Chapter

Potential Logographic Dyslexics Identified via Self-Reporting during a Questionnaire Survey in Taiwan

Ying-Fang Sun and Pei-Shan Liao

Abstract

According to the patterns of difficulties of the dyslexics that have been reported in Western societies, a questionnaire in traditional Chinese was developed to carry out initial screening among Taiwanese. The questionnaire includes 30 items with four-point scales and 7 open-ended questions. Of the 2133 copies distributed, a total of 1599 questionnaires were collected which gives a 75.0% response rate and 1442 were completed. The mean of 30-item scores collected from 1442 participants is 87.99 ± 11.9. Among these participants, 9 self-reported potential logographic dyslexics have been identified. The individual scores of 30 items of the nine subjects were at least 1 SD to 4.5 SD lower than that of their counterparts. There are two potential logographic dyslexics families show genetic influence. Since there is no standard test for dyslexics, we developed a 30-item questionnaire that can be completed in 15-20 minutes on average. The questionnaire may serve as a low cost, initial screening tool and allows the potential probands to self-report while the formal diagnosis is not available.

Keywords: Chinese, logographic, questionnaire, dyslexia, self-report

1. Introduction

Dyslexia was listed by World Health Organization (WHO) in International Classification of Diseases 11th Revision (ICD-11) as Symbolic dysfunctions, code as MB4B.0 [1], and also documented by The American Psychiatric Association on The Diagnostic and Statistical Manual of Mental Disorders (DSM) 5th edition [2]. The disorder has complicate patterns that can be observed in reading, spelling, and writing behaviors [3]. It is linked to the acquisition of cognitive and learning skills [4]. Despite the above disadvantages, some dyslexics show talents [3, 5–7], visuospatial strengths [8, 9], creative thinking [10] and the way to develop coping strategies [11]. For example, Albert Einstein was described as "*a late talker who was not only a mathematical genius, but also a self-admitted dyslexic*" Brain 123: p.2377 [12, 13].

Dyslexia may happen together with autism [14] and/or attention deficit hyperactivity disorder (ADHD) [15]. The proband has normal intelligence but seems to be a spectrum with different severities [16]. These primary syndromes may lead to long term disease, such as anxiety, and social problems later on.

In terms of the origin, studies on twins confirmed the involvement of gene/genes in dyslexia [17]. Researchers proposed that the genotypes cause the functional changes of the brain and generates the cognitive and perceptive deficits in dyslexics [18]. The predominant opinions agree that genes [19–21] and brain [16] are two areas to focus on [22]. The potential risk loci located on chromosome 1, 2, 3, 4, 6, 11, 12, 13, 15, 17, 18, and X [19]. Apparently, it is polygenetic. The left posterior temporo-parietal cortex, left occipital-temporal cortex and left inferior frontal gyrus are brain regions involved [16, 23, 24]. In addition, cerebellum might play a role [23–25]. It could happen across languages [26] and writing systems [16, 26]. For example, the brain activation is similar for Mandarin and English users with dyslexia [27]. However, the definitions of dyslexia used by different research groups vary, due to disagreement in its diagnosis criteria [28–30].

Recently, dyslexia was suggested as a coping response to environmental challenges [31]. In 2016, the prevalence of dyslexia was estimated to be 5-17% in the United States [32], however, no definitive answer has been found [33]. Since the clear mechanism for dyslexia remains unknown, the proposed theories for dyslexia have not reached consensus.

Previous studies have examined dyslexia in Taiwan from different perspectives. However, few has examined the strength of the affected individuals, despite that they may or may not be diagnosed with dyslexia. In order to identify the at-risk, we develop a questionnaire in traditional Chinese logographic characters for initial screening. This questionnaire allows self-report of symptoms, which is a reliable means [34–36] and non-costly. It might distinguish the affected from the non-dyslexics as well.

2. Methods and procedures

Based on the 20-item English version of the adult dyslexia checklist from The British Dyslexia Association [37, 38], a questionnaire in traditional Chinese characters with 30 items on a four-point scale (1 = often, 2 = sometimes, 3 = seldom, and 4 = never) was developed (appendix 1). Among the 30 items, the first seven items are related to reading, followed by items 8 to 11, which examine the sense of directions. Items 12 to 14 investigate writing ability and items 15 to 20 are associated with the numerical competency. Items 21-26 describe the individual behavior characteristics. The defective cerebellum hypothesis of dyslexia is assessed via item 27. The strength of the dyslexics is applied in item 28, which is less emphasized in previous studies. The clinical signs of fatty acid deficiency are exploited in item 29. The last item, item 30, examines if a heritable aspect to any dyslexia that is identified. The profiles for dyslexic difficulty patterns described by T.R. Miles [3] were adopted in items 1, 3, 4, 5, 9, 10, and 11. In addition to the 30 items, we incorporated seven open-ended questions that allowed the participants to self-report any related symptoms explicitly in written traditional Chinese.

3. Results and discussions

1. The frequency and mean of 30-item scores in the questionnaire survey

The questionnaire was self-administered and 2133 copies were distributed to 20 groups; mostly different levels of schools, during July to December, 2009. A total of 1599 questionnaires were collected with a response rate of 75.0%, and of which 164 questionnaires were dropped from analysis due to missing data. Response values of the 30 items were added, with a lower score indicating a higher chance of being

affected by dyslexia. The mean score for the 1442 completed questionnaires was 87.99, with a standard deviation (SD) of 11.9 (**Figure 1**). Among these respondents, the scores ranged from 36 (the most affected) to 120 (the least affected).

The participants can be classified based on the standard deviation around mean value of the 30 items. Among them, 233 had a score lower than 76, approximately 16.1% of the 1442 participants. The number of participants with a score of 2 SD below the mean value was 55, which is approximately 3.7% of the 1442 participants.

2. Identifying potential logographic dyslexics via self-reporting

The potential logographic dyslexics were identified by self-reporting either by themselves or by their family members. Interestingly, self-reported cases or proxy are all female. The phenomenon is in accord with the findings from the article [39] which found that the females have more positive altitude. The demographic characteristics of these individuals are presented in **Table 1**. We have documented the available information on these five potential probands, denoted as D1 to D5 in **Table 2**, and their offspring as carefully as possible since a standard test has not yet available for the adult dyslexics [40].

When compared D1's score of the 30 items, which was 83, with those at the same gender, similar age and education level (which was 91.67 ± 5.51), the former is found to be about 1.5 SD lower (**Table 2**). The score of 30 items of the gender, age matched subjects was 93.8 ± 9.33, which was 1SD higher than D1's score. In other words, the evaluation result of D1 based on the 30-item questionnaire is poor than the average of those with similar characteristics.

As described by his wife on March 6, 2010, *D1 cannot concentrate on what he is reading, becomes distracted very easily and cannot comprehend the meaning of context. He is very impatient when writing things, although his hand writing is readable. He loves arts, however, has never pursued it as a career. He was born as a left handed but was forced to change as a right hander at age of 2-3 years old.*

For the case *D2, reported by his mother, the thirteen-year-old boy was diagnosed as having "reading disability" by Kuan-Tu hospital several years ago. He fell asleep while conducting MRI scanning. Described by his mother, he cannot concentrate on the text that he is reading, and is unwilling to write the traditional Chinese characters. He becomes more energetic in the evenings than that in the mornings. He is right handed.*

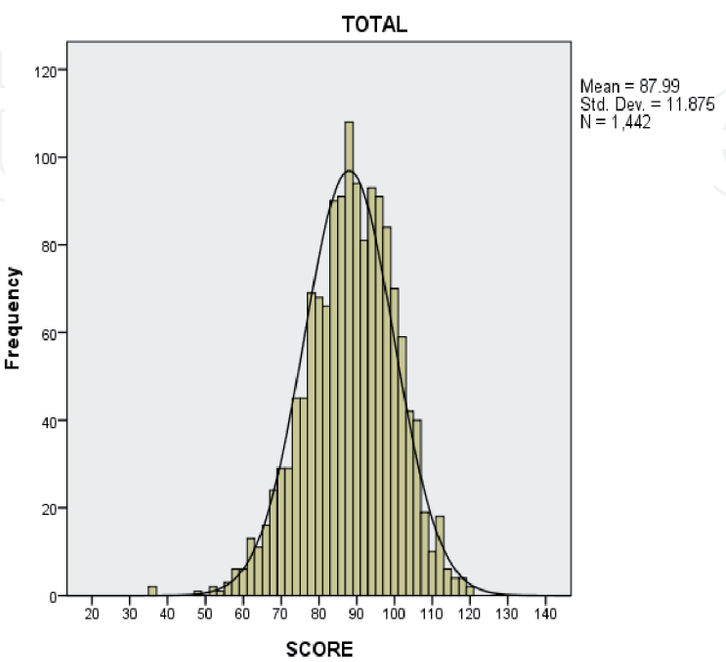

Figure 1.
The frequency and mean of the 30-item scores for all completed questionnaires.

ID No	Age	H (cm)	W (kg)	BMI	Hand	Edu. level	30-Item score
M1	19	175	60	19.6	R	C	90
M2	23	175	65	21.2	R	C	100
M3	43	182	85	25.7	R	M	117
M4	45	170	65	22.5	R	M	83
M5	52	173	70	23.4	R	H	116
M6	53	170	69	23.9	R	Ph	96
M7	69	166	61	22.1	R	Ph	96
M8	89	178	72	22.7	R	C	104
Mean ± SD	**40.7 ± 20.2**	**172.3 ± 4.7**	**66.4 ± 7.9**	**22.4 ± 2.5**			**90.6 ± 13.2**
F1	14	150	40	17.8	R	J	90
F2	23	164	68	25.3	R	M	96
F3	25	158	46	18.4	R	M	80
F4	39	163	62	23.3	R	M	93
F5	43	166	78	29.3	R	C	99
F6	51	150	46	20.4	R	Ph	88
F7	53	157	51	20.7	R	M	73
F8	56	162	65	24.8	R	C	103
F9	59	157	60	24.3	R	Ph	99
Mean ± SD	**40.4 ± 15.3**	**158.2 ± 6.3**	**56.9 ± 10.8**	**22.7 ± 3.8**			**88.6 ± 15.6**
D1	57	175	72	23.5	L + R	C	83
D2	13	165	72	26.4	R	J	77
D3	58	146	53	24.9	L/R	M	49
D4	61	165	60	22.0	R	C	+

***H**: Height **W**: Weight.*
***Hand**: Handedness was determined by filling out a structured form with 13 questions. L + R: Was a left hander and switched into right handed during schooling. L/R: Ambidextrous, use both right and left hands in daily life. R-L: A right hander but become left handed after impairment of the right hand.*
***Edu. level**: Education level **H**: high school **M**: master **J**: junior school **C**: college **Ph**: PhD.*
***S**: The scores of 30 items in a questionnaire survey conducted in July–December in year 2009.*
***+**: Could not complete the 4-page long questionnaire.*

Table 1.
Demographic characteristics of potential logographic dyslexics.

Some Chinese characters were replaced by phonetic symbols or English at the answers of the questionnaire that he submitted.

As a comparable group to D2, the mean of the score obtained from 30 items for 34 male junior school students is 95.59 ± 8.9 (**Figure 2**) which was 2 SD higher than D2's score of 77 (**Table 2**). The mean of scores from 30 items of the gender and age matched participants was 89.33 ± 12.07, which was 1 SD higher than that of D2.

For the case *D3, a high achieving, self-reporting female subject with a master degree. She found that reading is difficult and was medically diagnosed as having compensated learning disability, dysorthographia. That is a particular form of dyslexia* [41] and *logographic processing disorder diagnosed by a medical neurologist (stationed at Changhua Christian Hospital in 2009, personal communication, unpublished data upon request). Some of her hand writing was difficult to recognize and was criticized as lazy and stupid when she was young.*

ID	Gender	Age	Education level	Mean scores of the 30 items		
					Subjects matched with gender, age and education	Subjects matched with gender and age
D1	Male	57	College	83	91.67 ± 5.51	93.80 ± 9.33
D2	Male	13	Junior school	77	95.59 ± 8.92	89.33 ± 12.07
D3	Female	58	Masters	49	80.60 ± 6.58	90.04 ± 11.35
D3-1	Daughter 1 of D3	19/29	High school	74	87.33 ± 13.19	86.87 ± 10.94
D3-2	Daughter 2 of D3	19/29	Junior school	64	70	86.87 ± 10.94
D4	Female	61	College	+	78.75 ± 13.89	83.14 ± 13.06
D4-1	Daughter 1 of D4	34	Masters	50/75	90.62 ± 11.59	86.29 ± 14.49
D4-2	Daughter 2 of D4	NA	Masters	NA	NA	NA
D5	Female	61	College	+	78.75 ± 13.89	83.14 ± 13.06

*+ **D4** and **D5** as two potential logographic dyslexics had great difficulty in completing the 30-item questionnaire.*
***NA**: not applicable.*

Table 2.
The 30-item score of the potential logographic dyslexics identified via self-reporting.

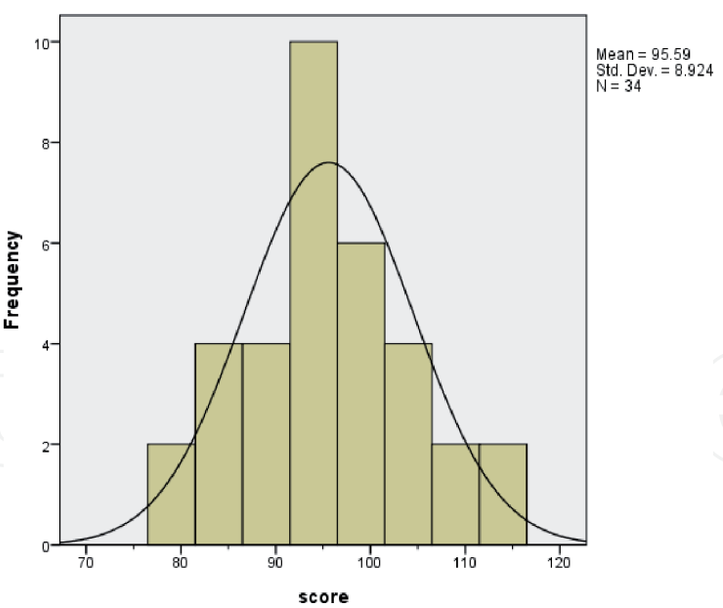

Figure 2.
The frequency and mean of the 30-item scores for junior high school participants.

She had a hard time keeping up with her classmates of the same age and had to spend an extra year at junior high school. She hates to recite, or write but appreciates arts and music. She has never learned to ride a bicycle due to balance problems, which is a sign of a defective cerebellum [42] *and is related to dyslexia* [43, 44]. *She was late on the day scheduled for MRI scanning though she did not mean to be. That indicated an impaired sense of time estimation, which is one of the symptoms of a typical dyslexic* [42]. *She also mentioned that she does better in the night times for schooling than that*

in the day times. Therefore, she had to attend night schools instead of going to regular schools operating in day times. Her two daughters (D3-1, D3-2) also experienced difficulties at school, specifically, reciting multiplication table, (reported by her mother, D3), which is a symptom of dyslexia [3]. D3-1 graduated from junior high school and the other, D3-2 did get high school diploma. Both were between 19 and 29 years old. This implies a genetic basis for the problems in this family. D3 showed a tendency to use two hands together and had a good taste in terms of design and art.

The mean of scores of the participants matched with gender, age and education level was 80.6 ± 6.58, which was about 4.5 SD higher than D3's score (49). The mean of scores of the participants matched with gender and age is 90.04 ± 11.35, which was about 3.5 SD higher than that (equals to 49) of the D3 (**Table 2**). When compared with the average score of 1442 participants, namely, 87.99 ± 11.9, D3's score was 3 SD lower.

For the case D3-1, the average of 30-item score of the participants matched with gender, age and education level and those with gender and age are 87.33 ± 13.19 and 86.87 ± 10.94, respectively, which were both 1 SD higher than that of the D3-1 (74). Similar patterns were found for the case D3-2. Her score (64) was about 2 SD lower

Description	Evidences, Tests	Subjects
Advantages of dyslexics (strengths)		
1. Imaginative writing creative writing	p.146 p.147	S192, S204, S237, S128, S46
2. Good at chess	p.144	S62, S118, S179
3. Gifted musically	Flute, "my sight reading is a bad point, eventually my fingers remember" p.145	S72, S74, S193, S147, S112, S241
4. Gifted in art and craft	p.146	S171, S199,
5. Remarkable drawing	p.146	S46, S54, S150, S179
6. Carving, woodwork, pottery, drawing	P.146	S123, S257, S120, S112, S199
7. A fine analytical mind able to accept, understand and implement new concepts	p.31	S95
8. Assembling the parts of a radio, a dyslexic person can perfectly well do in sequence	p.96	
9. Function more effectively when dealing with three dimensions than when dealing with two	p.230	
10. High score on the Advanced Raven's Matrices	p.228 total 48 adult dyslexics	norms for university students is 21 ± 4; three were of 30 or above and seven were between 25 and 29
11. Very strong at processing for sentence meaning	p.139	S59, S75, S83, S99
12. Unusual powers of creativity	p.189	Albert Einstein, Thomas Edison, WB Yeats

Table 3.
The strength of Dyslexia summarized from 1993 TR Miles.

than the average score (86.87 ± 10.94) of the participants matched with gender and age (**Table 2**).

D4 held a college degree in art and performance. She was also a talented singer but could not even complete the questionnaire that normally required 15-20 minutes on average. She is a mother of two daughters (D4-1 and D4-2) and was reported by her elder daughter, D4-1.

For the case *D4-1, the score of 50 was given by the subject and she claimed that it was based on her conditions before the age of 22. Her score at the time of completing the questionnaire was 75. Her score is 1.3 SD lower than the average score of the participants matched with gender, age and education level (90.62 ± 11.59), and was 1 SD lower than those matched with gender and age (86.29 ± 14.49) (**Table 2**). She was labeled as lazy and stupid at early schooling though she has talents in music and singing.*

Not until she went to the United States and obtained a master degree, she regained her confidence. She recalled that 22 years old is a turning point for her life. We are not sure how and when the compensation processes occurred for a person who uses both logographic (i.e., Chinese) and phonological language system (i.e., English) simultaneously. The brain organization is related to the compensatory process, specifically the right hemisphere [45]. As she was pregnant at the time of data collection, we cannot scan her brain with MR. We do not know whether she had adopted any strategies while she was in the United States.

The case *D5 was a 61 years old female with a college degree, and was an excellent art teacher in a primary school. She is constantly bothered by her problems and does not know why. She struggled through schooling and had to spend one more year at junior school. She has no sense of time with numerical difficulties and becomes confused about directions. She has talents in arts such as paper sculpture and knit weaving. She states her disadvantages and talents in Chinese characters at the questionnaire that she submitted.* The unusual balance of the skills was described by the book written by T.R. Miles [3] (p.189, p.237), see **Table 3**.

She could not complete the 4-page long questionnaire as normally done in about 15-20 minutes. Having problems with filling in forms is one of the symptoms of dyslexia [46]. Among the subjects from whom we received questionnaires, four females had a college degree and were 61 years old. Their average score of the 30 items was 78.75 ± 13.89, see **Table 2**.

Overall, our self-report cases support the involvement of genes and brain for dyslexia. The disorder did have a biological origin though the nature is unmasked. Each individual of these 9 logographic potential dyslexics possesses unique behavior, in agreement with the statement that "no typical phenotype could be claimed as dyslexia" [16]. In other words, the form and degree of dyslexia varied.

Each of our cases revealed specific symptoms of dyslexia. Case D1 has deficits of reading skills, which is probably related to ADHD [15]. Also, both of D2 and D3 are more energetic in the evening than in the daytime, in addition to reading and writing impairments. This may be related to hypothalamic–pituitary–adrenal (HPA) axis [4]. The two daughters of case D3 both experienced difficulties for schooling, suggesting that the genes are involved [20, 21]. D3 could not learn to ride a bicycle supports the cerebellum theory for dyslexia [23–25].

Although D4 and D5 could not finish the questionnaire and hate to deal with forms, D4 is a talent singer, and D5 is a great art teacher. These talents [5–7] documented in previous research had never been noticed when they were at school. D4's elder daughter D4-1, after suffering from schooling, was sent to the USA, where she found confidence. This is a typical compensated case, probably related to brain organization specifically in the right hemisphere [45]. Again, the cases of D4's family, as well as D3 's family, demonstrated the involvement of genes for dyslexia.

4. Conclusions and future work

It is found that the 30-item questionnaire allowed us to identify the potential logographic dyslexic probands. It should be noted that self-reporting cases are all females or identified by a female family member of the potential logographic dyslexics. The genetic influence was implied from the two potential dyslexic families of D3 and D4. More importantly, our data suggested that some of the dyslexics may carry gifted talents, which has never been recognized by local educators and teachers before. When reading and writing difficulties are found in students, along with observable focusing or balancing problems, educators are encouraged to employ this tool for initial screening on potential dyslexics and lend them necessary support. Future work should concentrate on the validity and reliability of the questionnaire for group screening [47]. A qualitative multiple case study of the potential logographic dyslexics is suggested.

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