

COMPARING DYSLEXIA IN ENGLISH AND MANDARIN CHINESE, AND
APPLYING COMMUNICATION DESIGN METHODS TO IMPROVE
THE CONDITION

by

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DEDICATION

I dedicate this thesis to my beloved family and people who have always supported me during my graduate education. I would like to thank my parents and my brother, Li-Hua Lan, Chin-Yi Chiu and Chun-Yu Chiu, for bringing me into this world, raising me with the greatest love, and encouraging me to pursue my interest in design education.

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ABSTRACT

This thesis is to research dyslexia in different language systems, English and Mandarin Chinese. Through observation of the two languages, this research compares dyslexia in order to better understand it under different conditions. It also helps develop learning from different cultural solutions under the two language systems. Based on the results of the research, design thinking and methods are used to improve the state of the target problem.

I. GENERAL INTRODUCTION

1.1 Introduction

Language is important in every aspect for communication and helps people integrate into society. It can be frustrating when people are unable to use language to express themselves clearly or to understand the meaning of words. Dyslexia is a language-based learning difficulty that makes it hard to learn literacy skills across all languages and it affects 15–20% of people in the world (International Dyslexia Association, 2020). People with dyslexia struggle with literacy activities such as reading and writing fluently. The brains of people with dyslexia are wired differently from others, which causes difficulties in processing language. The frustrations caused by the learning difficulties may lead people with dyslexia to lose interest in engaging in language-related activities.

Researching dyslexia in literate speakers of languages which have different writing systems can help to understand how the human brain processes different languages and gives possibilities to explore new ways of sending and receiving information. For example, English and Mandarin Chinese use different language writing systems. English writing belongs to the alphabetical system and the written language is the combination of letters and sounds. On the other hand, Mandarin Chinese writing belongs to a symbolic system that uses characters to present its written language. The form of Mandarin Chinese characters presents in a visual format of meanings.

As a person who is not interested in reading and studies bilingually in Mandarin Chinese and English, it is extremely difficult for me to complete any activity that requires me to read and write. The problem pushes me to think about whether reading and writing

is the same pain for people with dyslexia. As a communication designer, I try to use various forms of communication methods to convey ideas rather than just text. For example, using images, colors, or shapes to deliver communicative messages. Designers have the power to present ideas in a more intelligent way. Moreover, instead of using textual descriptions, designers enhance the establishment of the sensory experience by using non-text elements such as vision, hearing, touch, taste and smell to communicate ideas. Comparing how the two languages affect dyslexia may help to better understand the condition of dyslexia and prompt us to explore new possibilities of communication. Based on research findings of the commonalities of the two languages, this thesis aims to explore various forms of design methods to empower people with dyslexia and bring awareness to the public.

1.2 Statement of Problem

Language is an efficient way to communicate human ideas, thoughts and beliefs. However, mastering a language is especially hard for people with dyslexia. Dyslexia is one of the world's most common language-based learning difficulties across all languages. It is estimated that 15 to 20 percent of the world population have dyslexia (International Dyslexia Association, 2020). Even though dyslexia is a common learning issue, it is largely ignored due to a lack of awareness and understanding. Dyslexics learning a second language are even more likely to be ignored because it is assumed that they are only struggling with learning a new language (Rosen, n.d.). Dyslexia is a lifelong condition, but fortunately, researchers have discovered that the earlier you find dyslexia and give effective interventions, the better the learner can catch up to their age-appropriate learning levels. People with dyslexia most commonly face difficulty with

reading, writing, and spelling. Reading comprehension is also a problem for dyslexics. Dyslexics take longer to process text information than typical people and that slows down their learning speed. Due to their struggle with reading and writing, people with dyslexia lose interest in literacy activities and also lose their confidence to read (Shane, 2018). Besides, the problems of dyslexia also affect a learner's education achievement. According to a research study by Lamk Al-Lamki, people with dyslexia have a higher rate of dropping out of school, and have fewer life choices for their future. The dropout rate of dyslexics in the United States can be as high as 35 percent, which is twice the average school drop-out rate (Lamk, 2012).

1.3 Statement of Purpose

This research will investigate how different languages affect dyslexia in literate speakers of languages that use different writing systems. Based on the commonalities of dyslexia shared by speakers of the two languages, this thesis applies design thinking and explores different forms of communication tools to empower people with dyslexia and offer a better way to convey information for relieving the frustration caused by reading text. Moreover, the goal of the design project aims to enhance self-identifying and bring the awareness to the public.

When reading in English, readers tend to focus on phonological processing, which is the processing of the sounds of a language. Chinese readers tend to focus on visual processing, which is the processing of the visual symbols representing aspects of a language (Dyslexia Varies Across Languages, 2009). The processing differences may affect bilingual learners with dyslexia. Research on how dyslexia affects the two languages and finding the similarities helps to better understand dyslexia, advancing the

discovery of potential solutions that work in both languages. Researching the two languages by looking into their cultural background, history, and symptoms of dyslexia specific to each language will help to investigate how the brain processes different structures of languages. This research will review existing literature and potential treatments seen in both languages to understand the problem and offer potential strategies or tactics to help improve the condition. The main purpose of this research is to understand how dyslexia affects readers of different language systems and explore potential overlapping solutions. This research will apply design methods to explore solutions for improving dyslexia. The goal is to use design methods to explore the problem and hopefully improve the condition for dyslexics.

Even though dyslexia is a lifelong condition and cannot be cured, there are some suggested treatments that can help to improve the condition. For example, Dr. Samuel T. Orton has successfully applied multisensory teaching methods to improve reading ability in children (International Dyslexia Association). Multisensory teaching helps students to learn with more than one sense, specifically that helps them engage five senses to gain knowledge. In addition to multisensory teaching, there are methods that have been used to improve reading ability, such as using intervention and remediation to support struggling students and help them achieve their academic goals. The intervention methods focus on targeted teaching for those who are struggling to learn, while the remediation introduces different methods to re-teach learners for improving their reading comprehension. There are also design suggestions used to improve readability for people with dyslexia. According to the British Dyslexia Association Style Guide (2018), the choice of the typeface, color, and spacing affects readability for dyslexics. Due to the

differences between the two languages, the treatments used in English and in Chinese may not be the same. Research on the commonalities of the two languages to find solutions in one language may help the other.

II. SECONDARY RESEARCH

2.1 General Information about Dyslexia

2.1.1 *Introduction to dyslexia*

Dyslexia refers to a learning difficulty in which the reading and comprehension ability is lower than expected with normal intelligence and no external brain injury (The International Dyslexia Association, 2001). The International Dyslexia Association states the current definition of dyslexia:

Dyslexia is a specific learning disability that is neurobiological in origin. It is characterized by difficulties with accurate and/or fluent word recognition and by poor spelling and decoding abilities. These difficulties typically result from a deficit in the phonological component of language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction. Secondary consequences may include problems in reading comprehension and reduced reading experience that can impede growth of vocabulary and background knowledge. (The International Dyslexia Association, 2001)

Dyslexia causes a processing difference of texts in the brain when a person reads. The brains of people with dyslexia are wired differently from others, which causes a processing difficulty in reading and writing. The difference causes less efficiency in processing language in the brain, resulting in people with dyslexia facing difficulties engaging in language-related activities. Dyslexia is a common learning difficulty, and it is considered that there are 15–20 percent of people worldwide who are affected (International Dyslexia Association, 2020). In addition to that, dyslexia is an inherited

condition that can pass to their generations. Therefore, if someone has dyslexia, it may increase the possibility of their children also having it. The symptoms and severity of dyslexia can be different from person to person (Olson et al., 2013).

2.1.2 The Neural Nature of Dyslexia

Dyslexia is a neurological condition that causes a processing difference of language.

Unlike other learning disabilities, dyslexia is not affected by intelligence. According to Mayo Foundation for Medical Education and Research, "Dyslexia is a learning disorder that involves difficulty reading due to problems identifying speech sounds and learning how they relate to letters and words (decoding)" (Mayo Clinic, 2017). In reading, readers identify phonemes and correspond them to the letters or the characters to form a word.

The brain of people with dyslexia makes it hard to complete the process.

The human brain is composed of the left hemisphere and the right hemisphere. Although there are overlaps in left and right brain functions, each hemisphere is in charge of specific functions. The phenomenon of different brain functions is called brain lateralization. The term lateralization was first proposed by two neurophysiologists — Marc Dax and Paul Broca (鄭芬蘭, 2000). When a person receives information, his two hemispheres work together to process the received information for understanding. Although language processing is typically lateralized to the left hemisphere, some people's language processing is lateralized to the right hemisphere. According to MIT neuroscientists, people with dyslexia show different neural signatures in processing language that is lateralized to the right brain (Trafton, 2016). Judy Singeran (1998), an Australian sociologist, proposed the term "neurodiversity" to describe the differences in the structure and function of the human brain. The term of "neurodiversity" supports the

differences in the functional processing of human brain networks. According to Singeran's research, people with dyslexia use different neural circuits in their brains when reading. Each hemisphere is dominant in certain functions. For example, the left brain focuses on processing language, concept, analysis, logical reasoning, and other functions, whereas, the right brain is more related to music, painting, spatial geometry, and imagination processing. Research indicates that people without dyslexia show more activation on the left hemisphere which is responsible for phonological processing, letter-sound connection processing (Selwyn, n.d). People with dyslexia rely more on using the right brain to read instead of using the left brain. Research of functional brain imaging (fMRI), a brain scan machine to show how brain region acts, shows that people with dyslexia have decreased nerve activity in the left half of the brain (Sun & Lee, 2010). In learning to ride a bike, for example, one needs to know how to balance, to pedal, and to control the direction for moving forward. Reading to people with dyslexia is like using hands to pedal and using feet to control the handlebars when riding a bike. The brain of people with dyslexia does not use the corresponding language processing region to process language information, which causes difficulties in learning language (Marshall, 2003).

Research shows that people with dyslexia show less activity in the left brain that is typically used to process language (Selwyn, 2003). The condition makes it difficult to learn literacy skills and result in difficulties in reading, writing and spelling. Research also states out brain injury on the left hemisphere affects people's language processing (Executive dysfunction, n.d.).

The human brain processes language mainly through three important neural pathways (Bates, n.d).

1. The lower left frontal area, also called Broca's area, a region of the brain that involves the production of speech, is mainly used for articulation and slower word analysis.
2. Parieto-temporal region analyzes the word step by step
3. Occipito-temporal word-form area responsible for skilled, rapid reading.

People with dyslexia have a weak connection between word analysis and word form. Compared with the letter-sound correspondences in the left brain, people with dyslexia tend to use the right brain to see words as picture shapes. Even though dyslexics show lower activities on the left brain, educational neuroscience offers evidence that by receiving one year of early interventions, left brain activity increases (Selwyn, 2003).

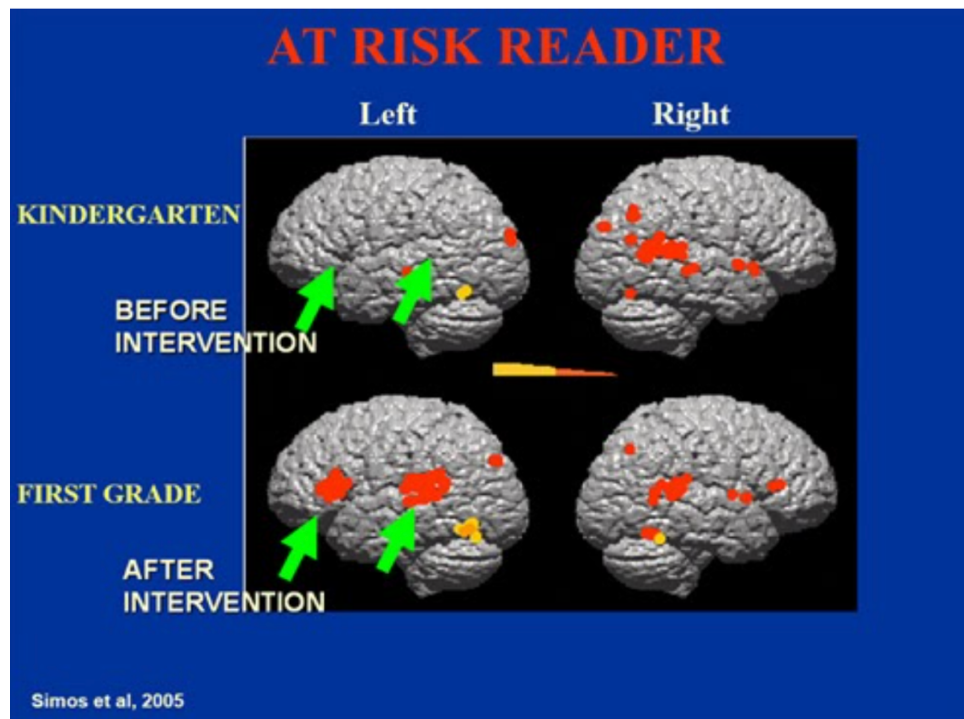


Figure 1. Brain comparison diagram before and after intervention (Simos et al., 2005)

2.1.3 Social Impacts of Dyslexia

Reading is important in communication for helping people integrate into society. Poor early reading skills can lead to behavioral problems. Research shows that "behavior problems among children with learning disorders are about 3 times than the norm by 8 years of age" (Mash & Wolfe, 2002). Scott Bezsylo, the executive director of Winston Preparatory school, explains that "a dyslexic person who has word-finding difficulties can have trouble with their expressive language (Child Mind Institute, n.d.)". Dyslexics may encounter communication problems when interacting with others, causing their confidence to lower. It is harder for dyslexics to express their emotions and thoughts compared to others and the situation causes problems in social functions. Researcher, Eissa Mai, evaluated a group of teenagers on their emotional and behavioral symptoms associated with dyslexia, and the research suggested that dyslexia has an adverse impact on their self-esteem. The teenagers with dyslexia not only showed higher rates of social problems but also showed significantly higher rates of mental problems such as depression and anxiety. Furthermore, the research also showed that people with dyslexia have a higher dropout rate and a higher rate of unemployment. The failure of reading and learning leads to low confidence in achieving goals for dyslexics (Lamk Al-Lamki, 2012).

2.2 Language and Reading

2.2.1 Definition of Communication

Different organisms communicate with each other by using different communication systems. For example, bees communicate with their companions by movement to locate food resources or other information; birds use sounds to

communicate with others. Different creatures have their own communication system. In human communication, most scholars stress the use of symbols to transfer the meaning of information for explaining the term communication. Such as “communication is the understanding not of the visible, but of the invisible and hidden. These hidden and symbolic elements embedded in the culture give meaning to the visible communication process. (Communication essay introduction, n.d.)” Moreover, communication is a process of passing facts, thoughts, ideas, feelings, values, and attitudes to another person or group. For instance, “Communication lies in the transmission and exchange of facts, ideas, feelings and actions. It is a process of thinking, a continuous process, and a process of symbolizing social procedures” (Brown, 1961).

2.2.2 Definition of Language

Organisms express their needs through communication, and human beings have evolved what appears to be a unique communication system for effective communication — the language system. Language is a tool for expressing human thoughts and feelings with sounds and symbols. Human communication started with oral language and then developed into writing language to achieve a better record and pass the resource to generations (for a comprehensive overview of the gradual development of writing systems, see Schmandt-Besserat (2014)). Language is acquired through learning and instruction. For example, from crying in infancy to learning to make a single sound, and then to communicate in words. Learning is the acquisition of new knowledge or skills through study, experience, or by being taught.

Language presents a systematic communication structure. David Crystal, Honorary Professor of Linguistics at Bangor University, gave an definition to language:

Language, a system of conventional spoken, manual (signed), or written symbols by means of which human beings, as members of a social group and participants in its culture, express themselves. The functions of language include communication, the expression of identity, play, imaginative expression, and emotional release.

(Crystal et al., 2021)

A language contains symbols and rules. Symbols can refer to texts that are transmitted by visual, sound or haptic, and the rules refer to grammar that is used to construct how text is arranged. Part of the reason why language can become an efficient communication method is that it gives sounds and symbols meaning, and their meaning is formed by conventional rules. Language is a system that is formed by a regular structure for people to learn for communication.

The evolution of languages are affected by different environments and cultural backgrounds. In a speech about language evolution in 2012, Tai-Li Chou, psychologist of National Taiwan University, explained human language has six features. 1.

Communicability: language is used to exchange and to communicate ideas. 2.

Dogmatism: Language learned naturally without hesitation under known language rules.

For example, individuals that have learned the past tense rules of adding an “ed” to the end of words, such as “returned”, auto apply it to all other past tense words. Therefore, individuals who have just started to learn words may say “comed” instead of “came”. 3.

Structure: Organize languages with different structures in different cultures, it can refer to grammar. For example, many English past tense words are present tense words followed

by ed. 4. Levels: The level of language from large to small units can be of four groups: chapter, sentence, word, and phonics. Different languages’ words use different levels to

describe ideas. For example, English prefixes and suffixes are processed into different meanings based on a single word such as the word “turn” can add a prefix to become “return” or can add a suffix to become “turned”. 5. Creativity: Language that arises naturally through one's own observation. 6. Dynamic: new vocabulary produced by the evolution of language. The development of language features help us to express ideas richer and deeper. Take making salad for an example, if there is only lettuce put in the bowl, the whole bowl looks all green. However, if you add minced meat, croutons and bell peppers into the bowl, it will not only look rich in color, but also create more layering of flavors.

Alongside these six features of human language, language is a tool of interpersonal communication in human life. Language can be used not only to convey opinions and express feelings, but also as a tool to help thinking and solving problems. Here are some definitions of language proposed by scholars.

“Language is a purely human and non-instinctive method of communicating ideas, emotions and desires by means of a system of voluntarily produced symbols”. (E.Sapir, 1921)

“Language is “the expression of ideas by means of speech – sounds combined into words, words are combined into sentences, this combination answering to that of “ideas into thoughts””. (Henry Sweet, n.d.).

“A formal language is a (usually infinite) set of sequences of symbols (such sequences are “strings”) constructed by applying production rules to another sequence of symbols, which initially contains just the start symbol”. (Chomsky, 1956)

Besides the definitions and features of language, the power of using language also involves connections with other senses. A German scientist ,Wolfgang Köhler, in 1929 made an experiment that asked testees in Tenerife, where the main language is Spanish, to link each of the two words "takete" and "baluba" to two shapes (see image).

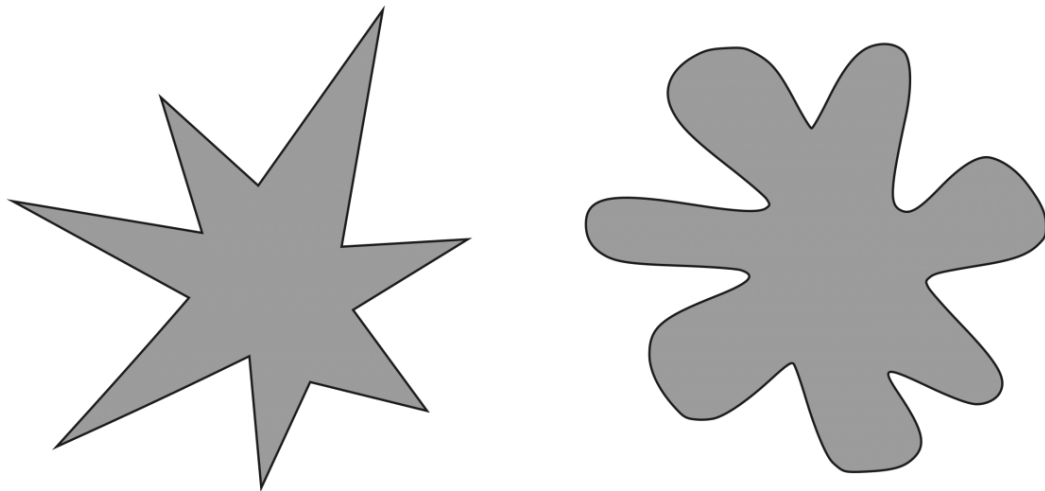


Figure 2. Sharp-edged image & round-edged image (Ramachandran, 2004)

The result showed most people tend to connect the sharp-edged image with takete, and link the round-edged image to bouba. In 2001, Ramachandran and Hubbard, American Indian scientists, repeated this experiment with American college students and Indians who spoke Tamil. They changed takete and baluba to kiki and bouba. The results showed again that 95%–98% of the people chose the round shape as bouba and linked the sharp-angled shape to kiki (Tavis, 2012). Even though we are still unable to explain this phenomenon, it pushes us to explore the connection between language and feelings. Most people tend to associate a sharp word with a sharp-shaped object. Therefore, the experiment results suggest literate learners associate word sounds with objects may be

not random and the connections reflect certain relationships between language and objects.

2.2.3 Definition of Reading

“Reading is a multifaceted process involving word recognition, comprehension, fluency, and motivation (Leipzig, 2020).” In other words, it is the process of making meaning from written languages.

Reading also involves tremendously complex skills that need to be learned through instruction. In order to read, one must learn how to master many skills and abilities such as attention, working memory and cognitive skills such as auditory capacity, and visual capacity. According to Amanda Morin, “working memory is responsible for many of the skills children use to learn to read. Auditory working memory helps kids hold on to the sounds letters make long enough to sound out new words. Visual working memory helps kids remember what those words look like so they can recognize them throughout the rest of a sentence (Morin, 2020).” When reading, working memory is required to transform and turn received messages into materials that can be used to construct and analyze messages in the brain for understanding. Working memory is composed with visual-spatial memory and auditory memory (Rosen, 2021). Readers keep these visual and auditory materials in their brains to decode and operate for analyzing and making connections. People with dyslexia show poor working memory. For example, readers need to know how to break sounds apart and link sounds to the concept of symbols. Readers with poor working memory miss received messages, which leads to difficulties in integrating information in the brain.

Besides, different forms of reading affects the reading comprehension of a reader. Reading text with pictures is easier to understand the contents than reading only the text. Text has no facial expressions. Unlike showing one's emotion or body gestures that shows the expression directly to the view, reading texts cannot convey emotions directly. However, visual images have a strong ability to express emotions. For example, the use of emoji. The use of emoji expresses a stronger expression and make up for the lack of expressions in the text. Communication through text messages may cause more confusion than using visual images when people choose the wrong words or don't give a complete content for the idea you want to convey. As a result, texts can cause misunderstandings in communication. For many people, they can draw the image of expressions by reading the complete contents of text and enjoy the process of comprehension. However, people with dyslexia have difficulty in processing texts, so they are more likely to encounter problems in communication. Fortunately, using more supporting images in the reading has been a good method for helping people with dyslexia to understand reading content better (Roberts, 2017). People with dyslexia have different brain circuits in processing language and have better picture-memory than typical people (Marshall, 2019). The use of images can make up for the inefficiency that people with dyslexia have when processing text contents.

2.2.4 Language and Reading

Compared with animals, humans have larger brains that can process language. When reading, the regions that process language in the human brain work together, and start to transform abstract concepts to link to language for building a semantic network that is stored in the human brain. Upon receipt of the messages, the brain integrates

information and extracts its meaning from the network. When reading, the information received by the eyes is converted into phonemes and combined with the words in the brain to get the meaning (Hudson et al., 2013).

Schema theory was first proposed by psychologist Frederic Bartlett in 1932, and it is often used in understanding the relationship between key factors and the comprehension process. Bartlett believes that humans obviously have common sense in the form of subconscious structures, and these structures will produce graphical errors in memory when interacting with new information. As a result, the old knowledge in the brain will affect how people understand new information. Therefore, schemata (plural of schema) are a mental concept proposed as a selected mental concept of some complex knowledge that are then stored in long-term memory (Pappas, 2019). Therefore, reading can be seen as a way of transforming information and building a network of meaning in the brain to understand and communicate. In other words, the reading process is building a constructive link between the information in the text and what is already in the brain rather than receiving a direct copy of information. In Stanislas Dehaene's book *Reading in the brain: The new science of how we read*, he pointed out: "the same mechanisms, in all humans, are systematically housed in identical brain regions, as though there were a cerebral organ for reading (Dehaene, 2010)." It explains how the human brains process all languages in the same pattern.

Even though the human brain has no big difference in processing languages, the brain focuses on slightly different regions due to different language structures. According to psychologist Tai-Li Chou's speech, children who study English showed that the activity of brain regions, inferior frontal gyrus and parietal lobe, used to process the

sound and the meaning are higher than children who study Chinese (Chou, 2012).

According to brain function analysis, the region on top is more for phonological processing, and the region lower is more focused on image processing.

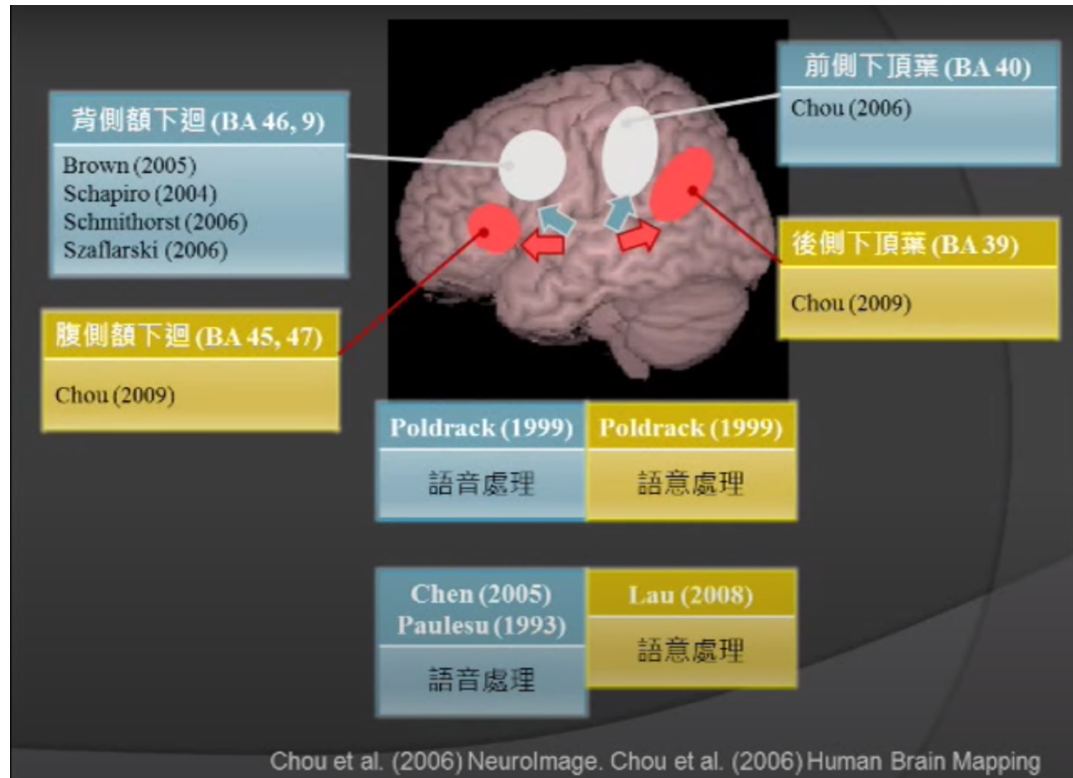


Figure 3. Neuroimage (Chou et al., 2006)

2.2.5 Orthography

Phoneme is the smallest unit of sound to form a word and grapheme is the symbol that presents a phoneme. It is believed that a transparent language would cause less problems for dyslexia learners because in a transparent language, each grapheme corresponds to a phoneme, such as in Korean, Italian and Spanish. On the other hand, an opaque language refers to a language that each grapheme may correspond to more than one phonemes such as English. Take “hot” and “dog” two words for an example. Both words have an “o” letter, however, the first “o” sounds “a”, and the second “o” pronounces “o”. As a result, Italian language learners learn the language quicker than

English language learners due to the consistency of correspondence between writing and pronunciation in Italian. Languages that are opaque such as English and German cause more problems for dyslexia learners than languages that are transparent such as Korean and Spanish.

Whether the language orthography is transparent or opaque directly affects the difficulty of learning language for people with dyslexia. Learning an opaque language causes more confusion than learning a transparent language. Toby Withers, professor of cognitive neuroscience at Brunel University in London, said in the BBC radio documentary, "Dyslexia: Language and Childhood: English reading and writing is so irregular, from the shape to the sound or from the sound to the text. There is no one-to-one correspondence." Toby said: "This kind of irregularity or inconsistency makes it particularly difficult for people to master English reading and writing skills." For example, "mint", "lint" and "hint" are pronounced differently from the word "pint" even though they all come with "int" in the word. This makes English an opaque language. The only way to remember the pronunciation of specific words is to learn and remember each different pronunciation separately (Withers, 2020). Luqman Michel, a teacher of children with dyslexia, expressed her opinion on the language orthography is transparent or opaque affects people with dyslexia:

Of course, this means that children reading in any of the transparent languages learn to read quicker because of the correspondence between writing and pronunciation. (Michel, 1970)

SUMMARY OF DYSLEXIA DISCUSSION

Definition of communication: Communications is the way how organisms make contact with others. Language system is a unique method that human beings use to communicate. However, there are differences in the communication way of communication among humans. People with dyslexia refer specifically to the difficulties they encounter when using language to communicate.

Definition of language: Language is the way human beings use to communicate with others. The language contains a system of rules that people must learn in order to use it. Language has been evolving and continues to evolve to what people want to express. Those lasting impressions rooted in the brain also affect people's feelings.

Definition of reading: Of the different definitions of reading which were presented, the definition which seems most relevant for the subject of dyslexia is "Reading is a multifaceted process involving word recognition, comprehension, fluency, and motivation (Leipzig, 2020)." for the following reason: Reading is a complex process that requires readers to utilize different skills for processing language. Besides learning how to master those reading skills, different forms of information messages such as images or texts affect readers' comprehension directly. People with dyslexia meet difficulties when learning these reading skills.

Language and Reading: How people process language in their brains usually uses a similar pattern. However, when the brain processes different languages, the patterns have a slight contrast due to different languages focusing on dissimilar reading skills.

Orthography: If a language is transparent or opaque relates to learners' intuitive cognition of the language and affect their learning speed, especially for people with dyslexia.

People with dyslexia meet unexpected difficulties when learning languages, so if a language is easier or harder to learn, it challenges them more than typical people.

2.3 General Language Information on English and Mandarin Chinese

2.3.1 English Historical and Cultural Background

English is the most commonly studied language in the world. There are approximately 360 million people in the world that speak English as their primary language, and about 1.5 billion people, which is about 20% of the world's total population, that speak English worldwide (Lyons Dylan, 2017). The evolution of English can be traced back to the Celts dialect. Around 500 BC, the Celts invaded and occupied the British Isles from the European continent. The Celts spoke their own language called Celtic dialect which is considered the earliest language in Britain. After that, around 43 BC, the Romans conquered Britain and brought the Roman culture such as Roman costumes, decorations, and glassware. Therefore, the Latin language was also introduced and used as their official language. In AD 407, the Roman Empire crumbled and eventually left Britain. Hence, Angles, Saxons and Jutes tribes conquered the British and built many kingdoms in Britain. For many centuries, the Germanic language — runes of Anglo-Saxon, also known as the Old English, became the common language in Britain. Runes is a group of letters written in runic alphabets.



Figure 4. The runic alphabet (The World's Text History of the Development, chart 17-4, pp390)

Around 700 AD, Vikings invaded Britain and brought in their language — the Old Norse. Therefore, the Old Norse language and the Old English mixed together and some of the Viking words such as “want” and ”leg” are still used in our English language today (Gardoqui, 2012). After that, the Viking people from France, Normans, invaded Britain and brought their French style and French language that became used in the royal family. The Normans also brought Catholic clergymen into Britain and they mixed Latin letters into the language. Through these events, Old English grew and evolved into Modern English (Gardoqui, 2012).

Each of the 26 letters in Modern English has its own unique story. Matt Baker, a designer and educator, made the origin and development of the alphabet into a diagram form based on his research. The diagram shows how the early shapes and symbols eventually transformed into the English letters we know today.

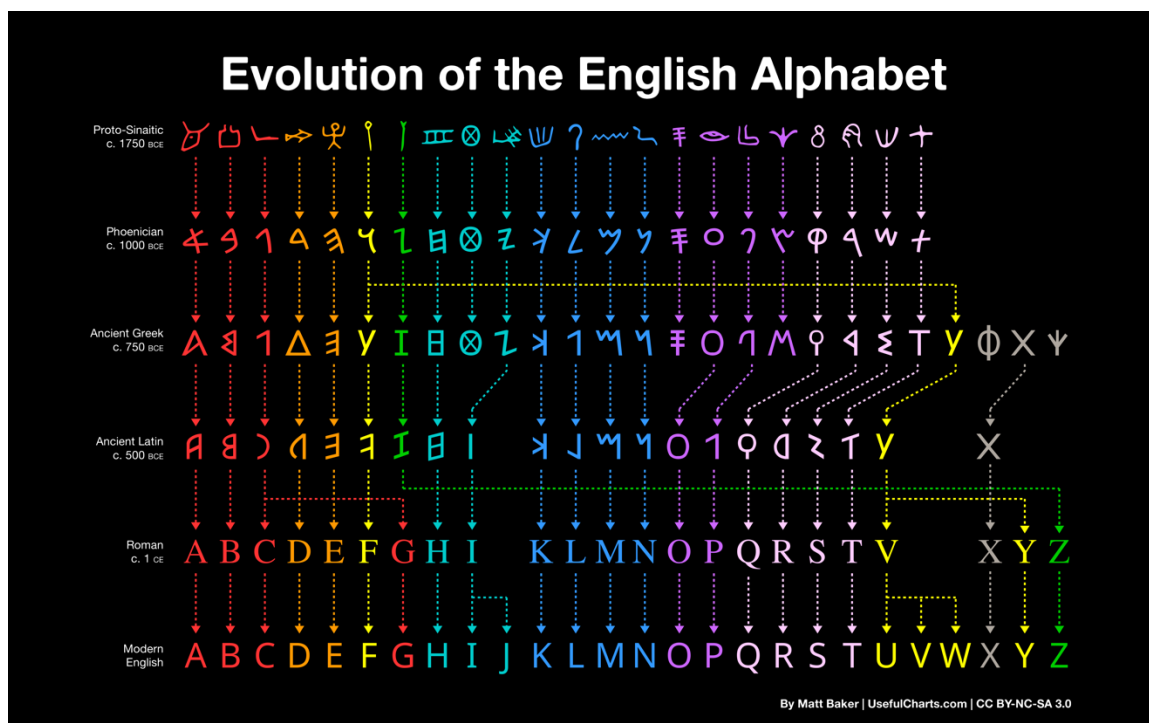


Figure 5. Simplified version of Evaluation of the English Alphabet (Matt Baker, 2018)

The English language also reflects its historical cultural background. Kate Gardoqui, a senior associate with the Great Schools Partnership, said in an education video, *How did English EVOLVE?*, “our history lives in the words we speak and hear (Gardoqui, 2012).” Gardoqui uses two scenes of phrases — “a hearty welcome” and “a cordial reception” to explain how words can show the cultural background of English words. For example, people may have two different pictures of the scenes in mind when they see the two phrases. When thinking about the phrase, “a hearty welcome,” a person may imagine a group of people wearing jeans, drinking beer, and talking loudly. On the other hand, when imagining the phrase, “a cordial reception,” a person may picture people wearing suits and drinking a glass of wine. Gardoqui explained that the reason why people have this impression of the phrases is because the words “hearty” and “welcome” come from Saxon words, whereas, “cordial” and “reception” are from French

words. Therefore, words with different cultural backgrounds evoke different feelings and impressions (Gardoqui, 2012). Do you feel the two phrases evoke the same feeling as how she described?

2.3.2 Mandarin Chinese Historical and Cultural Background

Around the 14th century BC, ideographic symbols, graphical symbols used to describe an idea, were used in Oracle bone script. Oracle bone script is a type of writing written on bones or tortoise shells, and it was mainly used for divination at that time.

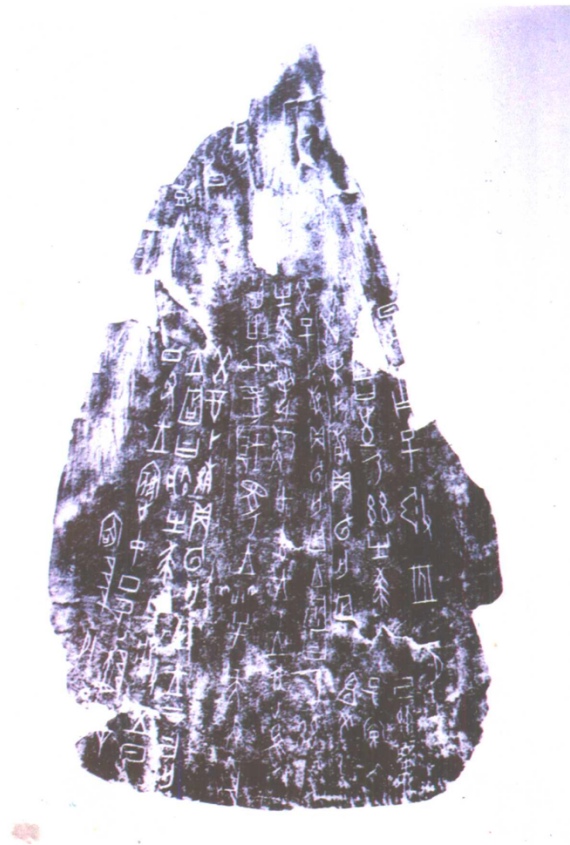


Figure 6. Oracle bone script (16th–10th century BC) (Chou, 1997)

It is considered the ancestor of Chinese characters and also the first form of Chinese characters. Therefore, with the extensive use of bronze ware, the characters evolved into Bronze inscriptions that were engraved on bronze ware.

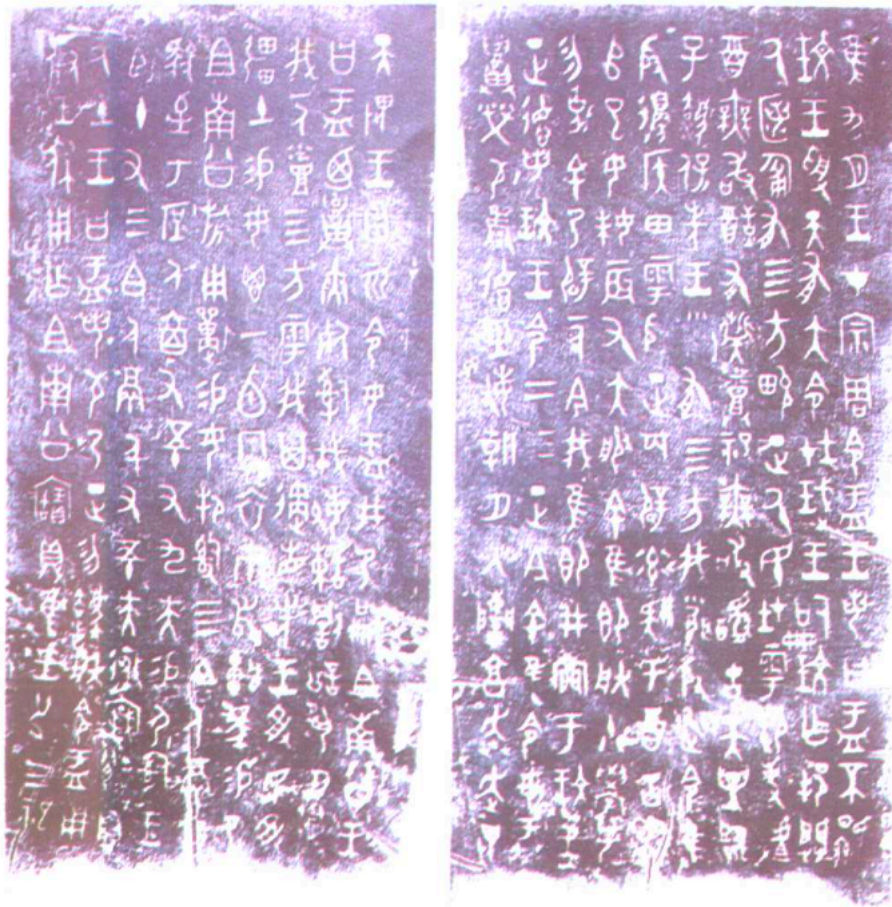


Figure 7. Bronze inscriptions (1300BC–219AC) (Chou, 1997)

Oracle bone script and Bronze inscriptions can also be collectively referred to as “Large seal script”, which is a kind of character that uses pictographic patterns as the main character with a rounded style and smooth strokes.



Figure 8. Large seal script (210–160BC) (書法藝術網, 2018)

In 221 BC, the first emperor of China, Qin Shi Huang, unified characters, weights and measures, and currency after which the Small seal script was born. The Small seal script is the evolution of the Large seal script. By eliminating the complex strokes and adjusting the thickness of the strokes to form more uniform and symmetrically squared characters.



Figure 9. Small seal script (221BC) (書法藝術網, 2018)

The Emperor Kangxi of the Qing Dynasty compiled the "Kangxi Dictionary" in 1716, and the dictionary collected 47,035 Chinese characters, which is extremely detailed. In the 1950s, scholars sorted out 3000 words in common use for reading ordinary books and newspapers.

In 1952, the China government established the Character Reform Research Committee to implement a plan to simplify Chinese characters. However, traditional Chinese characters are still used in Taiwan, Hong Kong, and Macau.

China's versus Taiwan's characters		
	Simplified	Traditional
Love	爱	愛
Noodle	面	麵
China	中国	中國
Taiwan	台湾	臺灣
Military	武	武

Figure 10. Examples for simplified Chinese and traditional Chinese (Cindy Sui, 2011)

The composition of Chinese characters uses basic unit meanings, the smallest part to present a meaning is known as a radical, used to combine and to form more meanings of a word. For example, the word "亻" on the left side of "信" represents people. The "言

" on the right represents language. The combination of two radicals together becomes the word 信", which means trust. Therefore, the combination of the radicals in “信” indicates a person should be as good as his word.

Chinese characters are an important carrier for the inheritance of Chinese culture. Various fonts formed in various histories reflect the society at that time. The most famous wordbook is Shuowen Jiezi (Chinese: 說文解字) written by 許慎 in the 2nd century AD. The book systematically discusses the evolution of Chinese characters. For example, Chinese character “一”, meaning one, presents that everything starts with “一”. “一” divides the world into the earth and the sky, and can turn to everything. And then “元” is composed with “一” plus “兀” that means the beginning. The top part of 元 is the “一” that already explained, and the bottom part “兀” means bald and empty (說文解字 ShuoWen.ORG, 2021). Chinese characters also reflect its culture. For example, the Chinese character "男" means man. The "田" at the top part of the character means frame, and the “力” at the bottom part means force. The character ”男” represents that men are the main force in farming in the traditional agricultural societies in China.

2.3.3 English Writing Structure

The English alphabet consists of twenty-six letters and each letter has its corresponding pronunciation. Letters are the basic units in the alphabet system that use independent vowels (a, e, i, o, u) and consonants (the rest of the letters) to form the writing system of words closely related to their sounds, though there is not a consistent one-to-one mapping between letters and sounds (cf. the earlier discussion of orthographic opacity/transparency). The combination of multiple letters forms a word and forms its

pronunciation. Phonological awareness refers to the skill of recognizing the sound structure of language. Readers use phonological awareness to decode words and pronounce words. The phonological awareness of English letters are learned through practicing the regularity of the languages' rules and allows readers to remember the patterns from words. For example, when pronouncing non-words such as symburt, craddy, bry. Most people don't pronounce the "y" using the same sound due to people who remembered the patterns of the pronunciation.

2.3.4 Mandarin Chinese Writing Structure

Texts are written symbols of language. The structure of texts like Mandarin Chinese is composed of form, sound, and meaning as three major factors. Form is the structure of a text, sound is the pronunciations of a text, and definition gives the meaning of a text. In addition to that, text symbols must be readable, writable, and can communicate certain meanings. Therefore, texts are used to record spoken language, and used to pass on knowledge (Li, 2005). Chinese characters were developed from the earliest symbolic texts to record daily life, and then gradually integrated into the phonetic component of spoken language. According to statistics, 90% of Chinese characters belong to the combination of form and sound. In comparison to phonetic languages, the development process of Chinese characters retains a higher component of form. Chinese characters are structured as square blocks. Radicals are the basic units of structuring Chinese characters. Each Chinese character is composed of single or multiple radicals in a two-dimensional square space, arranged and combined according to the rules of character grouping. If one radical is appearing in many characters, the radical becomes a recognized radical that can help to guess the meaning of a text. For example, Chinese

characters like 推, 拉, and 擁 all contain a 扌 that means “hand”. Therefore, it is reasonable to assume the three characters refer to something related to hands. Chinese characters are arranged in a two-dimensional square, which the shape of the character requires detailed analysis of the spatial information and the positions of various strokes (Tan et al., 2001). Here shows some common arrangements of structuring Chinese characters.



Figure 11. Common Chinese structure of arrangement (Chang et al., 2011)

The structure of Chinese characters composed with single-part or multipart characters. A text can only contains a single-part radical such as 人, 手, and 日. Multipart characters like 語 and 雪; and one component alone can become a single character, such as: 人, 火, 水, 金, etc. Multi-part characters are characters composed of two or more parts, such as being arranged up and down, or left and right, or combining multiple parts

into one word. For example: 杰, 钱, 赢. Modern Chinese characters are composed of three parts, accounting for about 40.32% of characters, followed by characters composed of two parts, accounting for about 34.04%; then, characters composed of four parts, accounting for 16.39% (Chen et al., 2011).

SUMMARY OF DYSLEXIA DISCUSSION

English historical and cultural background: The development of English has experienced the integration and development of various countries, and finally developed into a language system composed of letters and sounds. When learning English, learners learn how to combine letters, pronunciation and meaning to understand the meaning of the text.

Mandarin Chinese historical and cultural background: Chinese characters have been continuously simplified and modified, combined with pronunciation, and developed into the current square characters. Learners should have both phonological processing and visual spatial processing skills for reading.

English writing structure: From the above, it can be seen that the composition of English words and sentences is composed of letters and sounds. Words are combined into sentences, and finally assembled into paragraphs and articles. There is no imitation on the composition of English letters to form a word, so the words can be short or long. When reading English, the flow of eyes moves based on the length of words.

Mandarin Chinese writing structure: The composition of Chinese characters, words, is composed of a number of meaningful components as radicals. Therefore, a Chinese character may contain a broad meaning of the word. When reading, the reader must decode the meaning of each word.

2.4 Dyslexia in English

2.4.1 Current Situation

According to National Center on Improving Literacy, 48 out of 50 states in the United States have dyslexia legislation to support those who are struggling in literacy activities. The legislation includes setting up dyslexia screening and testing in public schools. The Regional Education Service Center employs dyslexia experts to compile a training list on dyslexia for educators, as well as develop plans for students participating in special education programs (State of dyslexia, 2020).

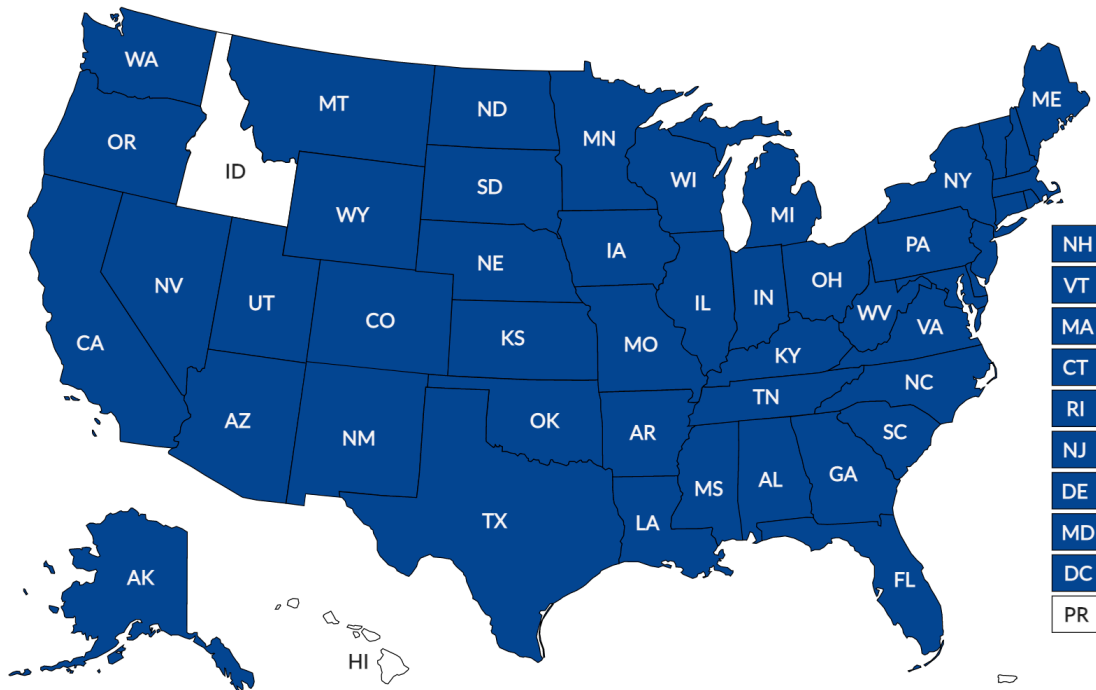


Figure 12. Dyslexia legislation map (National Center on Improving Literacy, 2020)

2.4.2 Signs of Dyslexia in English

There are common signs that can be seen without receiving a formal dyslexia test. The following lists signs based on different learning stages.

Preschool stage

- Learners have difficulty in learning nursery rhymes such as Jack and Jill.
- Learners may have trouble learning and recalling the name of letters in the alphabet.
- Learners appear to be not able to identify the letters in their name.
- Learners are confused with similar words and continue to use baby talk.
- Learners don't recognize rhyming patterns like cat, bat and rat.
- Family members may also have reading difficulties.

(Sally Shaywitz, 2003 , as cited The Yale Center for Dyslexia and Creativity, 2017)

Kindergarten & First Grade

- Learners may say different words than what are on the page when reading. For example, say “kitten” when seeing the word “cat” on a paper.
- Learners don't understand that words come apart.
- Learners may struggle in reading and complain about how hard reading is.
- Learners unable to sound out simple words such as cat and dog.
- Family members may also have dyslexia.
- Learners don't connect the sound with the letters.

(Sally Shaywitz, 2003 , as cited The Yale Center for Dyslexia and Creativity, 2017)

Second Grade through High School

- Learners read slowly and awkwardly.
- Learners have problems with reading unfamiliar words that they don't use strategies for.
- Learners don't like to read out loud.

- Learners use simple words instead of specific words to describe. For example, use “thing” to describe an object without using the name of the object.
- Learners use a lot of unnecessary words such as “um” when speaking.
- Learners confuse words with the same inflection. For instance, say “vol-ca-no” for “tor-na-do”.
- It takes longer for people with dyslexia to respond to questions.
- Learners have difficulty remembering things such as numbers, dates, time, and lists.
- Learners find it hard to learn a foreign language.
- Learners may frequently make mistakes on spelling.
- Learners’ handwriting is messy.
- Learners have lower confidence and lower self-esteem.

(Sally Shaywitz, 2003 , as cited The Yale Center for Dyslexia and Creativity, 2017)

Young Adults & Adults

- Learners struggle in reading and writing in childhood.
- Reading skills are developed slower than usual.
- Learners don’t like to read and read slowly.
- Learners avoid reading out loud.
- Learners read not fluently.
- Learners often pronounce the wrong names of people or remember the wrong time.
- Learners confuse words that sound alike.
- Learners response to conversation slowly.

- Learners struggle to recall words when using them.
- Learners' listening vocabulary is greater than spoken vocabulary.
- Trying to avoid using words that are not familiar with.
- Showing low confidence in reading.
- Learners suffer when reading.

(Sally Shaywitz, 2003 , as cited The Yale Center for Dyslexia and Creativity, 2017)

2.4.3 Dyslexia Symptoms in English

People with dyslexia may appear to have the following common symptoms. Even though every dyslexic shows different symptoms and the degree is differ from person to person, the following symptoms are usually seen in dyslexics.

Spatial/ Temporal problems

- Learners have difficulties in telling the time.
- Learners confuse Left and right.
- Lerner get lost easily.
- May experience math computation errors and difficulty memorizing math facts
- Memory difficulties
- Hard to remember dates.
- Problem with sequences such as alphabet, times, tables and numbers.
- Motor Control problems
- Coordination difficulties that make it hard to organize things.
- Difficulty in coping skills.
- Handwriting is messy.

Reading difficulties

- Move texts or overlapping texts when reading.
- Need to re-read in order to get the meaning.
- Lose places such as jump lines in texts of reading.

Spelling difficulties

- Confusing with similar sounds of words.
- Don't remember what words look like.

Listening difficulties

- Having problem with note taking.
- Find background noise distracting.

Writing difficulties

- Hard to get ideas on papers.
- Don't know how to structure sentences.
- Finding incorrect words in writing.

2.4.4 Identification and Assessment of Dyslexia in English

According to Dyslexia by Gavin Reid, children can be given a formal identification test that measures things such as phonological awareness which refers to the skill to distinguish the sound structure of language (Stanovich, 19964). Children can also be given a test on reading speed and reading fluency. Reading speed refers to how many words a reader can read in a specific unit of time and reading fluency is the pace a reader can keep reading accurately (Babbin, 2021). This identification can identify children with dyslexia as young as three.

Identifying if a literate learner has signs of dyslexia is important in early education so educators can pay attention to them and offer support when needed.

Therefore, identification is used to find at-risk students who struggle to learn. For example, most schools use Multi-tiered Systems of Support (MTSS) to identify if a student may possibly have dyslexia before offering early interventions. The MTSS is a comprehensive framework that is designed to support all students in their learning. The Multi-tiered Systems of Support (MTSS) identified students to three levels of severity — tier 1 to tier 3. Students in tier 1 is the last severity and can be offered the basic core instruction to teach. Students in tier 2 are offered targeted interventions that are more strategic support. Last group of students in tier 3 are given intensive support that is specific for their needs (India King, 2018).

The Woodcock Johnson assessment is used to diagnose Dyslexia. The assessment is a one on one test offered by a licensed educational psychologist. The tester gives points based on observing the testee's reading behaviors. For example, the tester asks the testee to read a paragraph aloud for checking his reading fluency and eye movement patterns.

The assessment from Woodcock Johnson:

Section 1 (2–2.5 hours)

Cognitive skill

Tester tells the testee a story and asks questions to determine the testee's comprehension.

Memory

Tester says a string of numbers or objects and then asks the testee to answer what numbers/objects in which place.

Processing speed

Testee is asked to circle the different patterns on the paper. Tester will give points on how many the testee circled. It may lose points on missed patterns.

Section 2 (2–2.5 hours)

Test of achievement

Reading fluency

Testee asked to read sentences out loud to show whether the reading is fluent or not.

Read

Testee is asked to read paragraphs and explain what they mean. Therefore it allows the tester to observe the testee's reading behavior based on the eye movement and reading comprehension.

2.4.5 Current Treatments of Dyslexia in English

Since there is no specific way to treat dyslexia, some methods have been suggested to achieve the purpose of improving reading abilities such as offering early interventions, remedial instructions and multisensory teaching. Early interventions are generally considered to be a formal process to help struggling students and are used to implement research-based teaching methods for specific skills deficits and to track progress on a regular basis. Remedial instructions means reteach. Remedial instructions introduce different methods or forms to deliver the same concept for helping learners who are struggling to understand the concept (Michell, 2020). Multisensory teaching engages all five senses to help learners build a strong connection between objects and texts. It is important to strengthen the reading skills during the learning process. As long as early intervention and special instructions for children with dyslexia can be offered in a timely manner, most children with dyslexia can reach the same reading level as their peers. If parents pay attention to children when they are young, it may prevent the problem from growing into reading failure in the future. Researchers have shown that

early intervention and remedial instructions can improve the abilities to read efficiently. According to researchers, Wilson and Daviss, 75% of students who completed the full 12- to 20-week intervention reach a fairly high level in reading and writing (Wilson and Daviss, 1994).

2.5 Dyslexia in Mandarin Chinese

2.5.1 Current Situation of Dyslexia in Mandarin Chinese

Even though dyslexia is not commonly known by the public in Taiwan, there are more and more people gaining awareness of dyslexia. The increase in confirmed cases indicates that more people are getting identified. According to statistics from Taiwan in 2018, the number of students with learning disabilities reached 26,263 students, and at least 85% to 90% of the number are children with dyslexia. Even though the number is twice more than in 2017, accounted for 0.11%, the percentage showed a wide gap between researchers', Stevenson et al., test result of 7.5%. Therefore, the condition showed the low rate of identification in Taiwan (陳珮雯, 2018).

2.5.2 Signs of Dyslexia in Mandarin Chinese

There are common signs that can be seen when a literate learner learns to read.

- Writing: Learners struggle with the shape and the sound of characters.
- Reading: Learners are less likely to use semantic, grammatical and semantic clues.
- Decoding speed: Learners' decoding speed is slower in recognizing single words, and the recognition of words' sounds is challenging.
- The level of understanding of different text structures is lower than the peers.

- Learners lack the ability to integrate contextual clues, prior knowledge and analysis the structure of the article.
- Learners tend to pronounce the sound of reading rather than understand and read silently.

(王瓊珠, 1992)

2.5.3 Dyslexia Symptoms in Mandarin Chinese

Some common symptoms can also be seen in people of Chinese dyslexia.

- The reading speed is slow because dyslexics take longer time in analyzing words.
- Learners struggle with reading content rather than hearing content.
- learners have difficulty in recalling known words.
- Learners are difficult to understand or remember new words.
- When learners read the text aloud, it is easy to make mistakes.
- Learners have difficulty in writing.
- Learners may encounter difficulties in calculation.

(王瓊珠, 1992)

2.5.4 Identification and Assessment of Dyslexia in Mandarin Chinese

In Taiwan, there is no standard test to identify students with dyslexia, however, there are some suggested checklists for screeners to identify those struggling students. It is important for screeners to see the signs and take steps to identify those students and offer further support.

One example of assessments that used to assess Chinese dyslexia in Taiwan. The learning performance in the following four dimensions is evaluated:

1. Attention and memory: evaluate the clinical manifestations of attention and memory, including attention operation, sensory attention, sensory memory, memory, etc.
2. Comprehension and expression: evaluate cognitive courses and problems that affect interpersonal interaction, including reading comprehension, math learning, auditory comprehension, written expression, oral expression, etc.
3. Coordination of knowledge and movement: evaluate the perception process and movement control problems, including visual perception, visual-spatial-motion integration, body intention and spatial orientation, etc.
4. Social adaptation: assessing interpersonal interaction, social skills, life adaptation, emotional processing issues.

(王瓊珠, 2001)

2.5.5 Current Treatments for Dyslexia in Mandarin Chinese

In Taiwan, there are no concentrated treatments for dyslexia. In the education system, the diagnosis and treatment of students with dyslexia is focused on kindergarten and elementary school students. Even though junior high schools have set special education classrooms for students with dyslexia, it still does not use consistent instructions for teaching those students. There are many different treatment methods to help students with dyslexia in Taiwan, however, offering early interventions is considered the impactful way to prevent the problem getting serious. The main focus for helping people with dyslexia is on one-on-one teaching and patience with students. In addition to offering the teaching aid, enhancing students' hope, building self-esteem and

teaching dyslexics to find out their own strengths is also the goal of current treatments (葉純菁, 2018).

Here are some suggested methods to moderate dyslexia symptoms:

- Support students with multi-scenery teaching such as using hands to write on sand or listening to audio while reading.
- Offering tools such as rulers that can help to prevent skipping lines, larger squared books that are easier to practice writing, and computers that can type in texts.
- Using strategies to enhance reading comprehension such as chopping long paragraph reading into small pieces and asking questions after reading every piece.
- Using games to practice learning languages. For example, play word solitaire, encourage literate learners to talk more and pick their main points.
- Develop a good habit for following and tracking their learning progress.

(李宜蓁, 2011)

2.6 Comparing Dyslexia in English and Mandarin Chinese

2.6.1 Dyslexia's Commonalities in English and Mandarin Chinese

From above readings, we can conclude that dyslexia is a learning difficulty that is neurological and happens across all languages. Most of the research indicates that dyslexia is mainly caused by phonological impairment, a reading skill to manipulate sounds of language, which leads to difficulties in text-related learning. The deficit causes continuous reading difficulties to dyslexics. Even though Mandarin Chinese and English language have different language structures, both Chinese and English reading requires

the process of phonetic decoding. Here are some commonalities of dyslexia in the two languages:

1. No big difference in incidence — Researchers, Stevenson et al. used standardized dyslexia tests to test the incidence of dyslexia in Taiwan and the United States. The result showed that the incidence rates in Taiwan and the United States were 7.5% and 6.3%, and there was no significant difference (Stevenson et al., 1982).
2. No big differences in language processing — Even though the human language developed different forms in different cultural backgrounds, the way the human brain processes languages has not much difference. For multilingual learners, the brain builds a more complicated network in processing different languages, and it needs to switch between languages. When the same concept is mapped to different languages, confusion arises. Take Apple as an example. In English the word “apple” is written as apple, and the word in Chinese is written as 蘋果. Even though the writing symbols are different, the two languages want to express the same concept of an object. In bilingual learners, when the idea “apple” appears, two different written symbols are linked with the concept in their brains. If they want to express the idea in one language, their brain must pick one connection and export it. If they want to export a sentence, every word in the sentence needs to switch to one chosen language. When the switch time takes too long, it will export a mixture of Chinese and English sentences because how the concepts are connected to written symbols are different. The written symbols appear first when they are connected stronger than the others. It is believed that the switch time can be improved by practice. For example, if a bilingual learner practices English

more, the English symbols connected to concepts in the brain will be better than the other languages in that he will extract English symbols faster than the other language (Chou, 2012).

2.6.2 Conclusion

Although the human brain does not show much difference in processing different languages, the difficulty of language learning is different due to the characteristics and cultural backgrounds of forming languages are not the same. For example, the orthography of a language is transparent or opaque as well as phonetic language that focus on pronunciation or logographic language that requires to focus on image processing are factors that directly affect the literate learner to learning language. These factors especially impact people with dyslexia. Therefore, the relationship between languages and dyslexia must be researched separately in order to better understand the causes and the possible treatment of dyslexia in different languages.

III. DESIGN POSSIBILITIES

3.1 Designer's Influence

Designers are like magicians that use different tricks to present their performance. Designers learn to use different methods to present their ideas such as using images and colors. The purpose of communication design is to communicate in various ways. The expression can be humorous or thrilling and vigilant. In addition to using words to explain the meaning, the design can integrate various sensory methods to create the atmosphere that you want to express. Multi-sensory teaching is commonly used to help people with dyslexia learn better. Dr. Samuel Orton, an American physician who specializes in the study of dyslexia, suggested using multisensory teaching to improve reading ability for children. Through the multi-sensory way of hearing, sight, smell, touch, and taste, it may be possible to strengthen the connection between objects and text to build a more consolidated brain network system. Studies have pointed out that most people with dyslexia are more sensitive to the ability of visual image processing. Therefore, in learning text reading, you can also accompany the description of the picture to strengthen the understanding of the meaning.

3.2 Design Purpose

Language is the most effective way of communicating and acquiring knowledge in the current society. Therefore, people with dyslexia have a particularly hard learning path when growing up. When their pace of learning cannot keep up with their peers, these frustrations in learning greatly increase. The problems also bring a huge negative psychological impact on the learners. People's self-confidence becomes low after facing great frustration. Like a snowball, the effect of dyslexia affects a person's physical and

mental health and brings social problems. Therefore, how to help people with dyslexia get out of difficulties and rebuild their self-confidence is particularly important.

The purpose of this research is to design a project that is used to empower people with dyslexia, to bring awareness to the public and also to enhance awareness of the signs and symptoms. The project includes identity design that is used to offer information on dyslexia, a character design that empathizes and comforts people with dyslexia, and a series of book designs that present dyslexia symptoms to bring awareness of this issue to the public. Through the book series design, it aims to help readers understand and be aware of dyslexia signs and symptoms as well as guide people where to seek support.

3.3 Design Methods That Are Used to Help People with Dyslexia

The British Dyslexia Association (2018), suggests rules in text that can apply to design to help dyslexics read easier in their Dyslexia friendly style guide. When editors such as designers and educators are designing digital or print publications, readability should be one of the main considerations to help readers get the content easily. The length of the reading paragraph, leading of the text, and font style affect how readers move their eyes to track the texts and get the meaning. Font choice for people with dyslexia is even more important. If the choice of the font does not have good readability, it negatively affects the reading comprehension of people with dyslexia. Therefore, the British Dyslexia Association has formulated and has published a set of research based font design and choices guidelines annually for improving readability in digital and printed publications for helping people with dyslexia. According to the guidelines of the British Dyslexia Society, the following features help reduce text confusion and improve the readability.

Fonts

- Font type: San-serif fonts such as Arial, Verdana and Tahoma are identified to be easy to read.
- Font size between 12-14 point is recommended.
- Avoid using underlined and italic fonts because they are not easy to read.

(The British Dyslexia Association, 2018)

Headings

- It is recommended that using a 20% larger size font of the body texts is better than using underlined texts to make a better hierarchy.

(The British Dyslexia Association, 2018)

Page Layout

- Left align texts and do not use justification on the texts to avoid causing rivers that may make the reading choppy.
- Avoid using too many colons like newspapers.
- 60–70 characters in one line is appropriate.
- Separate the text with headings in long documents and include a table of contents.

(The British Dyslexia Association, 2018)

Color Schemes

- Use pure color background instead of patterns to avoid distracting readers. It is reported that a white background may be too dazzling to read, so a softer color like cream would be a good choice.

(The British Dyslexia Association, 2018)

Writing styles

- It is harder for dyslexics to read long sentences. Therefore, using short paragraphs and adding imagery helps them to understand more easily.
- Bullet points also help to create a clear hierarchy.
- Avoid jargon and using abbreviations to increase the reading fluency.

(The British Dyslexia Association, 2018)

There are also some methods that use visual elements such as icons to achieve better communication goals. In a case study by Kent State University School of Visual Communication Design group members, the leader, Justin Ahrens, showed how visual communication tools help with delivering information by using a poster design. The purpose of the design project is to improve the existing visual solutions by designing a new set of visual communication tools to convey simple ideas. The tool simplifies complex contents and texts and uses simple and direct visual systems to enhance people's awareness of malaria in Kibera and to form their health-seeking habits (Ahrens, 2013).



Figure 13. Image of Healthcare Communication Tools (Ahrens et al., 2013)

3.4 Design Brief

Objective:

The project is based on the research of the commonalities of dyslexia symptoms in English and Mandarin Chinese to create a series of illustration books to present dyslexia symptoms. The project contains three parts that includes brand identity design, character design, and book series design.

1. Identity design:

The brains of people with dyslexia are wired differently which cause difficulties when processing language. The word “dyslexia” can be separated into two parts: dys and lexis. The word comes from Greek roots, dys means bad and lexis means word or speech

(Borrer, 1971). The brand name, differlexia, tries to express that people with dyslexia are dealing with text differently in their brain. The letterforms are all written in lowercase because it is easier for people with dyslexia to read. The primary colors, gray and yellow, are used to present the contrast of depression and hope.

2. Character design:

A character is designed to simulate people with dyslexia. The character and characteristics reflect the feelings of people with dyslexia to sympathize with them.

3. Book series design:

The book series has seven books and describes seven dyslexia symptoms in each book. By using image descriptions to present the power of image communication. The book uses side-by-side comparison to present how people and people dyslexia show different reading patterns. The goal is to bring the awareness to the readers. For example, when readers feel he seems have the similar reading pattern with the character, they will be lead to find out more information about why this may happen.

Design Methods:

Mind Mapping: Mind Mapping has been used as an important aid to push design thinking. It is a way to extend and generate more ideas of the main concept.

Empathy Map: An empathy map is used to gain deeper insights of the target users. The map simulates the target users' feelings by thinking in their angle. For instance, thinking about what the users may say, think, do and feel to put ourselves in the users' shoes. The project started with creating empathy maps of the common seven types of dyslexia symptoms— reading, writing, spelling, listening, spatial, memory and motor issues.

Character Design: Character design refers to that designing the appearance, personality, facial expression, and other settings of characters in a story.

Design Guidelines:

Target audience: general public who does not know much about dyslexia.

Illustration style: use hand drawing style to express the human touch feelings.

Color palette: Using soft colors to bring the comfortable and relax feeling to the readers.

Typeface choice: Using Sans-serif font that is more friendly to people with dyslexia.

Book design shapes: The book series is designed in hexagon shapes for presenting how dyslexia symptoms are close and related to each other. The Book series design contains of seven books. The seven books are based on the seven aspects of symptoms of dyslexia. Each book includes illustrations of the symptoms. The book binding bind on different sides of each book to present how people with dyslexia are not following the typically reading way.

1. Identity Design

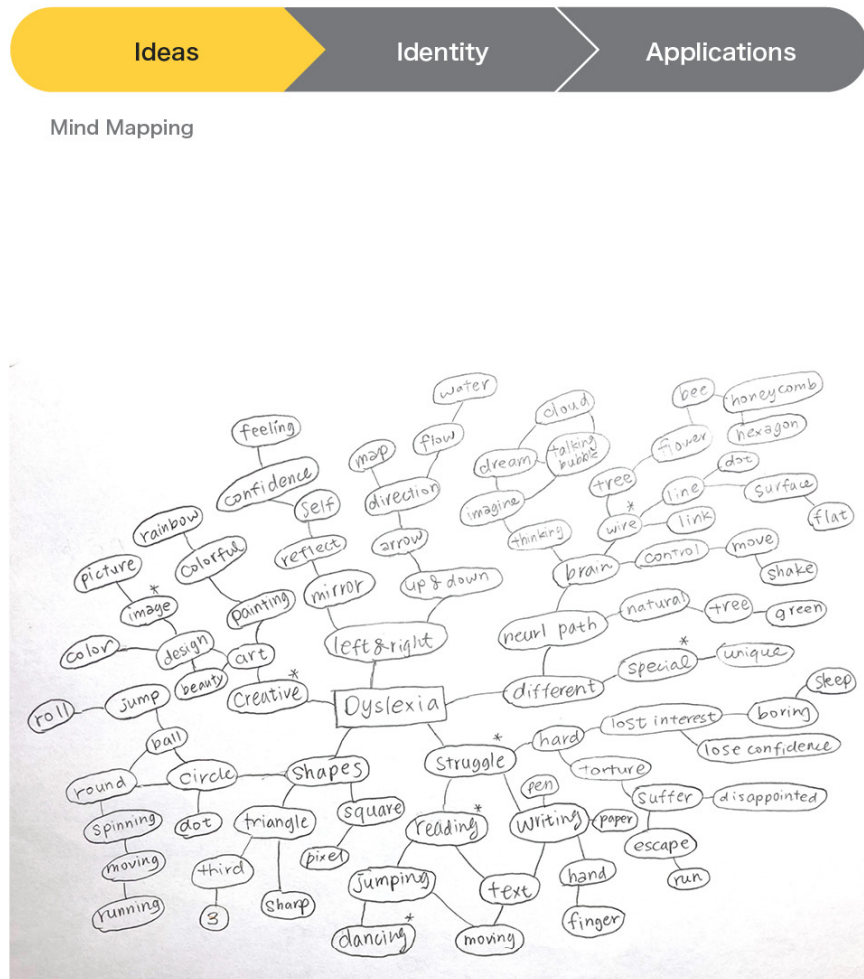


Illustration 1a. Brand Idea Mind Mapping

Mind Mapping



Illustration 1b. differlexia Logo Hand Sketches

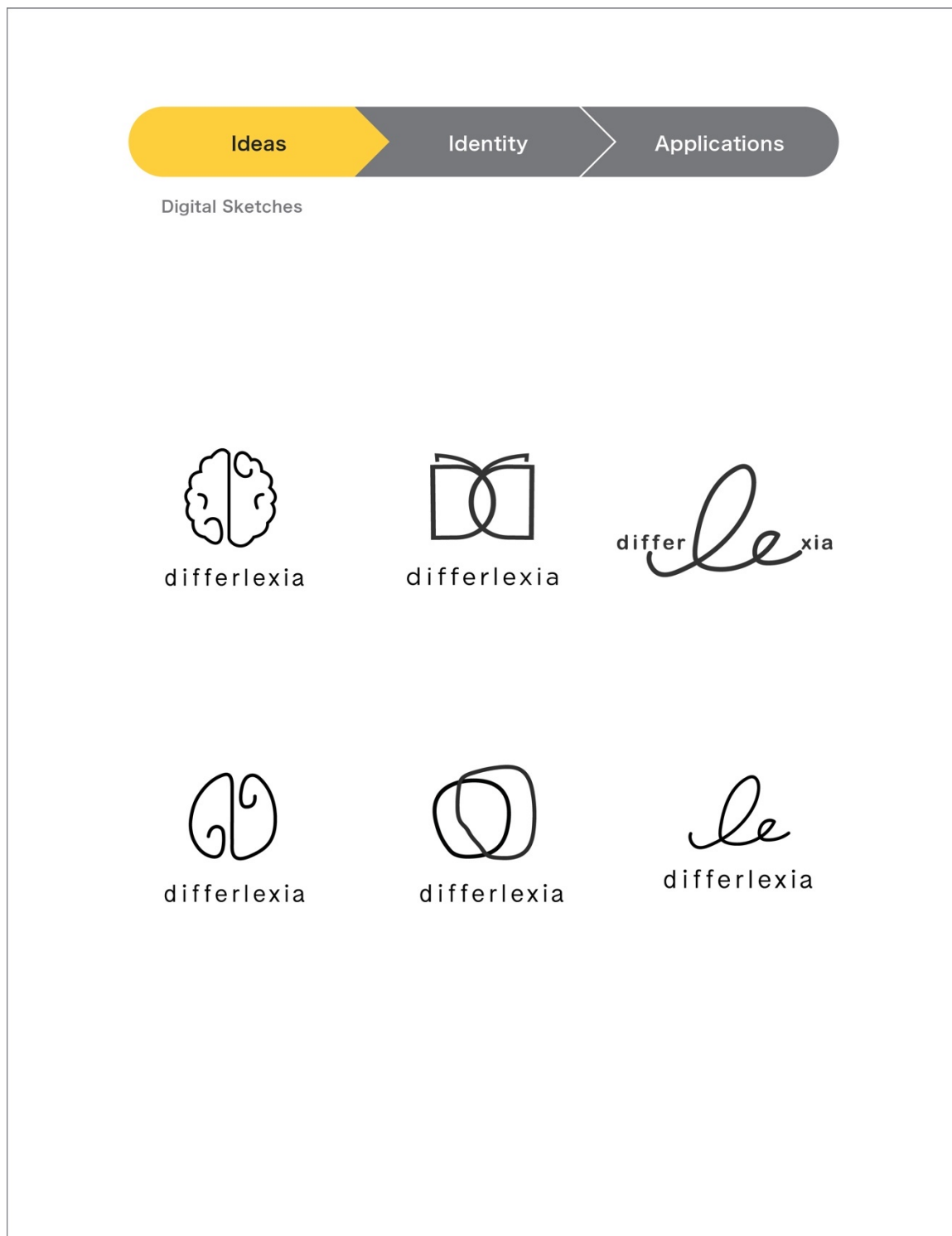


Illustration 1c. differlexia Logo Digital Sketches

Ideas

Identity

Applications

Logo Standardization

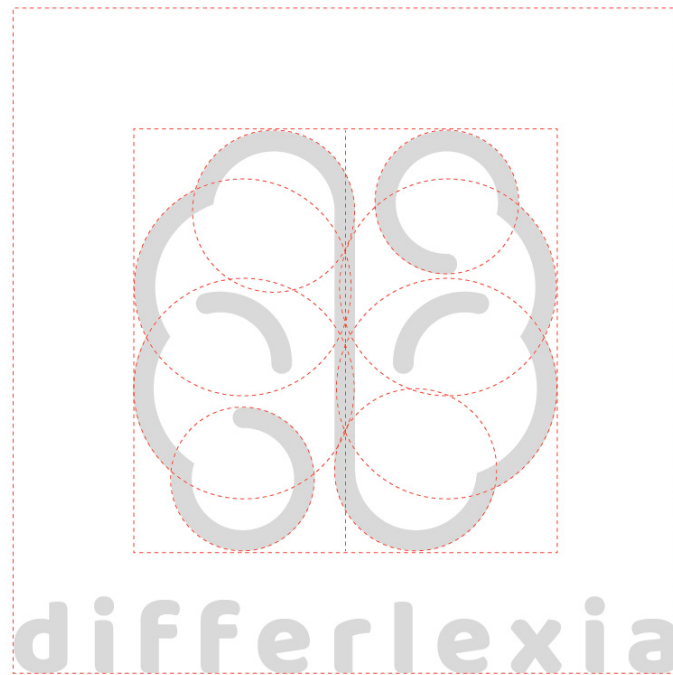
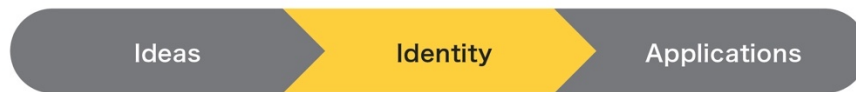


Illustration 1d. differlexia Logo Standardization



Final Outcome

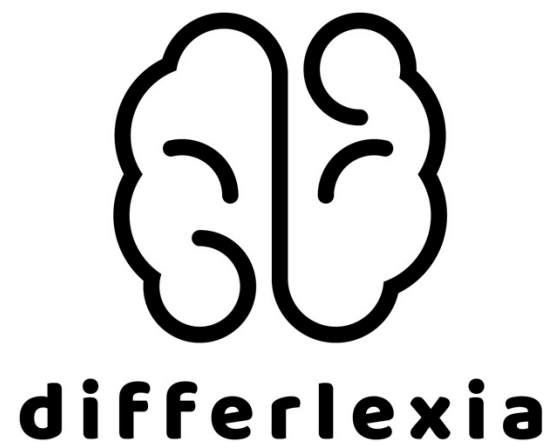
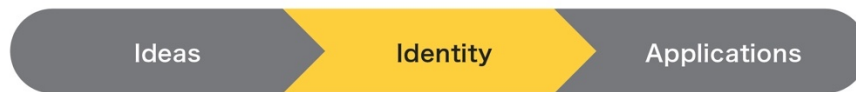
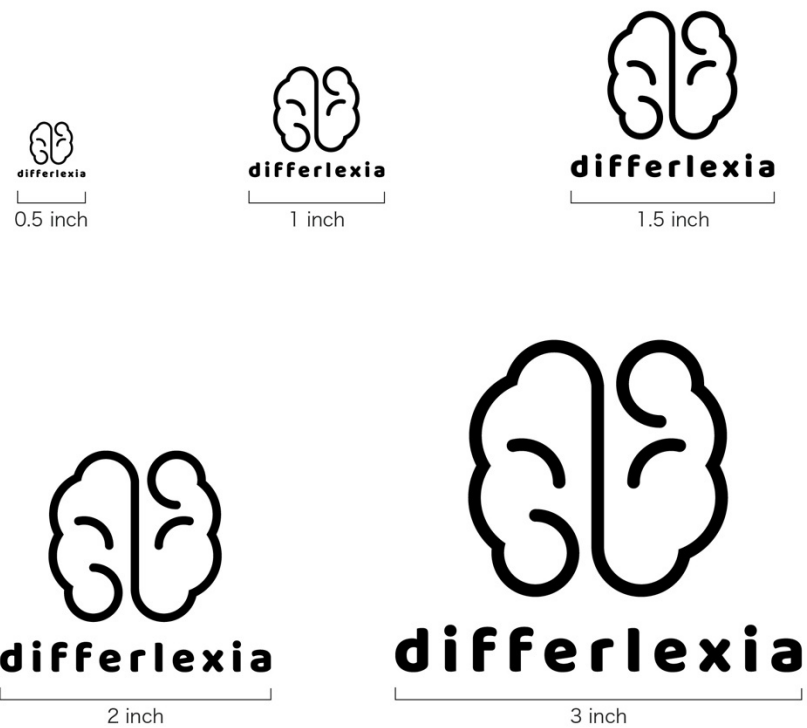


Illustration 1e. differlexia Logo Final Outcome

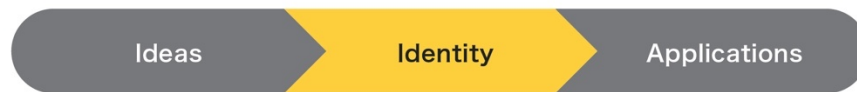


Scales



Width smaller than 0.5 inch is not allowed

Illustration 1f. differlexia Logo Scales



Color Palette

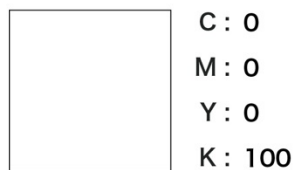


Illustration 1g. differlexia Logo Color Palette

Ideas

Identity

Applications

Typefaces

Baloo Bhai
Regular

A B C D E F G H I J K L M
N O P Q R S T U V W X Y Z
a b c d e f g h i j k l m
n o p q r s t u v w x y z
! @ # \$ % ^ & * () + - ?
1 2 3 4 5 6 7 8 9 0

Hiragino Sans CNS
W6

A B C D E F G H I J K L M
N O P Q R S T U V W X Y Z
a b c d e f g h i j k l m
n o p q r s t u v w x y z
! @ # \$ % ^ & * () + - ?
1 2 3 4 5 6 7 8 9 0

Hiragino Sans CNS
W3

A B C D E F G H I J K L M
N O P Q R S T U V W X Y Z
a b c d e f g h i j k l m
n o p q r s t u v w x y z
! @ # \$ % ^ & * () + - ?
1 2 3 4 5 6 7 8 9 0

Illustration 1h. differlexia Typeface Choices

Ideas

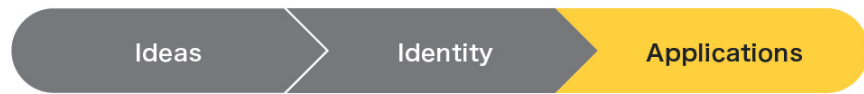
Identity

Applications

Logo Combinations



Illustration 1i. differlexia Logo Combinations



Postcard



Illustration 1j. differlexia Identity Applications – Postcard



Webpage

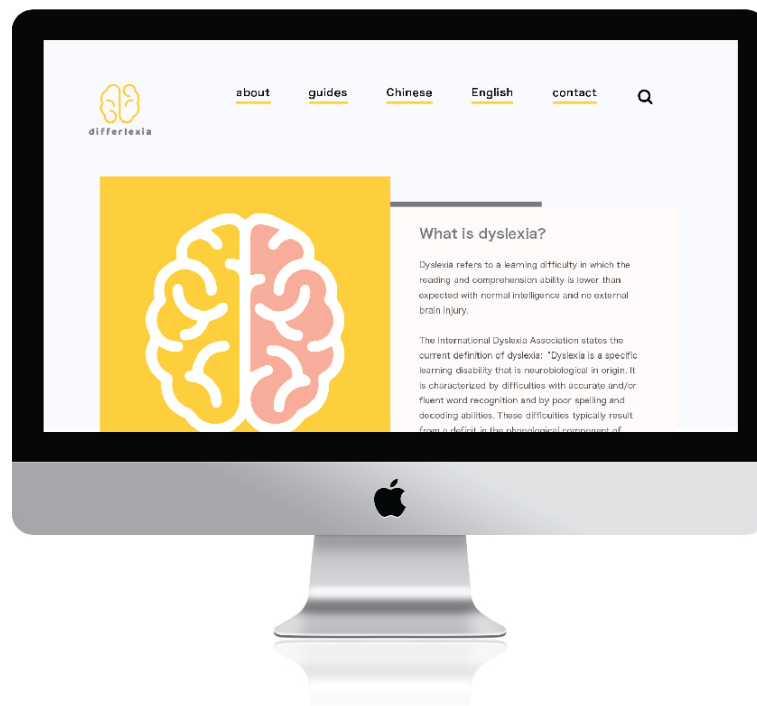


Illustration 1k. differlexia Identity Applications – Webpages

Ideas

Identity

Applications

Mug



Illustration 11. differlexia Identity Applications – Mug

2. Character Design

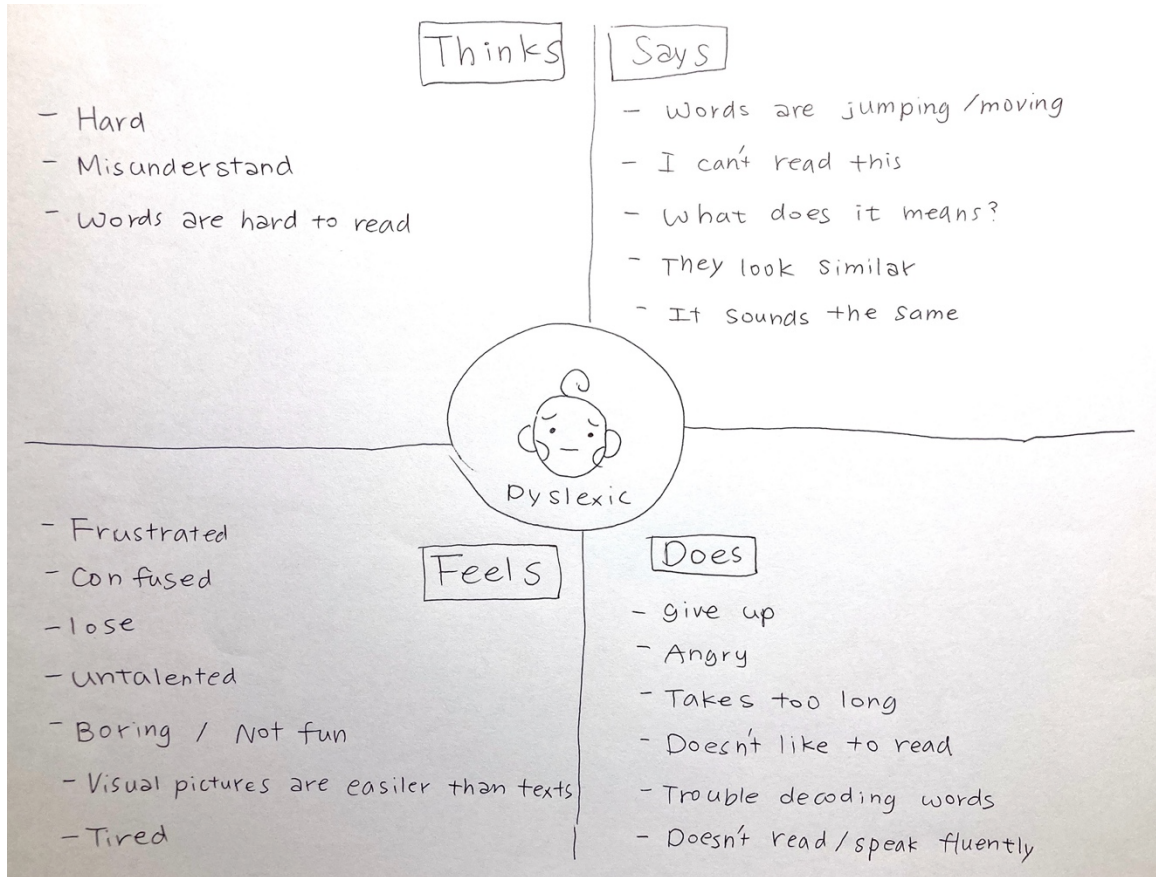


Illustration 2a. Empathy Map of The Character

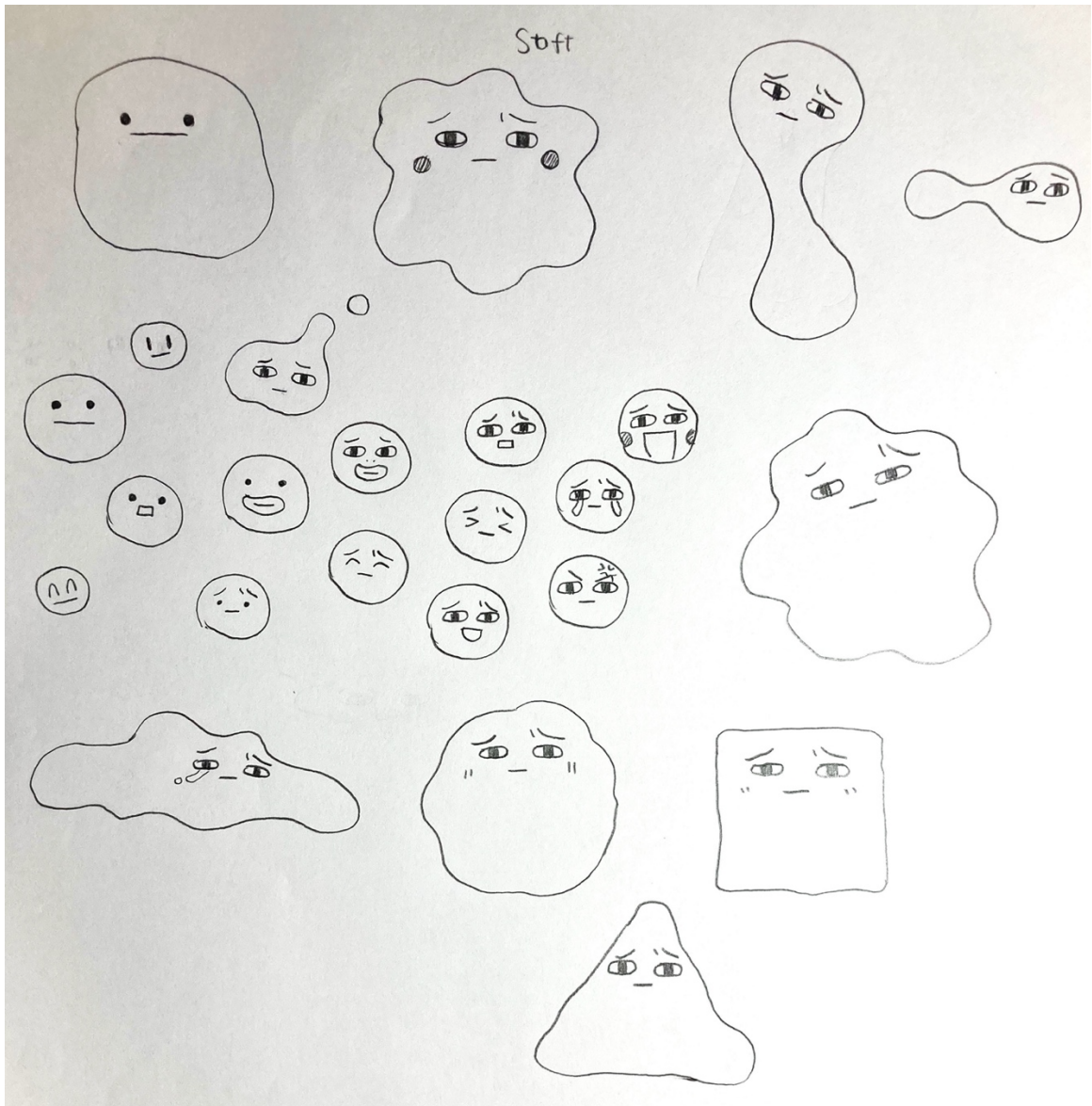


Illustration 2b. Character Hand Sketches Ideas

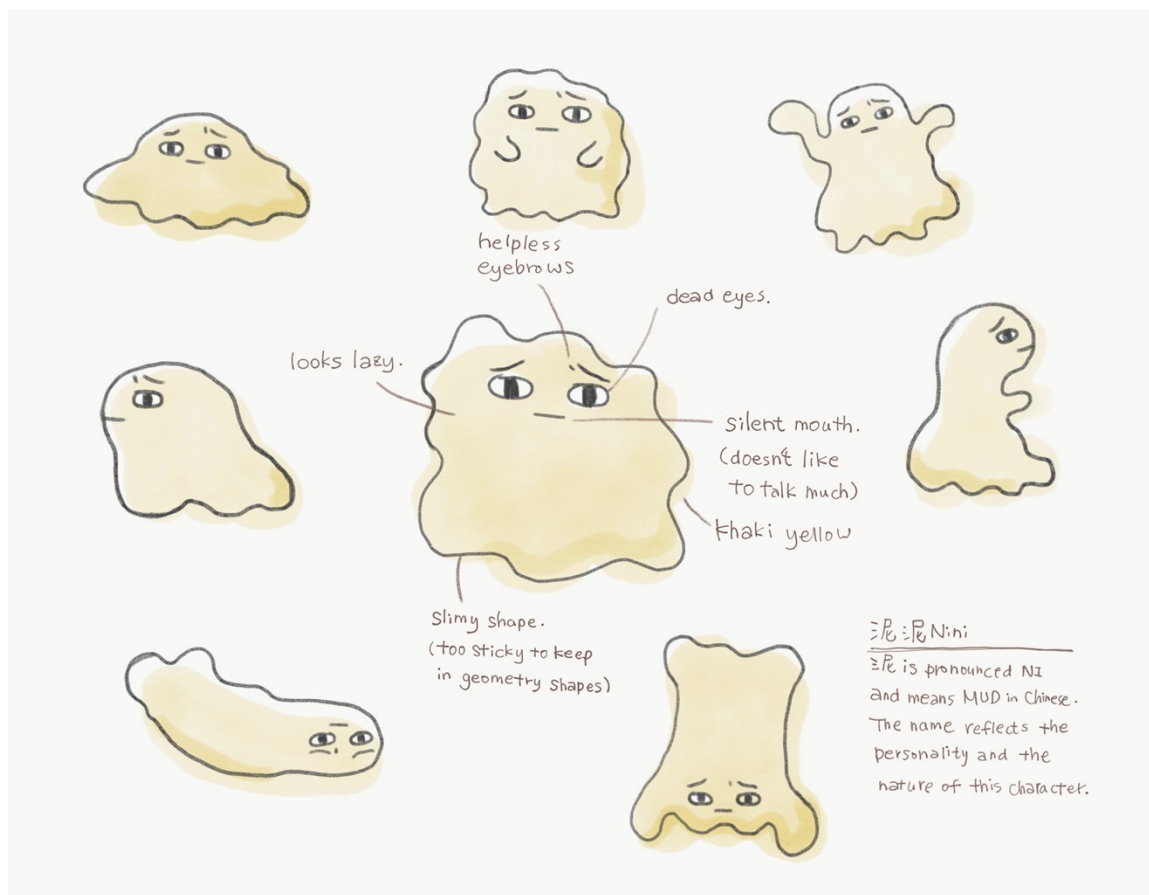


Illustration 2c. Character Settings

泥泥生活

life of Nini



Illustration 2d. Character's Background Story 1

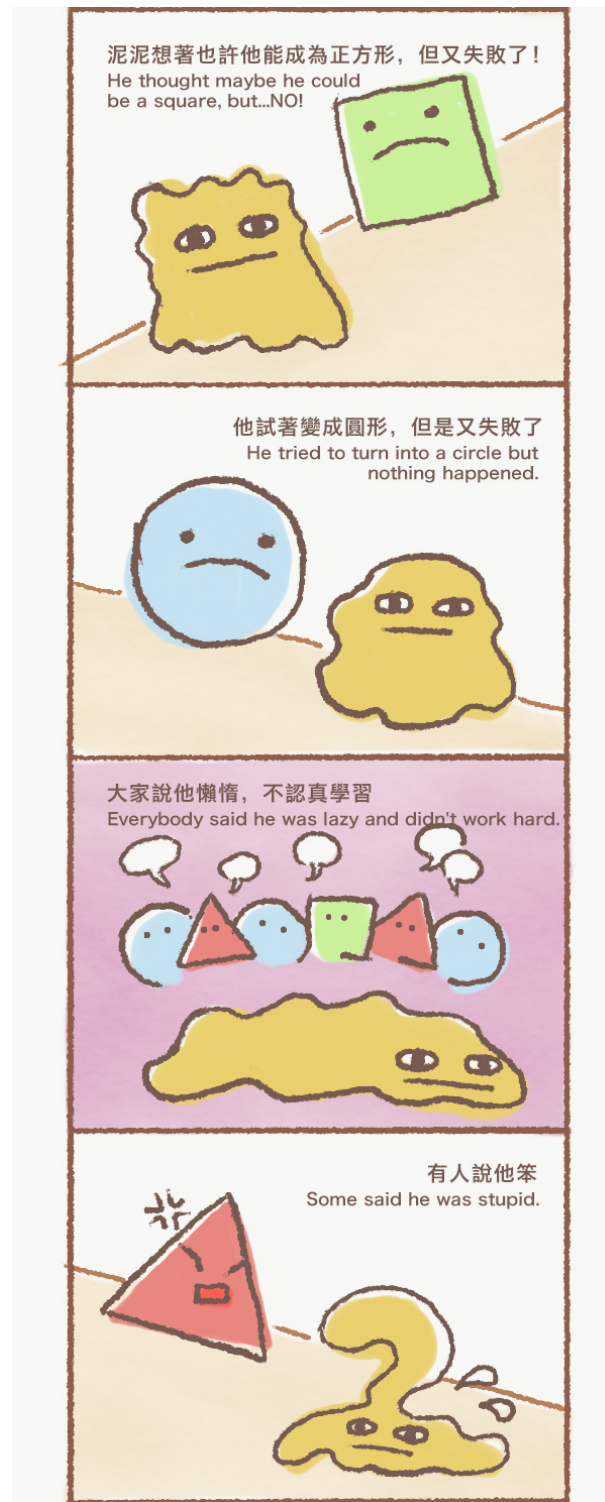


Illustration 2e. Character's Background Story 2



Illustration 2f. Character's Background Story 3

3. Book Series Design

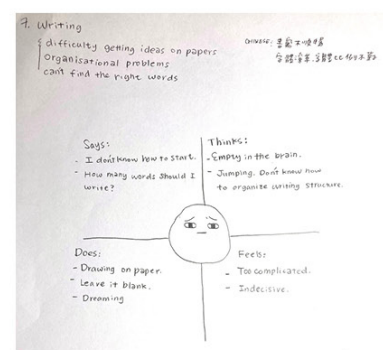
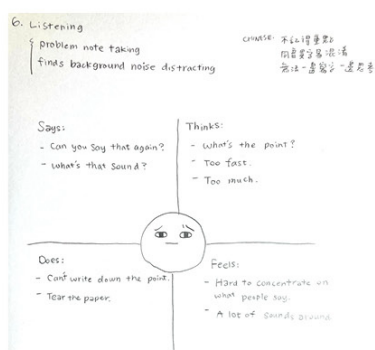
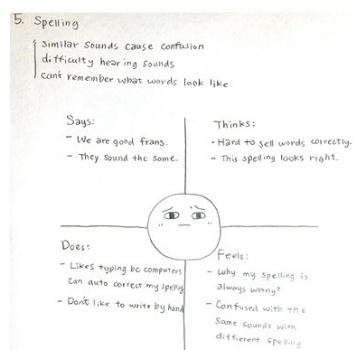
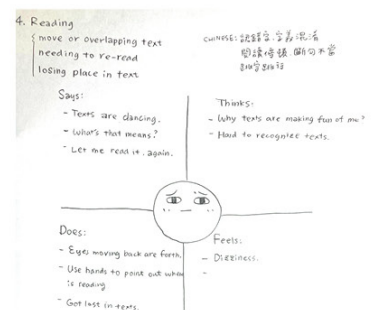
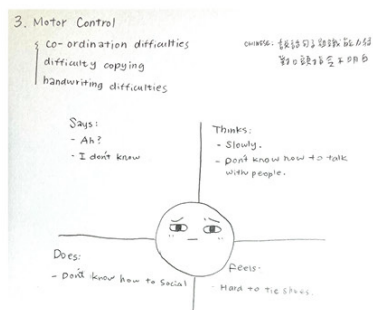
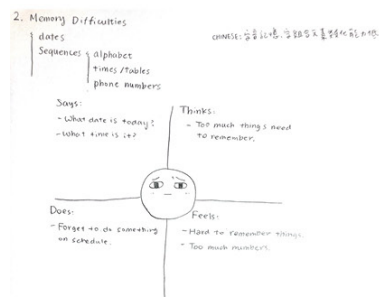
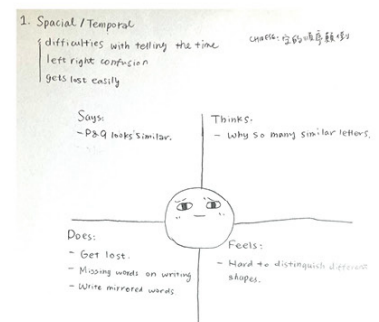
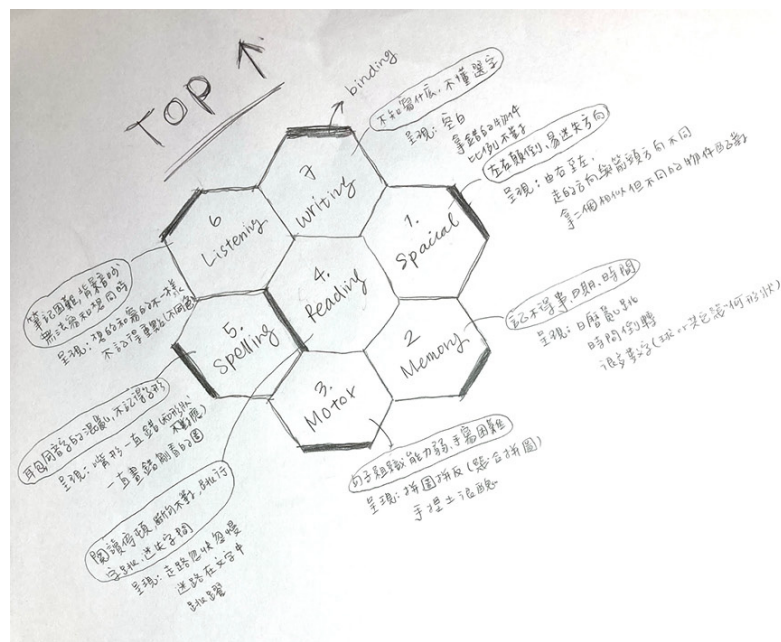


Illustration 3a. Book Design Sketches + Empathy Maps



Illustration 3b. Book Series Showcase



Illustration 3c. Book Cover Design



Illustration 3d. Book Intro Page + Title Page

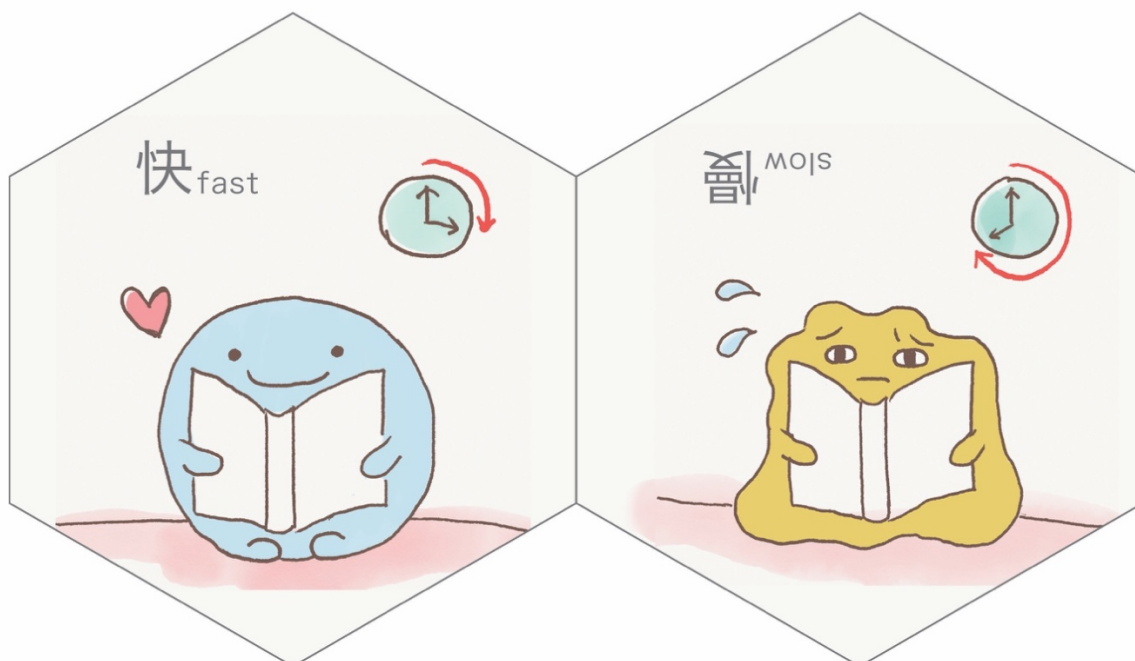


Illustration 3e. Book Interior Design – Reading Speed

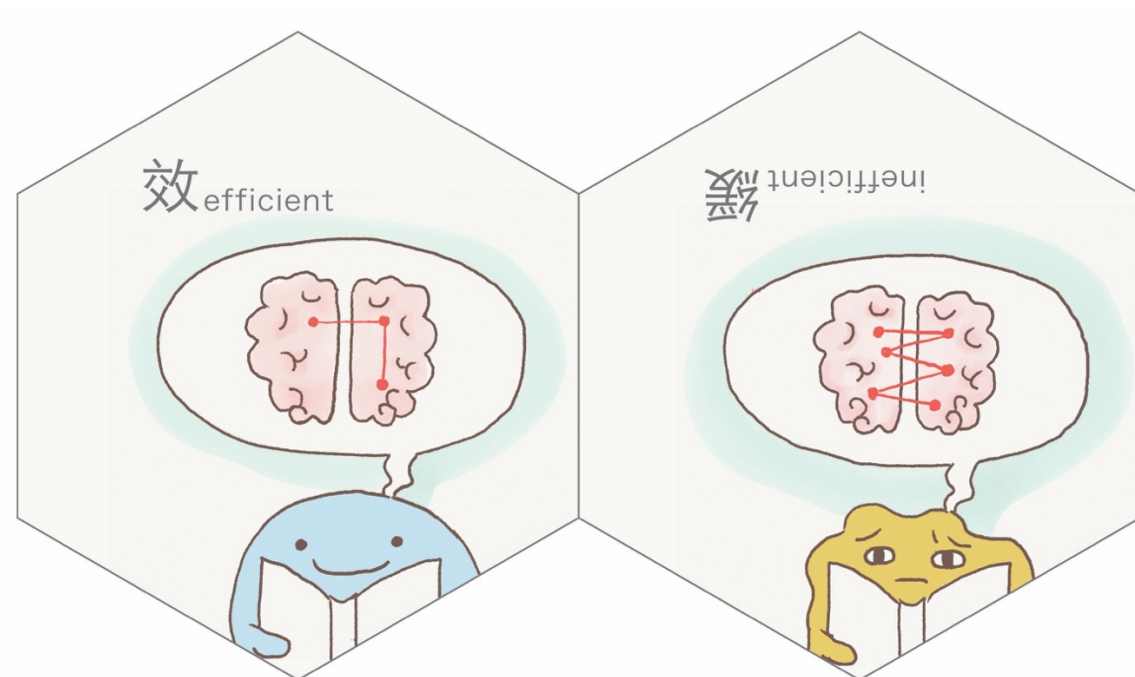


Illustration 3f. Book Interior Design – Reading Efficiency

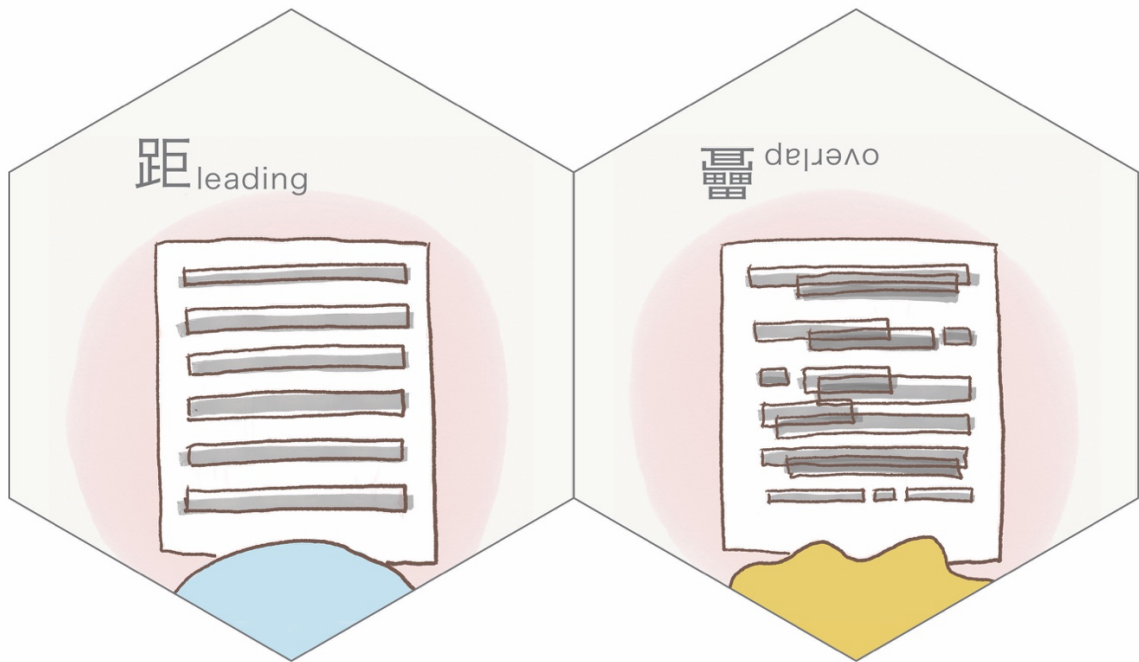


Illustration 3g. Book Interior Design – Reading Paragraphs

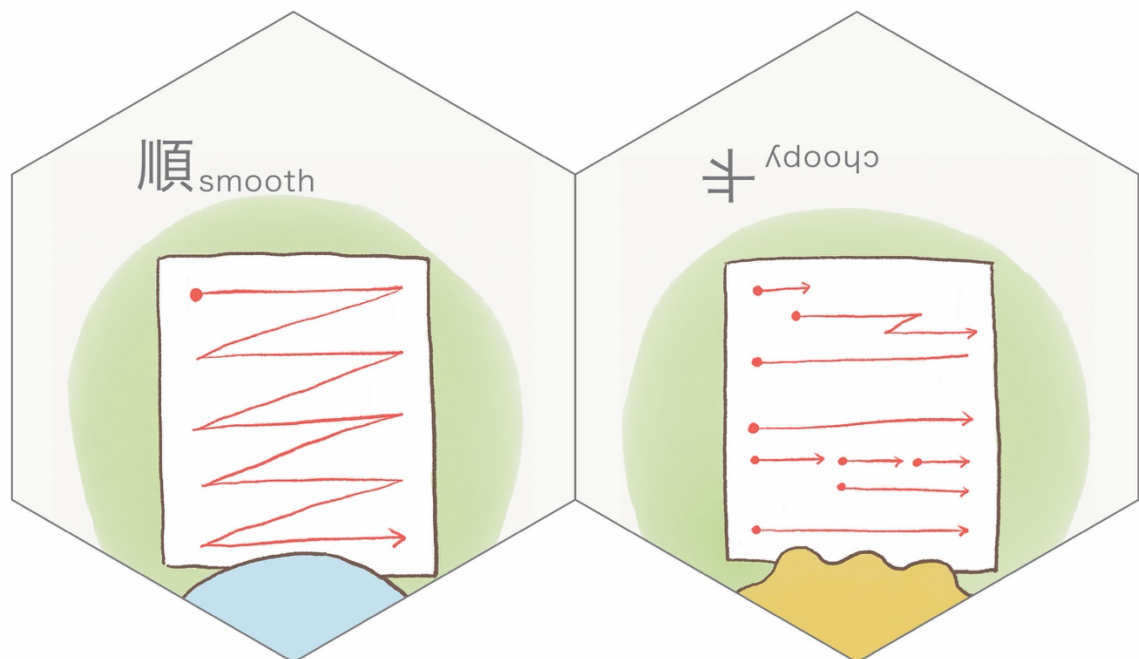


Illustration 3h. Book Interior Design – Reading Eye Flow

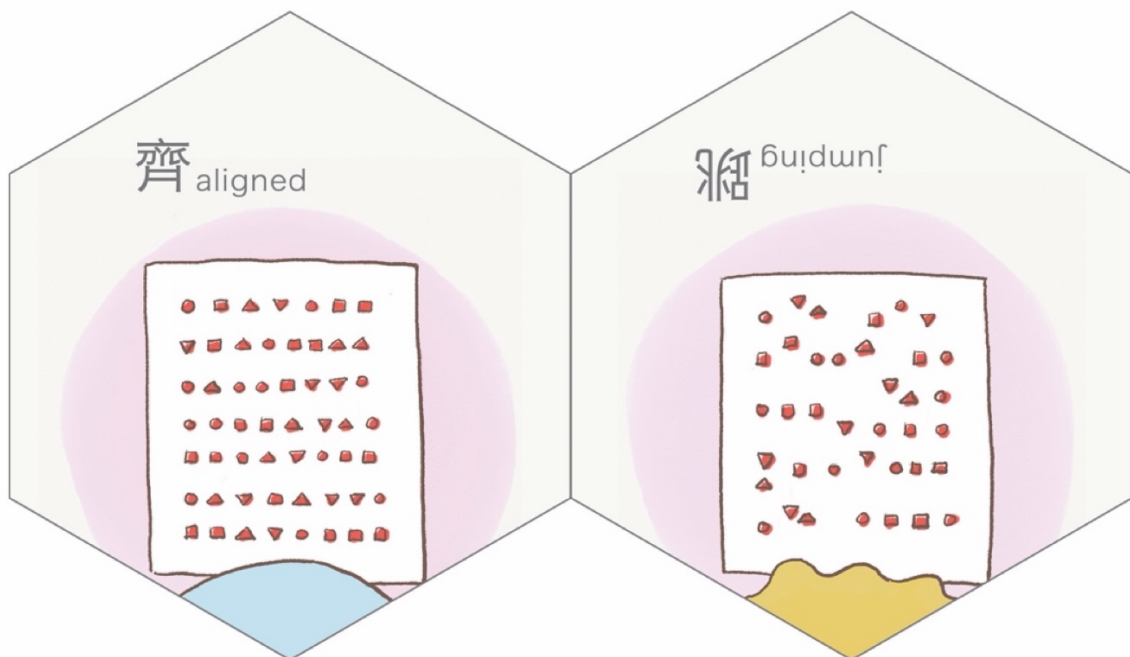


Illustration 3i. Book Interior Design – Reading Texts



Illustration 3j. Book Ending Page + Information

3.6 Conclusion

The world today is becoming more tolerant, and the acceptance of possibilities that are different from others is also increasing. People should learn to understand and support more people who are different from themselves. People with dyslexia are different from others in the way they process writing language systems. This does not mean that they are sick or inferior to others. Since written language is used by humans as one of the most effective forms of communication that ignores the feelings of people who have difficulty processing language. Therefore, learning to understand and tolerate people with dyslexia and provide support should be a goal of the world.

When people think of the difference between Chinese and English writing forms, people would think that Chinese characters do not seem to cause dyslexia because it is a logographic language that presents texts based on symbols. However, this is not true. The human brain has roughly the same steps in processing any language. Reading in Chinese also involves phonological processing that is identified as a key process in reading English. Researchers suggest that Dyslexia has almost the same rate in different languages. People with dyslexia who are learning Chinese are likely to be ignored due to the lack of awareness of the public in Taiwan. As a result, dyslexics may not be able to receive support at the stage that is important to build their reading ability. People with dyslexia who learn more than one language are more likely to be ignored because they are considered to be struggling with learning a second language.

IV. FUTURE RESEARCH & EXPANSIONS

4.1 Future Design and Expansions

1. *Test prototype*

The one book shown above will be tested and ask for feedback on how it works.

4. *Expansion on the book series*

Based on the feedback gathered from the first prototype, the other books will be designed and will address the feedback.

5. *Expansion on website*

A website about dyslexia in English and Mandarin Chinese for offering research resources will be created.

6. *Expansion on printed publication*

A manual guide book and printed poster based on research findings are expected to be designed for bring awareness to the public.

7. *Expansion on the brand side products*

The character design will be used as a mascot for the brand. The role of the character is a visual spokesperson, a representative of the image of people with dyslexia. It not only helps to communicate with the public in a visual and friendly way but also to spared the knowledge.

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