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## Comparison of the cognitive profiles and social adjustment between mathematically and scientifically talented students and students with Asperger's syndrome



Ching-Chih Kuo<sup>a</sup>, Keng-Chen Liang<sup>b</sup>, Christine Chifen Tseng<sup>c</sup>,  
Susan Shur-Fen Gau<sup>b,d,e,\*</sup>

<sup>a</sup> Department of Special Education, National Taiwan Normal University, No. 162, HePing East Road, Section 1, Taipei 106, Taiwan

<sup>b</sup> Department of Psychology, Neurobiology and Cognitive Science Center, and Graduate Institute of Brain and Mind Sciences, National Taiwan University, No. 1, Section 1, Ren'ai Road, Taipei 100, Taiwan

<sup>c</sup> Department of Applied English, National Taichung University of Science and Technology, No. 129, Section 3, Sanmin Road, Taichung 403, Taiwan

<sup>d</sup> Department of Psychiatry, National Taiwan University Hospital and College of Medicine, No. 7, Chang-Shan South Road, Taipei 100, Taiwan

<sup>e</sup> School of Occupational Therapy and Graduate Institute of Clinical Medicine, National Taiwan University College of Medicine, No. 17, Xuzhou Road, Taipei 100, Taiwan

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### ABSTRACT

This study compared the cognitive profiles and social adjustment of mathematically and scientifically talented (MST) students and students with Asperger's syndrome (AS) as compared to typically developing students. The applied instruments were the Wechsler Adult Intelligence Scale, 3rd version, Me Scale II, Social Responsiveness Scale (SRS), Adult Autism Spectrum Quotient (AQ), and autism diagnostic interview-revised. Eighty-four male students, aged 16–26, were assigned to four groups according to a talent in mathematics and science, diagnosis of AS, and the IQ level. The results showed that the high-IQ MST group exhibited balanced development in cognitive and affective aspects, the average-IQ MST group demonstrated weakness in perceptual organization and working memory, and problems with social awareness and socialness, and the AS group had weakness in performance IQ, particularly in digit symbol-coding and symbol search and a wide-range of autistic-like social deficits (SRS) and autistic trait (AQ), and reported lower empathetic and higher emotional and creative overexcitability. Our findings support differential cognitive profiles and social adjustment between the MST and AS groups, and the influence of IQ on these manifestations in MST students. More attention should be paid to the social difficulty of average-IQ MST students in addition to AS students.

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\* Corresponding author at: Department of Psychiatry, National Taiwan University Hospital and College of Medicine, No.7, Chung-Shan South Road, Taipei 10002, Taiwan. Tel.: +886 223123456x66802; fax: +886 223812408.

E-mail address: [gaushufe@ntu.edu.tw](mailto:gaushufe@ntu.edu.tw) (S.-F. Gau).

## 1. Introduction

Mathematically and scientifically talented (MST) students constitute the highest percentage of academically talented students in Taiwan. They are successful in international mathematics and science competitions and have exceptional academic achievements. Most of them enroll in the departments of medicine, physics, and engineering at prestigious universities in Taiwan. How these students differ from other students regarding brain structures and functioning has been an intriguing question and has drawn much more attention in recent decade in many countries and Taiwan as well. Kuo et al. (2012) applied magnetic resonance imaging (MRI) techniques and determined that senior high school students talented in mathematics and science, compared with their typically developing (TD) peers, possessed a lower volume of gray matter in the somatosensory-related cortical region (BA 40), which is associated with empathy and interpersonal perception (Kuo et al., 2012; Peelen & Downing, 2007). Based on their findings, educators are recommended to pay more attention to these students' social ability and adjustment than just academic performance (Kuo et al., 2012); further research to distinguish these students from those with Asperger's syndrome (AS) and a talent in science is warranted.

In England, a study addressing the association between AS and mathematical and scientific skills was conducted (Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001). Using the Autism-Spectrum Quotient (AQ), compared students studying the sciences, humanities, and social sciences, and observed an association between scientific and mathematical skills and autistic conditions (Baron-Cohen et al., 2001), they observed that mathematicians scored the highest and the Mathematics Olympiad winners scored significantly higher than the male humanities students at Cambridge University. Similarly, Liu reported that medical school students who attended gifted and talented classes in high school or college students who participated in the International Mathematics Olympiad scored significantly higher than students of the sciences and humanities, and TD college students (Liu, 2008).

The aforementioned research prompted us to compare the cognitive profiles, and social adjustment between MST students and students with AS as compared to TD students.

## 2. Literature review

### 2.1. Gifted and talented students

Among several definitions of gifted and talented students, the definition of Gagné (2000) has been widely applied. Gagné (2000) distinguished “giftedness” and “talent” as follows: “The term “giftedness” designates the possession and use of untrained and spontaneously expressed natural abilities (called aptitudes or gifts) in at least one ability domain, to a degree that places an individual among the top 10% of same-age peers [and] the term “talent” designates the superior mastery of systematically developed abilities (or skills) and knowledge in at least one field of human activity, to a degree that places an individual within the top 10% of age peers who are (or have been) active in that field (p. 67)” (Gagné, 2000).

In Taiwan, students with high IQ scores (2 standard deviations, SD, above mean IQ) are labeled as students with general intelligence (or giftedness), and students who may not possess high IQs but perform excellently in certain areas, such as mathematically talented students or artistically talented students, are called “talented students.” Thus, in a gifted and talented class, some students may innately possess superior intelligence and great talents, whereas others may not possess high IQs but demonstrate exceptional talents.

Gifted and talented students generally display broader interests and exhibit superior learning abilities in a wide range of domains like cognitive, social, emotional, and linguistic domains (Davis & Rimm, 1998; Gallagher, 1985; Lewis, 1943; Robinson & Noble, 1991). Of them, cognitive ability has long been the focus of educators of gifted students, they enjoyed learning and asking questions and demonstrated a long-lasting attention span on the tasks of interest (Baska, 1989; Blackburn & Erickson, 1986; Clark, 1992; Piirto, 1994). Moreover, gifted students possessed a higher level and higher quality of creativity, imagination, and divergent thinking (Silverman, 1990).

In addition to excellent academic performance, in recent decades, psychologists and educators have continued exploring the psychological traits of gifted and talented people. Regarding emotional traits, several studies have shown that gifted students were emotionally oversensitive (Altman, 1983; Clark, 1992; Cross, 1996; Larsen, Diener, & Emmons, 1986), sympathetic, passionate, and compassionate (Lovecky, 1992, 1993; Mendaglio, 1998; Silverman, 1983, 1993), and demonstrated perfectionism (Blackburn & Erickson, 1986; Buescher, 1985; Clark, 1992; Davis & Rimm, 1998; Lewis, Kitano, & Lynch, 1992; Parker, 1997; Roedell, 1984; Roeper, 1982; Whitmore, 1980). Concerning the personality traits of gifted students, Dabrowski (Dabrowski, 1938; Miller, Silverman, & Falk, 1995; Silverman, 1993) indicated five dimensions of heightened psychological responses presented by gifted and talented students: psychomotor (POEs; pressure for action), sensual (SOEs; sensate pleasures), imaginational (MOEs; active imagination), intellectual (TOEs; intellectual and moral pursuits), and emotional overexcitabilities (EOEs; intense connectedness with others).

According to Dabrowski's theory, overexcitabilities are crucial factors in emotional development that the more significant overexcitabilities a person presents, the higher the level of emotional development a person could achieve (Dabrowski, 1964). In addition, gifted and talented people were more inclined to demonstrate overexcitability traits than their counterparts (Dabrowski, 1964). This proposition has been tested in earlier (Dabrowski, 1970) and recent (Chang & Kuo, 2013) studies showing that gifted students exhibited various neurotic symptoms like nervousness, anxiety, depression, tics, and various forms of overexcitability, whereas students with mental retardation did not have these symptoms.

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