Scholarly Journal of Psychology and Behavioral Sciences
DOI: 10.32474/SJPBS.2021.04.000198
ISSN: 2641-1768
Research Article

The Developmental Theory of Sex Differences in Intelligence: Some Evidence from Taiwan

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Received: February 04, 2021 **Published:** February 12, 2021

Abstract

Sex differences are reported in the standardisation samples of the WPPSI-IV and the WAIS-IV in Taiwan. There were no sex differences in the Full Scale IQ, the Index IQs or most of the subtests in the WPPSI-IV but males obtained a significantly higher Full Scale IQ of 4.05 points, Index IQs and most of the subtests in the WAIS-IV. These results confirm the developmental theory of sex differences in intelligence that among adults' males have a higher average IQ than females of between 4-5 points.

Keywords: Taiwan; wechsler tests; sex differences; intelligence; developmental theory

Introduction

For the last century it has been asserted by numerous scholars that males and females have the same average intelligence, e.g., Halpern [1]: "Females and males score identically on IQ tests", [2] and "When it comes to intelligence, it has been convincingly established that there are no differences between the average woman and man", and [3-8]. This consensus has been disputed [8-11]. And who has advanced the developmental theory of sex differences in intelligence that maintains that while there is no sex difference in young children and early adolescence, males begin to obtain higher average IQs than females in mid-adolescence increasing to 4-5 IQ points among adults. Some evidence for this theory has been provided [11,12]. The present paper examines these two theories with some Wechsler data in Taiwan.

Methods

The data to be presented are for sex differences in intelligence in the Taiwan standardization samples of the Wechsler Preschool and Primary Scale of Intelligence-Fourth Edition (WPPSI-IV) for 2.5-7-year-olds and of the Wechsler Adult Intelligence Scale-Fourth Edition (WAIS-IV) for adults aged 16-74 years. The Wechsler Preschool and Primary Scale of Intelligence-Fourth Edition (WPPSI-IV) was standardized in Taiwan in 2012. The standardization sample consisted of 924 children (52.1 percent boys, 47.9 percent girls) aged from 2.5-7 years and was drawn from the north, central, east and south geographical regions with parents' education level percentages matched to those of the population given in the most recent census [13]. The structure of the Taiwan WPPSI-IV is the same as the American WPPSI-IV in consisting of 15 tests given in Table 1 that are scored to give the Full-Scale IQ, Verbal Comprehension Index, Visual Spatial Index, Fluid Reasoning Index, Working Memory Index and Processing Speed Index. The Wechsler Adult Intelligence Scale IV (WAIS-IV) was standardised in Taiwan between July 2015 and January 2016. The standardisation sample consisted of 1105 individuals (49.6 percent males, 50.4 percent females) aged from 16 to 90 years and was drawn from the north, central, east and south geographical regions with percentages matched to those of the populations given in the most recent census. In order to control for the educational level in males and females, the data of older adults aged 75 to 90 (N=251) were not used. This study used only the data of 850 adults aged 16 to 74 for whom the proportion of males and females at each education level is the same in (χ^2 =4.39, df=4, p=.35). The structure of the Taiwan WAIS-IV Wechsler is the same as the American WAIS-IV in consisting of 15 tests that are scored to give the Full-Scale IQ, the Verbal Comprehension Index, Perceptual Reasoning Index, Working Memory Index and Processing Speed Index. Notice that the WAIS-IV maintained the four-factor structure while the WPPSI-IV provided the updated five-factor structure. The WAIS-IV Perceptual Reasoning Index was divided into two WPPSI-IV indices, Visual Spatial Index and Fluid Reasoning Index, thus the constructs of Perceptual Reasoning Index covers the constructs of both Visual Spatial and Fluid Reasoning Indices.

Results

The results are given in Table 1. This shows, reading from left to right, the IQs and subtests, the sex differences on the WPPSI-IV expressed as *d* (the difference between the male mean-female mean divided by the pooled SD), the t values for the statistical significance of the sex differences, the sex differences on the WAIS-IV expressed as *d*, and the t values for the statistical significance of the sex differences.

Table 1: Sex differences on the WPPSI-IV and WAIS-IV in Taiwan.

	WPPSI-IV		WAIS-IV	
IQ/Subtest	**D**	**T**	**D**	**T**
Full Scale IQ	0.05	0.75	0.27	3.92***
Verbal Comprehension Index	0.1	1.51	0.27	4.00***
Perceptual Reasoning Index	-	-	0.37	5.36***
Visual Spatial Index	0.12	1.88	-	-
Fluid Reasoning Index	0.06	0.79	-	-
Working Memory Index	-0.07	-1.11	0.25	3.64***
Processing Speed Index	-0.05	-0.64	-0.14	-2.04*
Verbal-related subtests				
Similarities	0.04	0.57	0.18	2.66**
Information	0.17	2.65**	0.44	6.51***
Vocabulary	0.31	4.09**	0.09	1.28
Comprehension	0.21	2.73**	0.21	3.08**
Receptive Vocabulary	0.1	1.52	-	-
Picture Naming	0.21	3.28**	-	-
Perceptual Reasoning-related subtests				
Block Design	0.1	1.59	0.4	5.91***
Matrix Reasoning	0.1	1.45	0.2	2.90**
Object Assembly	0.11	1.71	-	-
Picture Concepts	0.07	0.93	-	-
Visual Puzzles	-	-	0.31	4.58***
Figure Weights	-	-	0.3	4.43***
Picture Completion	-	-	0.15	2.15*
Working Memory-related subtests				
Picture Memory	-0.07	-1.03	-	-
Zoo Location	-0.06	-0.84	-	-
Digit Span	-	-	0.25	3.59***
Letter-Number Sequencing	-	-	0.2	2.98**
Arithmetic	-	-	0.34	5.03***
Processing Speed-related subtests				
Bug Search / Symbol Search	-0.1	-1.36	-0.05	-0.81
Animal Coding / Coding	-0.08	-1.03	-0.18	-2.63**
Cancellation	0.01	0.15	0.05	0.73

Discussion

There are nine points of interest in the results. First, there was virtually no sex difference (.05*d*) on the Full-Scale IQ on the WPPSI-IV but on the WAIS-IV males obtained a statistically significant (p<.001) higher Full-Scale IQ (.27*d*), equivalent to 4.05 IQ points. These results therefore confirm the developmental theory of sex differences in intelligence that among adults' males have a higher average IQ than females of between 4-5 points. Second, males obtained statistically significant (p<.001) higher IQs of approximately the same magnitude on the WAIS-IV on the Verbal Comprehension Index (.27*d*), the Perceptual Reasoning Index (.37*d*) (including both Visual Spatial and Fluid Reasoning components) and the Working Memory Index (.25*d*). Third, on the Processing Speed Index females obtained a negligibly higher IQ of .05 on the WPPSI-IV and a statistically significant (p<.05) higher IQ (.14) on the WAIS-IV. Fourth, on the Similarities subtest there is virtually no sex difference (.04*d*) on the WPPSI-IV but males obtained a statistically significant (p<.01) higher score (.18*d*) on the WAIS-IV. These differences are closely similar to those of .05*d* and .27*d* on the Full-Scale IQ. This is predictable because this subtest poses questions like "In what way are work and play alike?" and "In what way are an enemy and a friend alike?" and measures verbal reasoning. The present results confirm the increase in verbal reasoning in males from .15*d* in 14-year-olds to .25*d* in 18-year-olds in the British standardization sample of the DAT (Differential Aptitude Test [14] and the higher verbal reasoning score .17*d* obtained by males in a Spanish sample of 23-year-old applicants to a university [8]. Fifth, on the Information subtest males obtained a significantly higher score of .17*d* in the WPPSI-IV and of .44*d* in the WAIS-IV. These results confirm numerous studies showing that males have more general knowledge than females [14-16]. The present results show that this advantage is present in 2–7-year-olds and increases with age. Sixth, on the Vocabulary subtest males obtained a higher score than females in the WPPSI of .31*d* in the WAIS of .09*d.* This is the only test in which males obtained a higher score than females on the WPPSI than on the WAIS [17]. On the Picture Naming subtest males obtained a higher score than females in the WPPSI of .21*d.* Picture Naming is a test of vocabulary in which the examiner points to a picture and asks What is this? This test is not present in the WAIS [18-25]. The higher scores obtained by males on the two vocabulary subtests in the WPPSI are unusual. Most studies have reported virtually zero sex differences in vocabulary. Hyde & Linn's meta-analysis of 40 American studies gave a female advantage of .02*d,* a subsequent American study by Salthouse (2004) gave a male advantage of .03*d* derived as the average of 33 studies of samples aged from 19 to 95 years*,* and a more recent study by Hyde gave a female advantage of .02*d.* The absence of a sex difference in vocabulary has been reported in the United Kingdom in the standardization samples of the Mill Hill Vocabulary Scale (mean age 12.5 years, *d* = 0.0; [17]) and in a further sample on the Mill Hill Vocabulary Scale (mean age 10.5 years, *d* = 0.0; [18]).

But a few studies have reported higher scores by males on vocabulary. A small male advantage has been reported in England in a sample on the Mill Hill Vocabulary Scale (n = 2000, mean age 9 years, *d* = .10; [23]) and in Belgium on the Boston Naming Test (n = 371, mean age 9 years, *d* = .08; Storms, Saerens & De Deyn). The only study to report a male advantage of about the same magnitude as those in the present results is Tombaugh & Hubley's in the norms for adults aged 25 to 88 years on the Boston Naming Test (n = 210; .26*d*). Seventh, on the Comprehension subtest males obtained a significantly higher score than females in the WPPSI of .21*d* and in the WAIS of .21*d* (p<.01) [24-27]. In this subtest, the examinee is required to answer questions based on his/her understanding of general principles and social situations. The male advantage is much greater than that in the United States where Schaie (2005, p. 102) reported a male advantage of .07*d* in verbal comprehension in 4850 American adults aged 25 to 81, Keith, Reynolds, Patel & Ridley, (2008) reported a male advantage of .07*d* in a sample of 6 through 59 year olds (n = 6970) on the latent comprehension–knowledge (Gc) factor in the Woodcock–Johnson Tests of Cognitive Abilities III, and Reynolds, Keith, Ridley & Patel (2008) reported a male advantage of .07*d* in a sample of 6 through 18 year old (n = 2375) on verbal knowledge in the Kaufman Assessment Battery for Children [28-30]. Eighth, on the Block Design subtest there is virtually no sex difference (.10*d*) on the WPPSI-IV but males obtained a statistically significant (p<.001) higher score (.40*d*) on the WAIS-IV. This subtest measures spatial ability and the higher score of adult males in the WAIS-IV confirms the meta-analysis of sex differences in spatial abilities adults in the United States [31-33] and that concluded that there is male advantage of .50*d,* the later meta-analysis [34-37] who gave the male advantage as .445*d,* and the more recent meta-analysis Archer [38] and who gives the male advantage as .46*d*. Ninth, on the three Processing Speed subtests, there were no significant sex differences on the WPPSI-IV but females obtained a statistically significant (p<.05) higher score (.18*d*) on Coding in the WAIS-IV. The higher score obtained by females is consistent with that in the standardisation samples of the WAIS-IV in South Korea of .38*d* [39,40]. The authors assert that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008 [41,42].

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DOI: 10.32474/SJPBS.2021.04.000198