ points per decade for 5–6 year olds was obtained as the average of five studies which vary considerably from 1.6 to 11.3 IQ points per decade. No American data for 5–6 year olds are given by Flynn and Weiss (2007) for the years 1972–1995. Taking the American results as a whole, it appears that the IQ gain in China reported here for 5–6 year olds is slightly less than those reported for the United States.

Second, the average VIQ increased by 4.27 points and the average PIQ increased 4.08 points. This is an unusual finding compared with the results obtained in economically developed Western countries, where performance (non-verbal, fluid intelligence) gains have generally been larger than verbal (crystallized intelligence) gains. It was reported by Lynn and Hampson (1986) in Britain that, from 1932 to 1982, six verbal IQ tests showed average gains of 1.5 IQ points per decade, while five non-verbal tests showed average gains of 1.86 IQ points per decade. Similar results have been reported for Germany, Switzerland, Austria and France (Flynn, 1987), and Northern Ireland (Lynn, 1990). A possible explanation for the greater verbal than performance (non-verbal) gains in the present study is that the samples are 5–6 year olds and no other data are available for this age group.

Third, although the 2006 sample generally outperformed the 1984 sample, this was not found for all the subtests. The 2006 sample scored significantly higher in information, vocabulary, math, comprehension, animal-house, maze, and geometric design subtests than the 1984 sample. However, the 2006 sample scored significantly lower in the block-design and similarities subtests, and there was a non-significant decrease in the picture-completion subtest.

The increase in intelligence in China is probably attributable to the same socioeconomic development and its accompanying changes in recent decades that have occurred in parallel with increasing IQs elsewhere. Standards of living in China have risen, and rapid urbanization has increased children's exposure to environmental and technological complexity. The prevalence of malnutrition and nutritional deficiencies has also continuously declined over the past few decades (Popkin, Horton, Kim, Mahal, & Shuigao, 2001; Zhai et al., 2004), while education has improved substantially in China, with adult literacy rates at 94% in 2008 and net enrollment/attendance in primary schools from 2005 to 2009 reported to be 100% (UNICEF, 2010).

Nutrition remains a large problem for populations in many economically developing countries and has probably impaired the rate of fluid intelligence gains while negatively impacting performance on certain subtests. Although the prevalence of malnutrition and nutrition deficiencies have decreased continuously (Popkin et al., 2001; Zhai et al., 2004), the prevalence of obesity has increased rapidly and poor growth rate remains common in rural areas (Chunming, 2000; UNICEF, 2010; Wang et al., 2009). This has led to the coexistence of highly prevalent undernutrition and over-nutrition in China, both of which can be effects of malnutrition (Tanumihardjo et al., 2007). Patterns include rapid shifts from a primarily plant- and grain-based diet towards an animal-based diet and decreased intake of protein, vitamins, and minerals (Zhai et al., 2009). Chinese children may be experiencing micronutrient deficiencies, such as essential fatty acids, calcium, and vitamin A (Chang et al., 1994; Chen, Wang, Yan, Yin, & Xu, 1992; Ge & Chang, 2001; Hu, Tong, Oldenburg, & Feng, 2001; UNICEF, n.d.). Failure to meet nutritional and energy requirements may partially explain the less-than-expected gains in fluid intelligence over the present study period.

China's education and learning models may also contribute to the explanation of the present findings. One important feature of Chinese education is its strong emphasis on basic knowledge and skill acquisition, in contrast to Western early education where creativity and abstract thinking are highly valued (Cheng, 2004). Chinese teachers emphasize specific learning procedures that focus on creating uniformity and consistency via repetition (e.g., learning drills) and memorization. In generating lists of learning-related terms, U.S. college students focused on mental processes, inquiry, and thinking, while Chinese students viewed learning in terms of their ability to memorize, copy, and follow instructions (Li, 2003). Furthermore, the Chinese students were significantly less likely to challenge authority and question ideas and assumptions.

These cultural differences in learning may reflect the influence of historical Confucian–Socratic frameworks adopted by the East and West, respectively (Tweed & Lehman, 2002). An emphasis on social learning (e.g. copying or imitating what others do in similar situations) rather than individual learning (e.g. figuring out a solution by oneself, such as through trial-and-error) may have arisen in China because it was more efficient and advantageous in the relatively unchanging environment experienced by Asian populations when compared to Europeans (Chang et al., 2011). Differences in learning approaches are reflected in the way learning is perceived and practiced, even at a young age. Li (2004) found that Chinese preschool children emphasized the learner's qualities of persistence, diligence, and concentration, whereas U.S. preschoolers were more likely to emphasize mind/task attributes, such as strategy use and task attempting (Li, 2004). Furthermore, Geary, Bow-Thomas, Liu, and Siegler (1996) found that over a period of just 6 months, Chinese kindergarten and primary school student shifted their strategies in single-digit addition problems from finger

Table 4
The correlations matrices of subtests in 2006 samples.

Test		Information	Vocabulary	Math	Similarity	Comprehension	Animal house	Picture completion	Mazes	Geometric design	Block design	Verbal scaled scores	Performance scaled scores	Full scaled scores
Information	r_1	1	0.54***	0.48***	0.35***	0.56***	0.39***	0.43***	0.29***	0.25***	0.22***			
	r_2	1	0.51***	0.46***	0.46***	0.50***	0.26***	0.43***	0.24***	0.19***	0.23***	0.78***	0.42***	0.70***
Vocabulary	r_1	0.54***	1	0.34***	0.42***	0.57***	0.25***	0.41***	0.21***	0.17***	0.22***			
	r_2	0.51***	1	0.031***	0.52***	0.55***	0.20***	0.39***	0.19***	0.11***	0.23***	0.77***	0.34***	0.65***
Math	r_1	0.48***	0.34***	1	0.30***	0.37***	0.38***	0.42***	0.38***	0.37***	0.27***			
	r_2	0.46***	0.31***	1	0.36***	0.34***	0.25***	0.39***	0.33***	0.29***	0.30***	0.650***	0.48***	0.65***
Similarities	r_1	0.35***	0.42***	0.30***	1	0.37***	0.11***	0.29***	0.18***	0.16***	0.13***			
	r_2	0.46***	0.52***	0.36***	1	0.48***	0.06***	0.39***	0.19***	0.13***	0.20***	0.77***	0.31***	0.63***
Comprehension	r_1	0.56***	0.57***	0.37***	0.37***	1	0.29***	0.39***	0.21***	0.16***	0.20***			
	r_2	0.50***	0.55***	0.34***	0.48***	1	0.24***	0.37***	0.18***	0.11***	0.22***	0.77***	0.35***	0.65***
Animal house	r_1	0.38***	0.25***	0.38***	0.11***	0.29***	1	0.30***	0.34***	0.30***	0.22***			
	r_2	0.26***	0.20***	0.25***	0.06***	0.24***	1	0.19***	0.26***	0.23***	0.23***	0.27***	0.57***	0.48***
Picture completion	r_1	0.43***	0.41***	0.42***	0.29***	0.39***	0.30***	1	0.41***	0.33***	0.25***			
	r_2	0.43***	0.39***	0.39***	0.39***	0.37***	0.19***	1	0.39***	0.28***	0.26***	0.53***	0.67***	0.69***
Maze	r_1	0.29***	0.21***	0.38***	0.18***	0.21***	0.34***	0.41***	1	0.42***	0.37***			
	r_2	0.24***	0.19***	0.33***	0.19***	0.18***	0.26***	0.39***	1	0.38***	0.35***	0.30***	0.74***	0.59***
Geometric design	r_1	0.25***	0.17***	0.37***	0.16***	0.16***	0.30***	0.33***	0.42***	1	0.30***			
	r_2	0.19***	0.11***	0.29***	0.13***	0.11***	0.23***	0.28***	0.38***	1	0.34***	0.22***	0.65***	0.49***
Bloc design	r_1	0.22***	0.22***	0.27***	0.13***	0.20***	0.22***	0.25***	0.37***	0.30***	1			
	r_2	0.23***	0.23***	0.30***	0.20***	0.22***	0.23***	0.26***	0.35***	0.34***	1	0.31***	0.66***	0.55***
Verbal scaled scores	r_2	0.78***	0.77***	0.65***	0.77***	0.77***	0.27***	0.53***	0.30***	0.22***	0.31***	1	0.50***	0.87***
Performance scaled scores	r_2	0.42***	0.34***	0.48***	0.31***	0.35***	0.57***	0.67***	0.74***	0.65***	0.66***	0.50***	1	0.86***
Full scaled scores	r_2	0.70***	0.65***	0.65***	0.63***	0.65***	0.48***	0.69***	0.59***	0.49***	0.55***	0.87***	0.86***	1

r_1 = the correlation coefficient of raw scores of subtests.
r_2 = the correlation coefficient of scaled scores of subtests.
*** $p<0.001$.

Table 5
The correlations matrices of VIQ, PIQ and FIQ in 2006 samples.

	VIQ	PIQ	FIQ
VIQ	1	0.50***	0.87***
PIQ	0.50***	1	0.86***
FIQ	0.87***	0.86***	1

*** $p<0.001$.

counting and fact retrieval to only fact retrieval (Geary et al., 1996), which yielded faster response times than same-aged American children who relied more heavily on a combination of finger counting and retrieval strategies. It is thus likely that educational practices and methods have affected the results obtained from our samples. Although general improvements in education may contribute to the overall PIQ gains observed in China, the focus on skill acquisition and memorization, as well as the limited opportunities for creativity and abstract thinking, may not have allowed for fluid intelligence gains to increase more than crystallized intelligence gains in our study.

Given the highly competitive nature of China's educational system and the cultural emphasis on academic achievement, anxiety induced by high levels of pressure in Chinese students may also be relevant (Leung, Yeung, & Wong, 2010). Anxiety has a documented, negative effect on Weschler performance subtests (Hopko, Crittendon, Grant, & Wilson, 2005) but not verbal subtests (Boor & Schill, 1968; Callens & Meltzer, 1969; Mishra, 1982; Schultz, Hoyer, & Kaye, 1980), and visuo-spatial tasks appear especially vulnerable to anxiety and decreased attention (Avila, 1995; Fox, Russo, Bowles, & Dutton, 2001; Purcell, Maruff, Kyrios, & Pantelis, 1998). Furthermore, anxiety disorders and state anxiety have been associated with decreased performance in specific subtests such as Block-design (Buckelew & Hannay, 1986; Moritz et al., 2005; Simeon & Ferguson, 1987) and Similarities (Wetherell, Reynolds, Gatz, & Pedersen, 2002). Hopko et al. (2005) found that test anxiety in U.S. college students not only had a significant negative impact on PIQ, but it predominately affected Block-design and Picture arrangement subtests (the latter of which was unmeasured in the present study). The authors suggest that these subtests' demand for complex visual–motor analysis and synthesis may be the key issue, as these may be influenced more substantially by anxiety-related responding (Barlow, 2004; Eysenck & Calvo, 1992).

Disclosure

This study is supported by National Institute of Environment Health Sciences (NIEHS, K01-ES015 877 and R01-ES018858) US. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

The authors have declared that no competing interests exist.

References

All China Data Center. (n.d.) China Data Online. Retrieved from http://chinadataonline.org

Avila, C. (1995). Facilitation and inhibition of visual orienting as a function of personality. *Personality and Individual Differences*, *18*(4), 503–509.

Barlow, D. H. (2004). *Anxiety and its disorders: The nature and treatment of anxiety and panic.* : the Guilford Press.

Boor, M., & Schill, T. (1968). Subtest performance on the Wechsler adult intelligence scale as a function of anxiety and defensiveness. *Perceptual and Motor Skills*, *27*(1), 33–34, doi:10.2466/pms.1968.27.1.33.

Buckelew, S. P., & Hannay, H. J. (1986). Relationships among anxiety, defensiveness, sex, task difficulty, and performance on various neuropsychological tasks. *Perceptual and Motor Skills*, *63*(2 Pt 2), 711–718.

Callens, C. J., & Meltzer, M. L. (1969). Effect of intelligence, anxiety, and diagnosis on arithmetic and digit span performance on the WAIS. *Journal of Consulting and Clinical Psychology*, *33*(5), 630.

Chang, L., Mak, M., Li, T., Wu, B., Chen, B., & Lu, H. (2011). Cultural adaptations to environmental variability: An evolutionary account of east–west differences. *Educational Psychology Review*, *23*(1), 99–129, doi: 10.1007/s10648-010-9149-0.

Chang, Y., Zhai, F., Li, W., Ge, K., Jin, D., & De Onis, M. (1994). Nutritional status of preschool children in poor rural areas of China. *Bulletin of the World Health Organization*, *72*(1), 105.

Chen, X., Wang, W. G., Yan, H. C., Yin, T., & Xu, Q. M. (1992). Studies on iron deficiency anemia, rickets and zinc deficiency and their prevention among Chinese preschool children. *Progress in Food & Nutrition Science*, *16*(4), 263.

Cheng, V. M. Y. (2004). Progress from traditional to creativity education in Chinese societies. *Creativity: When east meets west*, 137–167.

Chunming, C. (2000). Fat intake and nutritional status of children in China. *The American Journal of Clinical Nutrition*, *72*(5), 1368S.

Colom, R., Flores-Mendoza, C. E., & Abad, F. J. (2007). Generational changes on the Draw-a-Man test: A comparison of Brazilian urban and rural children tested in 1930, 2002 and 2004. *Journal of Biosocial Science*, *39*(1), 79.

Daley, T. C., Whaley, S. E., Sigman, M. D., Espinosa, M. P., & Neumann, C. (2003). IQ on the rise: The Flynn effect in rural Kenyan children. *Psychological Science*, *14*(3), 215–219.

Eysenck, M. W., & Calvo, M. G. (1992). Anxiety and performance: The processing efficiency theory. *Cognition & Emotion*, *6*(6), 409–434.

Flynn, J. R. (1984). The mean IQ of Americans — Massive gains 1932 to 1978. *Psychological Bulletin*, *95*(1), 29–51.

Flynn, J. R. (1987). Massive IQ gains in 14 nations — What IQ tests really measure. *Psychological Bulletin*, *101*(2), 171–191.

Flynn, J. R., & Weiss, L. G. (2007). American IQ gains from 1932 to 2002: The WISC subtests and educational progress. *International Journal of Testing*, *7*(2), 209.

Fox, E., Russo, R., Bowles, R., & Dutton, K. (2001). Do threatening stimuli draw or hold visual attention in subclinical anxiety? *Journal of Experimental Psychology. General*, *130*(4), 681.

Ge, K., & Chang, S. (2001). Dietary intake of some essential micronutrients in China. *Biomedical and Environmental Sciences: BES*, *14*(4), 318.

Geary, D. C., Bow-Thomas, C. C., Liu, F., & Siegler, R. S. (1996). Development of arithmetical competencies in Chinese and American children: Influence of age, language, and schooling. *Child Development*, *67*(5), 2022–2044.

Gong, Y. X., & Dai, X. Y. (1986). China-Wechsler Younger Children Scale of Intelligence (C-WYCSI). *Psychological Science*, *2*(23–30).

Gong, Y., & Dai, X. (1988). China-Wechsler Younger Children Scale of Intelligence. *Acta Psychologica Sinica*, *20*, 364–376.

Hopko, D. R., Crittendon, J. A., Grant, E., & Wilson, S. A. (2005). The impact of anxiety on performance IQ. *Anxiety, Stress and Coping*, *18*(1), 17–35.

Hu, W., Tong, S., Oldenburg, B., & Feng, X. (2001). Serum vitamin A concentrations and growth in children and adolescents in Gansu Province, China. *Asia Pacific Journal of Clinical Nutrition*, *10*(1), 63–66.

Khaleefa, O., Sulman, A., & Lynn, R. (2009). An increase of intelligence in Sudan, 1987–2007. *Journal of Biosocial Science*, *41*(2), 279–283, doi: 10.1017/S0021932008003180.

Leung, G. S. M., Yeung, K., & Wong, D. F. K. (2010). Academic stressors and anxiety in children: The role of paternal support. *Journal of Child and Family Studies*, *19*(1), 90–100.

Li, J. (2003). US and Chinese cultural beliefs about learning. *Journal of Educational Psychology*, *95*(2), 258.

Li, J. (2004). Learning as a task or a virtue: US and Chinese preschoolers explain learning. *Developmental Psychology*, *40*(4), 595.

Liu, J., & Lynn, R. (2011). Factor structure and sex differences on the Wechsler Preschool and Primary Scale of Intelligence in China, Japan and U.S.. *Personality and Individual Differences*, *50*(8), 1222–1226, doi: 10.1016/j.paid.2011.02.013.

Liu, J., McCauley, L. A., Zhao, Y., Zhang, H., & Pinto-Martin, J. (2010). Cohort profile: The China Jintan child cohort study. *International Journal of Epidemiology*, *39*(3), 668–674 dyp205 [pii]10.1093/ije/dyp205.

Lynn, R. (1990). Differential rates of secular increase of five major primary abilities. *Social Biology*, *38*, 137–141.

Lynn, R., & Hampson, S. L. (1986). The rise of national intelligence: Evidence from Britain, Japan and the USA. *Personality and Individual Differences*, *7*, 23–32.

Meisenberg, G., Lawless, E., Lambert, E., & Newton, A. (2005). The Flynn effect in the Caribbean: Generational change of cognitive test performance in Dominica. *Mankind Quarterly*, *46*(1), 29–69.

Mishra, S. P. (1982). Intelligence test performance as affected by anxiety and test administration procedures. *Journal of Clinical Psychology*, *38*(4), 825–829.

Moritz, S., Kloss, M., Jacobsen, D., Kellner, M., Andresen, B., Fricke, S., et al. (2005). Extent, profile and specificity of visuospatial impairment in obsessive–compulsive disorder (OCD). *Journal of Clinical and Experimental Neuropsychology*, *27*(7).

Popkin, B. M., Horton, S., Kim, S., Mahal, A., & Shuigao, J. (2001). Trends in diet, nutritional status, and diet-related noncommunicable diseases in China and India: The economic costs of the nutrition transition. *Nutrition Reviews*, *59*(12), 379–390.

Purcell, R., Maruff, P., Kyrios, M., & Pantelis, C. (1998). Neuropsychological deficits in obsessive–compulsive disorder: A comparison with unipolar depression, panic disorder, and normal controls. *Archives of General Psychiatry*, *55*(5), 415.

Schultz, N. R., Hoyer, W. J., & Kaye, D. B. (1980). Trait anxiety, spontaneous flexibility, and intelligence in young and elderly adults. *Journal of Consulting and Clinical Psychology*, *48*(2), 289.

Simeon, J., & Ferguson, H. (1987). Alprazolam effects in children with anxiety disorders. *The Canadian Journal of Psychiatry/La Revue canadienne de psychiatrie*, *32*(7), 570–574.

Song, J., & Yue-mei, Z. (1987). Wechsler Pre-school and Primary Scale of Intelligence. *Children intelligence and development examination* (pp. 152–266). Shanghai: Shanghai Scientific & Technical Publishers.

Tanumihardjo, S. A., Anderson, C., Kaufer-Horwitz, M., Bode, L., Emenaker, N. J., Haqq, A. M., et al. (2007). Poverty, obesity, and malnutrition: An international perspective recognizing the paradox. *Journal of the American Dietetic Association*, *107*(11), 1966–1972.

te Nijenhuis, J., Cho, S. H., Murphy, R., & Lee, K. H. (in press). The Flynn effect in Korea: Large gains. Personality and Individual Differences.

Thomson, G. H. (1949). Intelligence and fertility: The Scottish 1947 survey. *The Eugenics Review*, *41*, 163–170.

Tuddenham, R. D. (1948). Soldier intelligence in World Wars I and II. *American Psychologist*, *3*(2), 54–56.

Tweed, R. G., & Lehman, D. R. (2002). Learning considered within a cultural context: Confucian and Socratic approaches. *American Psychologist*, *57*(2), 89.

UNICEF (2010, March 2). from. http://www.unicef.org/infobycountry/china_statistics.html

UNICEF (n.d.). from http://www.unicef.org/china/nutrition_565.html

Wang, X., Höjer, B., Guo, S., Luo, S., Zhou, W., & Wang, Y. (2009). Stunting and 'overweight' in the WHO child growth standards — Malnutrition among children in a poor area of China. *Public Health Nutrition*, *12*(11), 1991–1998.

Wechsler, D. (1967). *Manual for the Wechsler Preschool and Primary Scale of Intelligence.* : The Psychological Corporation.

Wetherell, J. L., Reynolds, C. A., Gatz, M., & Pedersen, N. L. (2002). Anxiety, cognitive performance, and cognitive decline in normal aging. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *57*(3), P246.

Yang, L. L., Liu, M. L., & Townes, B. D. (1994). Neuropsychological and behavioral status of Chinese children with acyanotic congenital heart disease. *International Journal of Neuroscience*, *74*(1–4), 109–115.

Zhai, F. Y., Wang, H. J., Chang, S. Y., Fu, D., Ge, K., & Popkin, B. M. (2004). The current status, trend, and influencing factors to malnutrition of infants and children in China. *Journal of Community Nutrition*, *6*(2), 78–85.

Zhai, F., Wang, H., Du, S., He, Y., Wang, Z., Ge, K., et al. (2009). Prospective study on nutrition transition in China. *Nutrition Reviews*, *67*, S56–S61.

Zhu, Y. M., Lu, S. Y., & Tang, C. H. (1984). The employment of the Wechsler Pre-school and Primary Scale of Intelligence in urban Shanghai [in Chinese]. *Information on Psychology Science*, *5*, 22–29.