

The Relationship Between Audiovisual Integration and Reading Ability in Chinese Children With and Without Dyslexia

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Introduction

- Reading is a process that requires the interaction of visual and auditory information and learners have to bind these audiovisual stimuli into units. Many studies have found that dyslexia has a deficit in integrating audiovisual information. More and more researchers believe that dyslexia results from the deficit of audiovisual integration rather than the defect in a single pathway.
- Audiovisual integration means the ability that individuals can percept the visual and auditory information, which appear simultaneously or with specific intervals, into one unit. The ability of audiovisual integration includes at least three aspects, they are audiovisual temporal sensitivity, the output mode of audiovisual integration, and the identification of visual speech information. A defect in any one of them might lead to dyslexia.
- Audiovisual temporal sensitivity means the sensing capability one perceives the onset time between visual stimuli and auditory stimuli. Several studies have examined that dyslexia has a deficit in audiovisual temporal sensitivity.
- There will be three types of outputs after integration; they are visual-based output, auditory-based output, and the fused output.
- Some research revealed that the ability to identify visual speech information had a strong relationship with reading and it could support the development of some necessary skills related to reading.
- The goal of the present study is to explore: 1) if Chinese dyslexic children have a deficit in audiovisual integration; 2) if audiovisual integration ability could contribute to character recognition after controlling for other reading-related skills.

Methods

- Participants: Grade 2 to Grade 5 students from Beijing. Dyslexic group and normal developed group both included 25 children. They were matched with age and IQ.
- Measures:
 - Audiovisual temporal sensitivity - simultaneity judgment task was used under speech stimuli and non-speech stimuli condition. Children needed to judge if visual and auditory stimuli appeared at the same time.
 - The output mode of audiovisual integration - McGurk identification task was used. Participants were presented the sound /apa/ and watched a video in which a person pronounced /aka/. Then reported which pronunciation they percept.
 - Identification of visual speech information - speechreading task was used. Materials included five syllables that have different places of articulation. Children were presented silent videos and needed to identify the pronounced syllable.
 - Phonological awareness - phoneme deletion task was used. Children needed to pronounce syllables with part of the phoneme deleted.
 - Rapid automatized naming – digit naming task was used. Children needed to name digits as quickly as possible.
 - Sound-Shape binding – Used katakana and Korean characters as materials. Each katakana and Korean characters were matched with a pseudo-sound. Children learnt the pairs first and then received the test. Two kinds of tests were used: chose the corresponding shape according to the sound and chose the corresponding sound according to the shape.

Results

- Dyslexia had poorer performance on audiovisual temporal sensitivity ($F(1, 48)=4.651, p=0.036, \eta^2=0.088$) under the speech stimuli condition; And behaved worse in the speechreading task ($F(1, 48)=4.941, p=0.002, \eta^2=0.031$). Both groups had similar output mode of audiovisual integration.
- Dyslexic children had significantly poorer performances in reading-related abilities.

Table.1 Performances on reading-related skills

	Dyslexic children (n=25)	Typical children (n=25)	t	p
PA	14.76 (5.88)	18.24 (5.67)	-2.129	.038*
RAN	21.62 (6.19)	16.25 (4.03)	3.638	.001*
Shape to Sound	2.36 (1.68)	3.92 (1.55)	-3.410	.001*
Sound to Shape	2.52 (1.66)	3.32 (1.99)	-1.541	.130

- Results of hierarchical linear regression analysis found that after controlling the reading-related abilities, the ability of audiovisual integration could still explain the variance of character recognition score independently.

Table.3 Result of hierarchical linear regression analysis

Variable	Model 1			Model 2			Model 3		
	B	SE	β	B	SE	β	B	SE	β
Reading related skills	512.08	83.37	0.66**	512.08	71.60	0.66**	552.20	284.02	0.72
Audiovisual temporal sensitivity				-142.51	71.60	-0.19	-148.50	242.66	-0.19
Visual speech processing				278.34	71.60	0.36**	184.90	229.24	0.24
Group*Reading related skills							-24.88	177.52	-0.05
Group* Audiovisual temporal sensitivity							6.18	174.42	0.01
Group* Visual speech processing							65.97	154.99	0.13
Adjusted R ²	0.43			0.58			0.55		
F changes	37.73**			9.54**			0.07		

Discussion

- Audiovisual integration has specific contributes to reading. This finding is consistent with some previous studies, which concludes that the defect in multisensory integration is a primary pathway for impaired reading ability.
- Integrating visual and auditory information is necessary for learning to read in Chinese and audiovisual temporal sensitivity plays an important role in this process.
- Some studies did not find the role of visual speech processing in reading. Possible reasons: indicators of reading ability, the age of participants and include other components.
- Future directions: 1) exploring the neurobiological mechanism; 2) comparing the developmental trajectory in different ages; 3) developing interventions based on audiovisual integration.

Conclusion

Audiovisual integration plays an important role in the development of Chinese reading ability. The deficit in audiovisual integration might be a primary source of Chinese dyslexia.

Reference

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