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Study on the Processing of Modern Chinese Proverbs in High-Functioning Autism Spectrum Disorder Children

高功能自閉症學童對現代華語諺語處理之研究

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摘要

本研究旨在瞭解高功能自閉症學童與一般典型發展學童在現代華語諺語理解之差異，由於自閉症學童在非字面意義的語言理解較有侷限性，所以本研究特別針對現代華語諺語語句作為實驗材料來測試。研究對象為 6 名國小三至六年級之高功能自閉症學童，與 6 名同年級之典型發展學童。研究參與者在隱喻諺語故事測驗，會進行畢保德測驗以及錯誤信念測驗，以事先了解學童的語言能力和自己或與事情有不同的信念之理解能力。本研究的主要實驗為隱喻諺語故事測驗，一共有二十四組材料，每一組約 150 字內的短篇貼近日常生活故事，每一個故事的最後一個語句為諺語或隱喻。這些諺語或隱喻語句分為三個類別：以人為主詞的隱喻語句、以動物為主詞的隱喻語句、生活化的隱喻語句。例如：「熱鍋上的螞蟻」為動物類語句，是指一個人很緊張或者很焦慮的狀態，而非是螞蟻真的在熱鍋上爬。故事結束後會有一個跟隱喻相關的理解問題，會提供三張圖片讓學童選擇，一個圖片是字面意義之語詞、一個圖片是隱喻相關語詞、最後一個圖片是不相關語詞。學童所選擇的答案顯示他是否理解故事和諺語隱喻語句內容。

實驗結果顯示，在畢保德測驗中，一般典型發展學童語言程度高於高功能自閉症學童。其中，高功能自閉症學童在處理感官情緒認知之概念錯誤率高。在錯誤信念測驗結果中，高功能自閉症組在初級和次級錯誤信念測驗中的整體上與一般發展學童組相比稍低，可能與語言發展未成熟相關。諺語故事測驗結果顯示，一般典型發展組學童在語言理解能力上優於高功能自閉症組學童，分別達 90.65%和 75.45%的正確率。進一步細分諺語主詞為人和動物的隱喻，一般典型發展學童相對優於高功能自閉症學童，特別是在動物主詞方面，差距高達 25%。然而，在生活化隱喻方面，兩組學童表現相對一致。高功能自閉症學童在生活化隱喻方面較易理解，且更容易與他們所知的諺語隱喻連結。

本研究希望能藉由能進一步了解高功能自閉症學童的非字面語言理解困難加深我們了解高功能自閉症的孩童在語言方面理解上的困難，提升師生互動與同儕互動的關係，進而提升教育之品質。

關鍵字: 高功能自閉症、非字面意思語言、現代諺語、認知語言學、故事實驗

Abstract

The aim of this study is to investigate the differences in the comprehension of modern Mandarin idioms between high-functioning autistic children and typically developing children. To account for the difficulties in non-literal language comprehension among autistic children, this research specifically employs modern Mandarin idioms as experimental material. The study comprises six high-functioning autistic (HFA) children from grades three to six and six typically developing (TD) children of the same grade level. Participants completed three language and belief understanding assessments: The Peabody Picture Vocabulary Test, the False Belief Task and the Metaphorical Proverbial Story Test. The main experiment was the Metaphorical Idiom Story Test, which consisted of twenty-four sets of materials. Each set included a short story of approximately 150 words, closely related to daily life experience, with the terminal sentence being a proverbial or metaphorical expressions. The proverbs or metaphors include three types: those with a human subject, those with an animal subject, and those with a daily-life-related subject. For instance, the metaphorical proverb 熱鍋上的螞蟻 *rè guō shàng de mǎ yǐ* involves animals and signifies a person being nervous or anxious, rather than a literal scenario of ants on a hot pot. Following each story, a comprehension question related to the metaphor is provided. Participants were presented with three images to choose from: one representing the literal meaning, one related to the metaphor, and the last one unrelated. The selected answers reflected the child's comprehension of the stories and the meanings of the idiom/metaphor.

The results show that TD children outperformed those with HFA in language proficiency in the Peabody Picture Vocabulary Test. In particular, there was a higher error rate in processing concepts of sensory-emotional cognition by autistic children, suggesting challenges in this aspect. In the False Belief Task, the group with HFA demonstrated slightly lower performance in both primary and secondary false belief tasks compared to the typically developing group. This may be associated with immature language development of the HFA. In the Metaphorical Proverbial Story Test, the TD children demonstrated superior language comprehension abilities with a correctness rate of 90.65%, compared to 75.45% for the HFA group. Further analysis revealed a significant discrepancy, particularly in metaphors with animal serving as subjects, where typically developing 34 children outperformed the other group by 25%. However, in everyday life metaphors, both groups performed similarly. Children with high-functioning autism are more likely to understand metaphorical expressions in daily life, and they are also more likely to connect them with the proverbial metaphors they already know. It is hoped that this study will help to further understand whether children with HFA are unable to fully comprehend modern Chinese proverbs and sentences. This research aims to deepen our understanding of the linguistic difficulties faced by children with HFA and to enhance teachers' knowledge and understanding in the field of education. This study can enhance our understanding of the language difficulties experienced by children with high-functioning autism, and improve relationships between teachers and students as well as peer-to-peer interactions. Consequently, our study can contribute to improving the overall quality of education.

Keywords: high-functioning autism, non-literal language, modern proverbs, cognitive linguistics, storytelling experiments

1. Study Purpose & Research Questions

Previous research on language comprehension in high-functioning autism (HFA) children has frequently used engaging short jokes, stories with large text and images, satirical formats, emotional speeches, and metaphors as main experimental materials. However, there is a gap in systematic research on how HFA children understand basic single sentences. This study seeks to explore if HFA children struggle with comprehending straightforward single sentences.

In the current field of education, there is a general lack of understanding of high-functioning autism among both teachers and students, leading to misconceptions. Additionally, most interventions for HFA children primarily focus on social skills, such as communication, expressive language skills, interpersonal relationships with peers, and emotional expression. There is insufficient emphasis on enhancing the language comprehension abilities of HFA children. This study seeks to delve deeper into research, recognizing the necessity for teachers to maintain a close professional relationship with students, guiding their development in values, relationships with others, and even connections with society. The hope is that this research will elevate awareness of high-functioning autism in educational settings, guide its direction, enhance the quality of teacher-student and peer interactions, and ultimately improve the overall teaching quality.

The study aims to investigate the comprehension levels of high-functioning autism (HFA) children and typically developing children regarding modern Chinese proverbs. Additionally, we aim to explore whether theory of mind (ToM) abilities are correlated with non-literal meaning/metaphorical understanding. The three research questions include:

(1) Do children with high-functioning autism (HFA) children find it more challenging to comprehend non-literal aspects compared to typically developing children?

(2) Specifically, do children with HFA encounter greater difficulties in understanding proverbs compared to typically developing children?

(3) Can Theory of Mind (ToM) abilities be used to predict skills in understanding non-literal language?

2. Literature Review

2.1. Definition of High-Functioning Autism

Within the spectrum of autism, a small subset of individuals exhibits superior cognitive abilities, with milder developmental and language impairments compared to the general autism population. These individuals are often referred to as high-functioning autism (Chen & Lin, 2008). However, in the realm of academic and professional diagnosis, there remains a lack of consensus on diagnostic criteria for high-functioning autism children who present with milder manifestations in areas such as learning difficulties, social skill deficits, language impairments, and peculiar behaviors (Tasi & Scott-Miller, 1988).

2.2. Communication Impairments in Autism

Individuals with autism typically experience several language and communication challenges, including the inability to develop secondary theory of mind, difficulty comprehending non-literal language, and challenges in recognizing and understanding emotions.

2.2.1. False Belief

The understanding of metaphor relies on a first-order theory of mind (ToM), while a second-order theory of mind is essential for comprehending irony. The term "false belief" refers to the incongruence between an individual's internal thoughts and the actual situation, categorized into primary false belief and secondary false belief. The former denotes an individual's awareness that others may possess beliefs different from their own or the objective reality, while the latter involves the capacity to consider the thoughts of others, i.e., understanding the feelings of others from a third-party perspective (Perner, Frith, Leslie, & Leekman, 1989). Individuals with autism often lack the ability to comprehend secondary false beliefs.

In assessments, by examining the participants' responses to confirmation questions (explanations regarding belief-related inquiries), we can determine if the participants possess the ability to differentiate belief disparities between themselves and others. In other words, participants' capability to confirm the development of the entire narrative

and infer what A thinks about what B believes (i.e., participants understanding A explaining B's thoughts about C) can be evaluated. The research findings indicate that among individuals with autism who can successfully navigate primary false beliefs, less than one-tenth of them can accurately answer questions related to secondary false beliefs.

2.2.2. Understanding Non-Literal Semantics

Overall, individuals with autism often encounter difficulties in comprehending non-literal semantics, such as humor, irony, jokes, and metaphors, which carry an underlying layer of meaning. Studies have demonstrated challenges in individuals with Autism Spectrum Disorder (ASD) and adults with Asperger's syndrome. Consistent with these findings, adults with ASD exhibit poorer understanding of ironic texts compared to typically developing (TD) adults, with mismatches in age, expressive vocabulary, and non-verbal intelligence (Saban-Bezalel & Mashal, 2019).

2.2.3. Recognizing and Understanding Emotions

Across a series of studies on emotional processing in autism, it has been observed that, on the whole, children with autism exhibit weaker performance in the clarity of understanding emotional tone and expressing emotions compared to typically developing peers of the same age. Findings indicate that elementary school children with autism demonstrate a lower accuracy in understanding emotional tone in conversational forms compared to the general typical group, with significantly longer required response times. Notably, children in the autism group exhibit pronounced difficulties in judging and comprehending the "happy" emotional tone presented in others' spoken language. Test results on emotional tone expression show no significant differences in accuracy between the two groups of children. However, children with autism display significantly lower clarity in expressing "neutral" and "happy" emotional tones than typically developing children. Moreover, a significant positive correlation exists between emotional tone understanding and expression abilities in the autism group (Yu & Liu, 2018).

Another study reveals that when there is a discrepancy between contextual cues and intonation, the majority of individuals with Autism Spectrum Disorder (ASD) exhibit context bias. In other words, they tend to rely on contextual cues to infer the

speaker's intent rather than relying on emotive intonation, even when they have the ability to interpret emotional tones not embedded in contextual backgrounds (Sourn-Bissaoui, et al., 2013).

2.3. Definition of Proverbs

Proverbs are a form of non-literal semantic language that originates from people's shared perspectives and experiences with certain events or objects. They express these ideas using commonly understood and fixed-form words, serving the purpose of imparting experiences and offering educational advice.

The term "proverb" can be interpreted as concise expressions to "common saying" or "ancient wisdom." Proverbs have a long historical origin and are a cultural phenomenon that thrives within a native language. Exploring proverbs allows us to understand how our ancestors, in challenging environments, discovered numerous philosophical insights. Proverbs gather the experiences and wisdom of the masses, presenting meanings succinctly and appealing to both refined and common tastes, contributing to their widespread popularity. Examining proverbs passed down through oral tradition in daily life is a feasible approach. In Taiwan, where many students and teachers come from families where Taiwanese is their mother tongue or daily language, several proverbs like "細漢偷挽瓠、大漢偷牽牛" *xì hàn tōu wǎn hù ,dà hàn tōu qiān niú* ,"囡仔人，有耳無喙" *nān zǎi rén, yǒu ěr ww huu*, and "一枝草、一點露" *yī zhī cǎo, yī diǎn ll* are well-known.

Proverbs, also known as popular sayings or colloquial expressions, were described by the ancient Chinese scholar Xu Shen in "Shuowen Jiezi" (Xu Shen, 25-206 CE) as words passed down through generations and rooted in language. Proverbs are considered the "living fossils" of language, and further referred to them as the relics of language, possessing communicative, educational, social, and literary value. They encapsulate ancestral wisdom and convey concepts from the cultural heritage of our forebears. The study of proverbs is helpful in understanding the culture of language communities (Zhang, 2010).

2.4. Experimental Studies on Non-Literal Semantic or Metaphorical Sentences

Zheng et al. (2015) found that children with high-functioning autism perform significantly worse in understanding metaphorical language, both in terms of metaphor and metonymy. Children with high-functioning autism performed similarly to typically developing children in novel metaphor conditions but showed poorer performance in conventional metaphor conditions. Within each group, the contrast suggests that typically developing children perform better in understanding conventional metaphors than in comparing them to novel metaphor conditions. Children with high-functioning autism perform similarly to typically developing children in novel metaphor conditions but exhibit poorer performance in conventional metaphor conditions. Considering the absence of significant differences in scores between the two groups of children, it can be concluded that static vocabulary semantic knowledge is not a strong predictor for understanding metaphors and personification.

Additionally, research by Saban-Bezalel et al. (2019) showed that when the two groups were matched in age and vocabulary scores (but differed in performance on the inference test), typically developing children outperformed the high-functioning autism group in understanding sarcasm (M=89, M=79). Adjusting group matching based on test scores, they reanalyzed the data. Each participant with high-functioning autism was matched with a typically developing participant who had a similar or close score on the "inference test" (secondary false belief questions). This indicates that when both groups are matched for mentalizing abilities assessed in the "inference test," they exhibit similar performances in tasks related to understanding sarcasm.

Researchers Herwegen & Rundblad (2018) examined changes in the understanding of new metaphors and metaphors among individuals with Autism Spectrum Disorder (ASD) during the age development process, using both cross-sectional and longitudinal experimental designs. The study investigated the correlation between understanding metaphors in individuals with ASD, vocabulary knowledge, and visual-spatial abilities. In the cross-sectional experiment, approximately fifteen adolescents to adults with high-functioning autism listened to 24 stories containing metaphors or metonymies (12 metaphors and 12 word substitutions). At the end of each story, there was a sentence with a metaphor or metonymy. After listening to the story, participants were asked a question about the metaphor or metonymy in the story and

two additional questions (one memory question and one control question). The memory question pertained to something mentioned in the first three sentences of the story, ensuring that participants were engaged and understood from the beginning, while the control question explicitly asked about the intended meaning of the question.

For the metaphor/metonymy question, participants were shown three pictures on the screen (one depicting the metaphorical meaning, one depicting the literal meaning, and one interference picture). Participants had to choose one, and the memory and control questions were "yes/no" questions requiring participants to press the green or red circle on the screen. The results of the study by Herwegen & Rundblad (2018) showed that the performance of high-functioning autism children tends to normalize over time. These findings are significant for education and research, as they indicate that performance can improve over time.

Based on the aforementioned research, we have identified a limited focus on the correlation between false belief understanding and metaphor comprehension in autism research in Taiwan. Therefore, this study aims to investigate whether the false belief understanding ability of children with autism is associated with their comprehension of proverbs. Additionally, we will test three different types of proverbs, including animal proverbs, anthropomorphic proverbs, and everyday-life proverbs. We intend to compare the comprehension abilities of typically developing children and children with autism in these three types of proverbs. The research questions of our study are as follows:

(1) Do children with high-functioning autism (HFA) children find it more challenging to comprehend non-literal aspects compared to typically developing children?

(2) Specifically, do children with HFA encounter greater difficulties in understanding proverbs compared to typically developing children?

(3) Can Theory of Mind (ToM) abilities be used to predict skills in understanding non-literal language?

3.Methodology

This study aims to assess 12 elementary school students, with half being typically

developing and the other half having autism. All 12 participants will take part in three experiments: the initial experiment involves a pre-test using the Peabody test to evaluate the language skills of the participants in terms of listening and reading vocabulary. The second experiment is the false belief test, and the third experiment is the proverb story metaphor judgment test.

3.1. Participants

This study aims to enroll 6 high-functioning autistic children in grades 4 to 6 of elementary school, along with 6 typically developing children of the same age range (around 10-12 years old). The participants will be selected from elementary schools in Chiayi City and Tainan City, with one group consisting of high-functioning autistic children and the other of typically developing children. The criteria for selecting participants are as follows: High-functioning autistic children must have a mild or moderate autism diagnosis in the disability handbook, a Wechsler Intelligence Scale score above 70, and parental consent. Typically developing children must be native Chinese speakers in grades 4 to 6 of elementary school and have parental consent.

3.2. Pretest: Peabody Picture Vocabulary Test-Revised (PPVT-R)

The Peabody Picture Vocabulary Test (PPVT) is an intelligence assessment tool that evaluates participants' auditory and visual vocabulary skills to determine their language proficiency and intelligence. It is commonly used to assess children's intelligence and consists of two forms, Form A and Form B, each with 125 questions. Participants are shown four pictures on a page and must select the picture that best matches the vocabulary heard or read. The PPVT is recognized for its engaging format, which helps reduce pressure during assessment, especially for children. By combining picture viewing and vocabulary listening tasks, the PPVT offers insights into the language proficiency of test-takers. The test results can be used to gauge the general vocabulary and language abilities of students, providing valuable information on the language levels of both experimental and control group students.

3.3. Experiment One: False Belief Test

False belief is the recognition that individuals may have differing beliefs influenced by various factors such as context and experiences. It involves understanding that people can have different perspectives and thoughts based on their

surroundings and personal encounters, which may not align with one's own beliefs, knowledge, and perceptions. False belief is divided into two categories: basic or primary false belief and advanced or secondary false belief. The primary false belief test evaluates a child's ability to consider others' beliefs by taking into account contextual cues and viewing situations from another person's viewpoint rather than solely relying on their own immediate understanding. The secondary false belief test builds upon the primary test by assessing a child's capability to infer what one person thinks about another person's thoughts. This test involves understanding a scenario where person A explains person B's thoughts about person C, making the scenarios more intricate. Typically, children around the ages of four to five can pass the primary false belief test, while those aged six to seven can pass the secondary false belief test, enabling further examination and comparison.

3.3.1. Experimental Materials

The Primary False Belief Test is based on the Sally-Anne task developed by Baron-Cohen, Leslie, and Frith in 1985, shown in Figure 1a. The Secondary False Belief Test is derived from a narrative about an ice cream truck (Figure 1b). The images used in both tests were hand-drawn by the Cognitive and Language Laboratory under the guidance of Professor Shu-Ping Gong.

3.3.2. Experimental Procedure

Before starting the experiment, participants are given an explanation that they will hear stories about false beliefs. These stories will be told verbally while relevant images are displayed on PowerPoint slides. Participants are told to listen carefully to the stories as they will end with a question. After hearing the entire false belief story, participants are asked to share their thoughts or perceptions in response to the question. The experiment starts with the basic Primary False Belief Test and then moves on to the more advanced Secondary False Belief Test. If participants don't have any questions after a practice round, the formal experiment begins. The entire experiment is expected to take around 20 minutes.

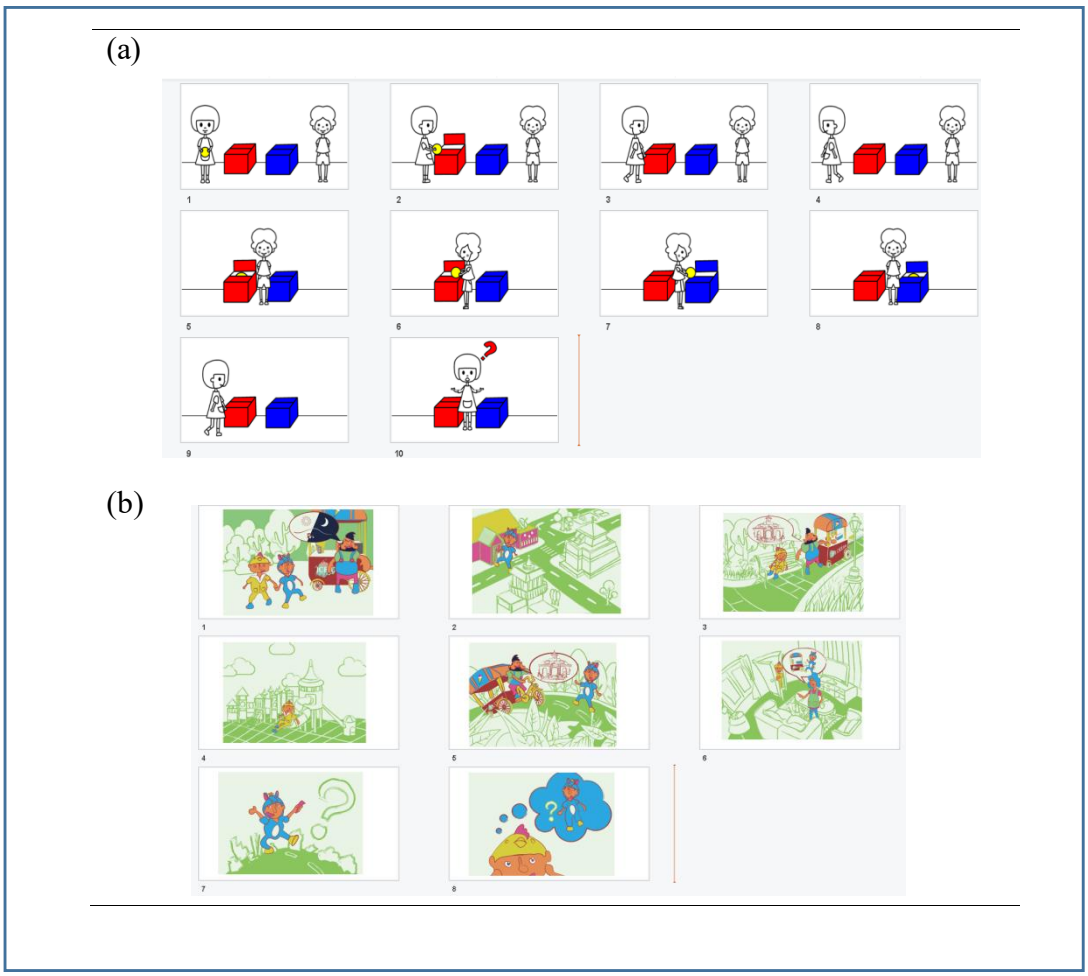

Figure 1: Experimental Materials for False Belief

3.4. Experiment Two: Metaphorical Proverbial Stories Test

The aim of this experiment is to investigate whether factors such as the comprehensibility, life-relatedness, and animacy (i.e., examples where animals serve as subjects) of proverbs affect the understanding of metaphorical sentences in children with high-functioning autism. We adapted the experiment from Van Herwegen & Rundblad (2018). After listening to short stories accompanied by pictures, participants are required to choose the answer that best aligns with the metaphorical statement at the end of each story. The three options include: a literal word, a metaphorically related word, and an unrelated word. For example, in the sample from Figure 2, the concluding sentence of the short story is "Ants on a hot pan." The true meaning of this expression does not describe the subject of the metaphor, such as someone being very nervous or anxious, rather than actual ants climbing on a hot pan.

3.4.1. Experiment Materials

The experimental materials primarily consist of proverbs, cited from the website: Chinese Words - Classic Proverbs/Idioms Collection (https://www.chinesewords.org/sentence/486-780.html). We selected 20 proverbs (Table 1) categorized into three main types: proverbs with human subjects (e.g., 老王賣瓜 *lǎo wáng mài guā* "Old Wang sells melons", as shown in Figure 3), proverbs with animal subjects (e.g., 螞蟻 *mǎ yǐ* "Ants", as shown in Figure 2), and proverbs related to daily life (e.g., 加油 *jiā yóu* "add oil"). Using these sayings as inspiration, we created twenty-four brief anecdotes about everyday life, each around 150 words long. Every story is paired with three images: one with direct words, one with metaphorical words, and one with unrelated words. The final sentence in each story features a metaphorical phrase. We shared these stories through a spoken presentation with accompanying PowerPoint slides. Participants listened to the story, viewed the images, and then selected the option that most closely matched the metaphorical message.

Table 1 : Examples in Metaphorical Proverbial Stories Test

Types	Proverbs whose subject is person	Proverbs whose subject is animal	Metaphors for everyday life
Proverbs	2 *guān gōng miricashuǎ dà dāo* (關公面前耍大刀) 5 *xiā zǐ dài yǎn jìng de háng wéi* (瞎子戴眼鏡的行為) 6 *ní pú sà guò jiāng* (泥菩薩過江) 9 *táng sēng de xīn cháng* (唐僧的心腸) 13 *sāi wēng shī mǎ* (塞翁失馬) 18 *lǎo wáng mài guā* (老王賣瓜) 19 *hé shàng dǎ sǎn* (和尚打傘)	1 *rè guō shàng de mǎ yǐ* (熱鍋上的螞蟻) 3 *tù zǐ kàn rén* (兔子看人) 4 *tiě zuò de gōng jī* (鐵做的公雞) 7 *ròu bāo zǐ dǎ gǒu* (肉包子打狗) 10 *guò jiē de lǎo shǔ* (過街的老鼠) 12 *huà shé tiān zú* (畫蛇添足) 14 *hóu zǐ dǎ shuǐ* (猴子打水) 17 *fēi é pū huǒ* (飛蛾撲火)	8 *dà hǎi lāo zhēn* (大海撈針) 11 *pō chū qù de shuǐ* (潑出去的水) 15 *yàmiáo zhù zhǎng* (揠苗助長) 16 *jǐng dǐ zhī wā* (井底之蛙) 20 *jiǎo zǐ pò pí* (餃子破皮)

3.4.2. Experiment Procedure

As Figure 4 shows, before the experiment began, participants read the experiment instructions, which informed them that they would see twenty-four short stories containing metaphors. After each story, three pictures matching the story would be presented, and the participants would hear a verbal presentation of the story along with the pictures. Participants were then asked to choose the answer that most closely matched the metaphorical expression in the last sentence of the story from the three options: literal words, metaphorically related words, and unrelated words. After a practice session, if there were no questions, the main experiment commenced. The entire experiment was expected to take approximately 30 minutes.

Figure 2: Experiment 2 - Example of Animal-Centric Proverb Materials

Figure 3: Experiment Two - Example of Human-Centric Proverb Materials

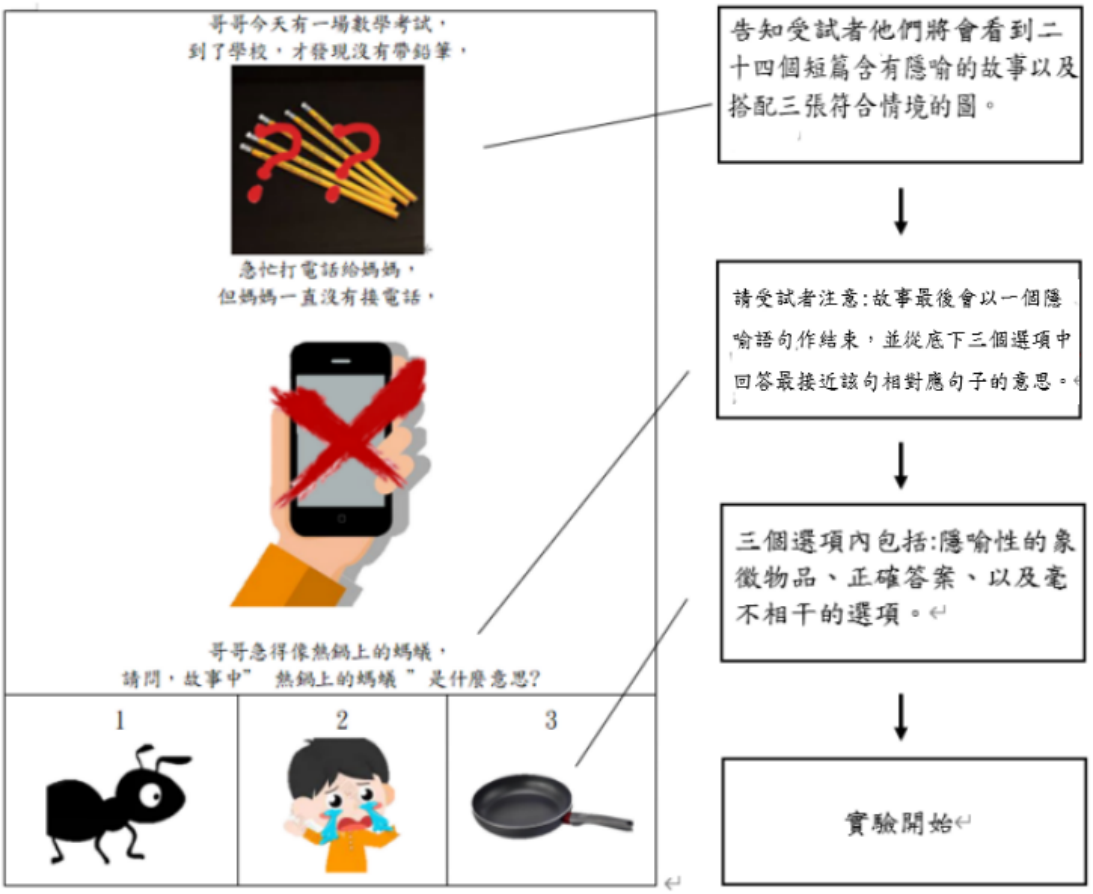

Figure 4: The Procedure of Metaphorical Proverbial Stories Test

4. Results and Conclusion

We will calculate the scores for each question of the participants. If the selected option correctly represents the extended metaphorical meaning (Figure 5a), 5 points will be given. If the selected option represents the literal meaning of the words, 2 points will be given (Figure 5b). If the selected option is completely unrelated (Figure 5c), 0 points will be given. Finally, we will calculate the total score, average, and correct answer rate for each individual.

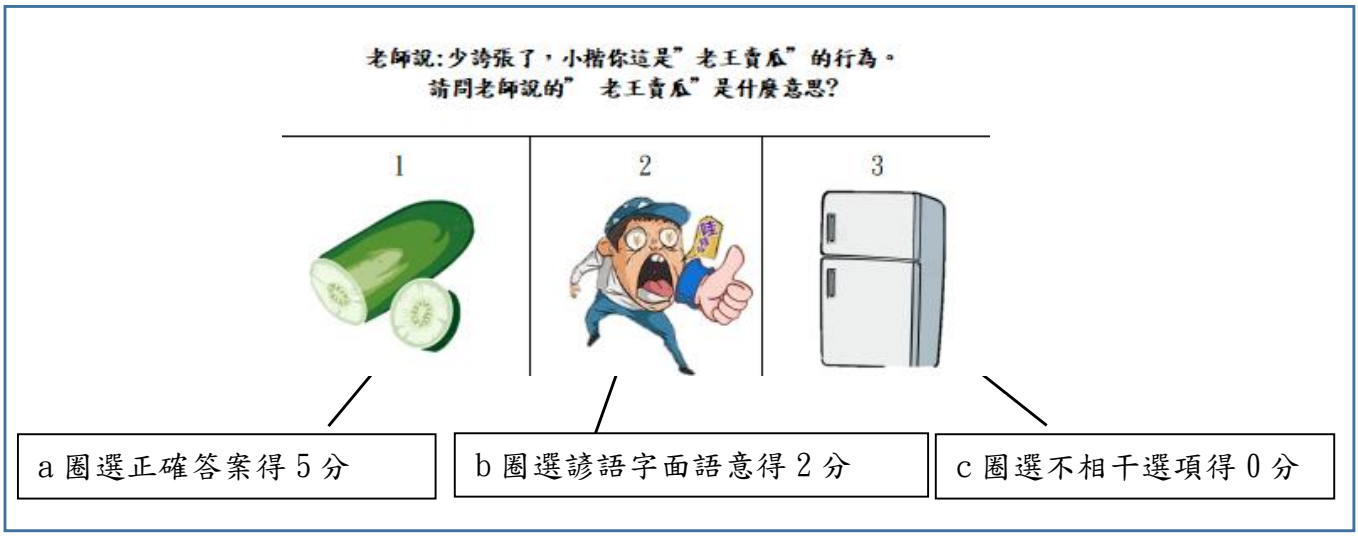

Figure 5: Scoring Method for Metaphorical Proverbial Stories Test

4.1. Results of Peabody Picture Vocabulary Test-Revised (PPVT-R)

The Peabody Test results (Table 2) indicate that typically developing children generally have higher language proficiency levels compared to children with high-functioning autism. However, among the high-functioning autism group, participants S2 and S4 had higher error rates, particularly in tasks related to processing sensory emotions like "anxious," "relaxed," and "worried." These two participants struggled with identifying facial expressions and sensory feelings in pictures but performed well in other language comprehension tasks.

The language development of other high-functioning autism participants (S1, S3, S5) was not significantly different from typically developing children, with scores averaging above 95%. While S2 and S4 faced challenges in tasks related to processing sensory emotions, overall, the language proficiency of high-functioning autism participants was similar to typically developing children.

Next, the study will compare the two groups in their understanding of primary and secondary theory of mind tasks and metaphorical comprehension in proverbial stories. If there are notable differences in these areas between the groups, it may be due to variations in metaphorical understanding rather than disparities in general language comprehension abilities.

Table 2: Results of Peabody Picture Vocabulary Test-Revised (PPVT-R)

High-functioning Autism Spectrum Group			
No	Original Scores	Standardized Scores	P-Rating (Performance-Rating)
S1	125	125	95
S2	110	105	63
S3	122	131	98
S4	116	104	61
S5	119	123	81
S6	120	125	95
Mean	118.67	118.83	82.17
Typically Developing Group			
No	Original Scores	Standardized Scores	P-Rating (Performance-Rating)
N1	125	130	98
N2	123	129	97
N3	119	123	94
N4	118	120	91
N5	119	123	81
N6	120	125	95
Mean	120.67	125	92.67

4.2 Results of False Belief Test

As Table 3 shows, the false belief test is divided into primary false belief test and secondary false belief test. In the primary false belief test, we found that the average correct percentage for the high-functioning autism group was 83%. Only one high-functioning autistic child (S4) answered incorrectly: they answered that the little girl opened the blue box after the little boy swapped the ball to a different box in the experimental material. (The correct answer should be that the little girl should open the red box). This indicates that in the primary false belief test, this high-functioning autistic child (S4) cannot consider others' beliefs based on situational context or see things from the other person's perspective. They judge based solely on their own knowledge or their own assumptions. In addition to this, all other high-functioning autistic children answered correctly.

Table 3: Accuracy rates of two groups of students in the test of false belief test

False belief test	Autism Group	TD Group
Primary false belief Test	83%	100%
Secondary false belief Test	83%	100%

In the secondary false belief test, the average correct percentage was also 83%, with only one high-functioning autistic child (S4) answering incorrectly. After reading the experimental materials (adapted from the ice cream truck story), three questions were asked: a belief question, a reality question, and a memory question. In the responses of the high-functioning autistic child (S4), although they found the belief and reality questions difficult and did not answer correctly, they were willing to try to recall (with a very high motivation to seek the correct answer). This result indicates that the high-functioning autistic child (S4) has difficulty considering the thoughts of others and understanding the feelings of others from a third-party perspective (i.e., cannot understand that A explains what B thinks C). In addition, they were able to answer correctly in the memory question (they could recall that the ice cream shop owner originally sold ice cream in the park). This indicates that the high-functioning autistic children in the group performed relatively well in terms of memory.

In both the primary false belief task and the secondary false belief task, we found that the average percentage of correct answers among typically developing children was 100%. This result indicates that among the six typically developing children, they generally showed sensitivity to context and context, and had the ability to consider others' beliefs. In addition, they were able to see things from the perspective of others and had the ability to consider the thoughts of others. Furthermore, they were able to understand others' feelings from a third-party perspective, in other words, they could understand A explaining B's belief in C's point of view.

Overall, the results showed that the high-functioning autism group had a slightly lower understanding of the false belief task compared to the typically developing children group. However, if we exclude the high-functioning autism child (S4), overall, there was not a significant difference in the understanding of the false belief task between the high-functioning autism group and the typically developing children group. However, we found that although the high-functioning autism child (S4) may have encountered some difficulties in answering belief and reality questions, we speculate that one possible reason is that his language development is not mature (inferred from the results of the pre-test Bodde test), which may have led to a decrease in belief ability

and therefore inaccurate responses. However, he showed a high level of motivation for memory, which indicates his strong motivation for learning. This highly motivated behavior may reflect his active pursuit of knowledge, as he still showed strong motivation to answer correctly even when faced with complex questions.

4.3 Results of Metaphorical Proverbial Stories Test

In the metaphorical proverbial stories test, overall, the language proficiency of typically developing children is relatively higher than that of children with high-functioning autism (Table 4). The correct answer rate for typically developing children is 90.65%, while for children with high-functioning autism, it is 75.45%. However, proverbs can generally be divided into three categories: proverbs with human subjects, such as 老王賣瓜 *lǎo wáng mài guā*; proverbs with animal subjects, such as 熱鍋上的螞蟻 *rè guō shàng de mǎ yǐ*; and proverbs with everyday life subjects, such as 加油 *jiā yóu* and 揠苗助長 *yà miáo zhù zhǎng* "to help them grow". We will compare and analyze the language proficiency of typically developing children and children with high-functioning autism in these three categories.

Table 4: Accuracy rates of two groups of students in the test of Metaphorical Proverbial Stories Test

Proverbial Metaphor	Autism Group	TD Group
Proverbs with human subjects	73.28 %	92.71 %
Proverbs with animal subjects	70.50 %	95.75 %
Proverbs involve daily life scenarios	83.00 %	80.04 %
Average scores	75.45%	90.65%

In proverbs with human subjects, such as 老王賣瓜 *lǎo wáng mài guā* and 關公面前耍大刀 *guān gōng miàn qián shuǎ dà dāo*, we found that typically developing children have an average correct answer rate of 92.71%, while children with high-functioning autism have a rate of 73.28%. This indicates that typically developing children perform relatively better than children with high-functioning autism in proverbs with human subjects. Additionally, we also found that both groups found it difficult to understand the proverb 塞翁失馬 *sāi wēng shī mǎ*. From their answers, we learned that both groups found the story content, metaphor, and non-literal language

beyond their language and cognitive abilities, making it difficult to answer.

In sentences where the subject of the proverb is an animal, such as 熱鍋上的螞蟻 *rè guō shàng de mǎ yǐ* or 鐵做的公雞 *tiě zuò de gōng jī*, we observed an average correct response rate of 95.75% in the typically developing children group. In contrast, the high-functioning autism group exhibited a lower average correct response rate of 70.50%. This indicates that the typically developing children outperformed the high-functioning autism group by 25% in comprehending metaphorical sentences with animal subjects. Notably, in one proverb story, 塞翁失馬 *sāi wēng shī mǎ* , both groups struggled, with an average correct response rate below 60%. Participants from both the typically developing children group and the high-functioning autism group found this particular proverb challenging, suggesting that the content, metaphor, and non-literal language in this story exceeded their linguistic and cognitive capacities, leading to difficulty in providing accurate responses.

In sentences where the proverbs involve daily life scenarios, such as 潑出去的水 *pō chū qù de shuǐ* or 揠苗助長 *yà miáo zhù zhǎng* "to help them grow", the typically developing children group demonstrated an average correct response rate of 80.04%. Surprisingly, the high-functioning autism group showed a slightly higher average correct response rate of 83%. This result indicates a relatively consistent performance in understanding proverbs with daily life scenarios between the two groups. While the difference in correct response rates is smaller compared to proverbs with human or animal subjects, it is sufficient to show that proverbs with daily life scenarios are relatively easier for the high-functioning autism group to comprehend. For instance, in the last question, 餃子破皮—露餡 *jiǎo zǐ pò pí —lù xiàn* , high-functioning autism children found the metaphor in daily life scenarios easier to understand, as it aligns more closely with their experiences, making it easier to connect with the understood metaphorical expressions in other proverbs. On the other hand, typically developing children expressed uncertainty about the intended metaphor in the image, making it challenging for them to connect with the understood metaphorical expressions in other proverbs.

4.4 Conclusion

This study addresses three main issues:

(1) Do children with high-functioning autism (HFA) children find it more

challenging to comprehend non-literal aspects compared to typically developing children?

(2) Specifically, do children with HFA encounter greater difficulties in understanding proverbs compared to typically developing children?

(3) Can Theory of Mind (ToM) abilities be used to predict skills in understanding non-literal language?

In our initial predictions about metaphorical story sentences, children with high-functioning autism performed lower than typically developing children in understanding metaphorical stories. Among the three types of proverbs, children with autism showed the highest average comprehension percentage in proverbs related to daily life, followed by animal proverbs, and the most challenging comprehension was for proverbs with human subjects. Similar results were found when discussing the three types of proverbs: children with autism had the highest average scores in understanding proverbs related to daily life. The high-functioning autism group considered proverbs to be a form of life metaphor, finding this language form closer to daily life situations, making it easier to understand and relate to their everyday experiences. This kind of life metaphor not only deepened their understanding of proverbs but also facilitated the connection of acquired knowledge with real-life experiences. However, the most challenging comprehension was for proverbs with animal subjects, followed by proverbs with human subjects.

Sequentially answering our three research questions based on the experimental results:
(1) Do children with high-functioning autism (HFA) children find it more challenging to comprehend non-literal aspects compared to typically developing children?

Yes, the data from the experiment indicates that children with high-functioning autism perform less well in the understanding of non-literal language.

(2) Specifically, do children with HFA encounter greater difficulties in understanding proverbs compared to typically developing children?

Yes, overall, children with high-functioning autism indeed performed worse than typically developing children. However, in different types of proverbs, especially in proverbs related to daily life, children with high-functioning autism performed slightly

better than typically developing children.

(3) Can Theory of Mind (ToM) abilities be used to predict skills in understanding non-literal language?

Yes, the experiment data reveals a certain correlation between the ability to understand others' false beliefs (ToM) and the comprehension of non-literal language. As Figure 6 shows, the performance of children with autism in false belief tasks correlated with lower scores in metaphorical proverb comprehension, with a prediction accuracy of 75%. In contrast, typically developing children showed a flawless performance in false belief tasks, accurately predicting a 90% correct rate in proverb comprehension. These two abilities are positively correlated: higher accuracy in false belief tasks in children with autism indicates higher non-literal language comprehension ability, and vice versa.

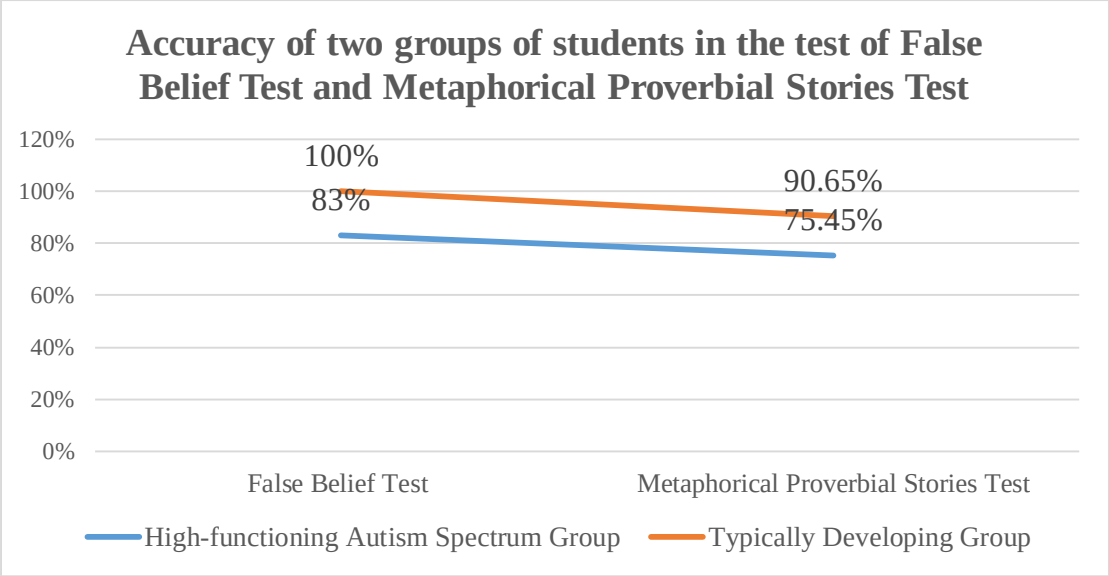

Figure 6: The line chart displays the performance of two groups of students on the False Belief Test and the Metaphorical Proverbial Stories Test.

4.5 Implications For Teaching

This research project's results provide instructional strategy suggestions for the application of teaching, particularly addressing the difficulties that high-functioning autistic children may encounter in understanding non-literal language materials during reading. The following are our recommendations, categorized into different aspects:

First of all, at the pre-teaching level, individualized assessment is recommended for high-functioning autistic children before instructing them in reading non-literal

language materials. Conduct a preliminary assessment to understand each student's cognitive and language development levels. Utilize standardized tests and observations, with a particular focus on performances related to understanding false belief and metaphorical understanding of idioms. This information is crucial for tailoring individualized teaching plans.

Second, in terms of teaching strategies, we suggest differentiated instruction and immediate feedback. Implement differentiated instruction based on the pre-test levels of cognitive learning. Break down the instructional content into small, sequential steps, progressing gradually. Provide clear and concrete steps during teaching, ensuring that each step is understandable. Offer immediate feedback to high-functioning autistic children, with additional multimodal supplementary materials and explanations to enhance their understanding.

The third aspect involves instructional materials. Based on the experimental results, high-functioning autistic children demonstrated better performance in understanding idioms with real-life contexts. Therefore, we recommend presenting content in a simple and multimodal format. Provide diverse sensory stimuli such as images/videos, real objects, tastes, sounds, etc., and integrate comprehensive questions (5W1H) to ensure a holistic understanding of the problem.

Fourthly, in terms of teaching activities and exercises, we suggest incorporating simple examples, story scenarios, role-playing, and group discussions to teach students how to understand others' beliefs and perspectives in different situations. Using idioms from daily life as examples, introduce common idioms and slang in class, use real-life scenarios for illustration, and encourage students to apply idioms in their daily conversations.

Fifth, for instructional evaluation, regular assessments are crucial in ensuring students' learning progress. Quantify students' learning performance and gain in-depth insights into their shortcomings in non-literal language understanding. Tailor teaching strategies based on identified weaknesses to enhance motivation and participation, and adjust teaching plans to better meet the learning needs of high-functioning autistic children.

Lastly, in emotional education, we recommend incorporating emotional intelligence, empathy, problem-solving skills, and interpersonal relationship skills into the curriculum. Cultivate students' emotional awareness and emotional management abilities to help them understand and express their emotions effectively, fostering

positive and healthy interpersonal relationships in both personal and social contexts.

In conclusion, these six aspects contribute to the practical application of our research project. Through continuous and effective teaching, observation, and evaluation, educators can better understand the needs and language comprehension difficulties of high-functioning autistic children. This allows for the provision of more effective resources and assistance, promoting their overall development, improving teacher-student and peer interactions, and enhancing the quality of education.

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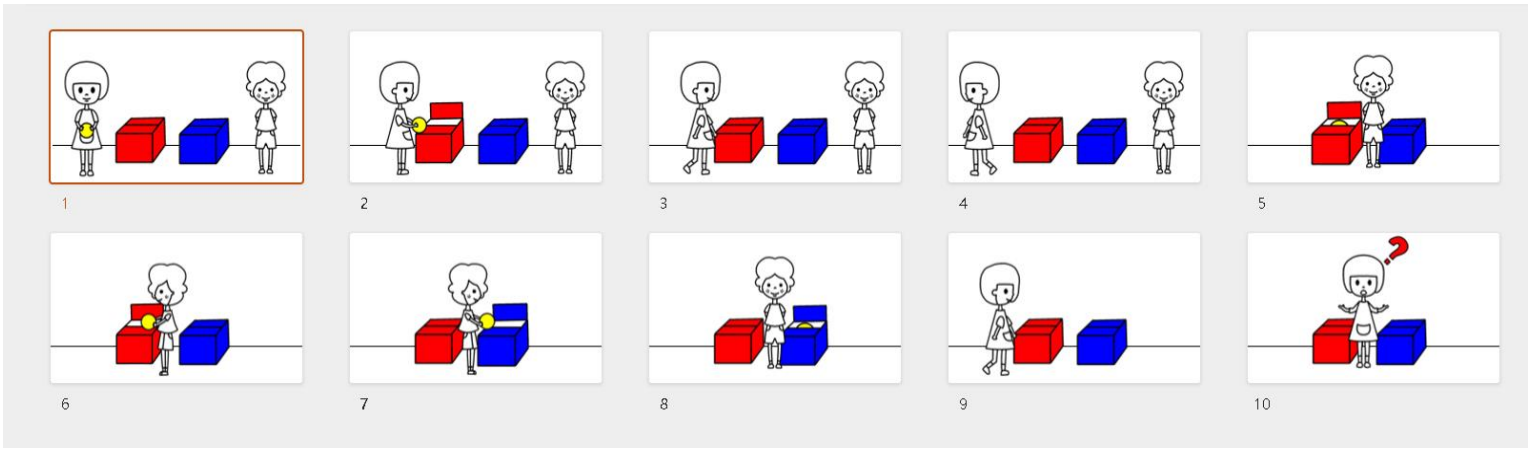
Appendix A Examples of False Belief Tests



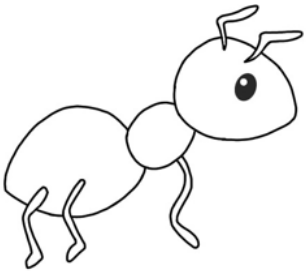
Appendix B　Example of the Metaphorical Proverbial Stories Test

哥哥今天有一場數學考試，
到了學校，才發現沒有帶鉛筆，

急忙打電話給媽媽，
但媽媽一直沒有接電話，

哥哥急得像<u>熱鍋上的螞蟻</u>。

請問，故事中「熱鍋上的螞蟻」是什麼意思?

1	2	3
		

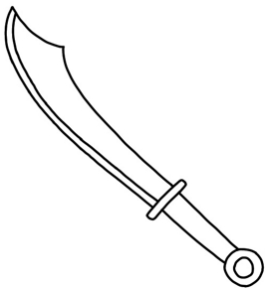
小明暑假期間在補習班學了 26 個字母

A- Z

開學的時候，竟然說要與英文老師挑戰英文單字

同學都笑著說: <u>關公面前耍大刀</u>

請問:「關公面前耍大刀」是什麼意思?

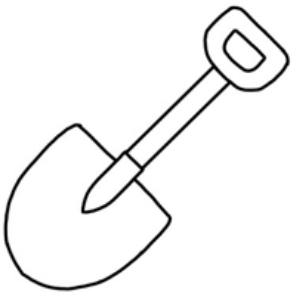
1	2	3
		

今天是發成績單的日子，
班上大部分同學都考不好

只有小明一個人考 100 分，

這時小花突然說:小明說不定是抄別人的
這時，老師說:勿用<u>兔子看人</u>

請問，老師說的「兔子看人」是什麼意思?

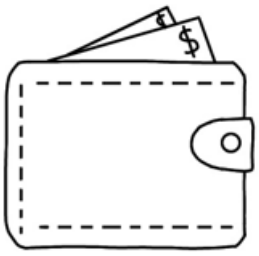
1	2	3
		

王先生是鎮上的有錢人，

但他從不借他人錢，
也不從事公益活動，
更不曾參與公共衛生打掃，

因此，居民都稱王先生為<u>鐵做的公雞</u>

請問，居民說的「鐵做的公雞」是什麼意思?

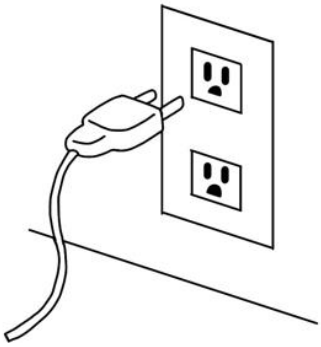
1	2	3
		

今天上課老師提出問題:

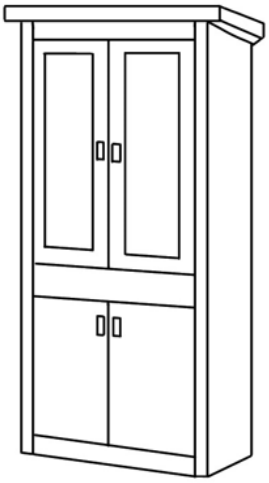
如果遇到地震該怎麼辦?

小花說:趕快跑出去，老師點點頭

小華說:把插頭拔起來，老師也點點頭

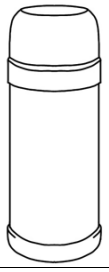


小明說:躲在大櫃子底下



這時老師則搖搖頭說:你這樣是<u>瞎子戴眼鏡的行為</u>。

請問，老師說的「瞎子戴眼鏡的行為」是什麼意思?

1	2	3
		

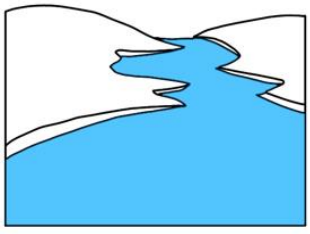
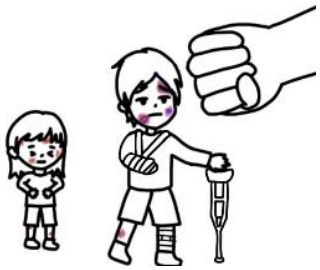
今天要收數學回家作業，

但小華忘記寫了

於是，他向小花借作業來參考，

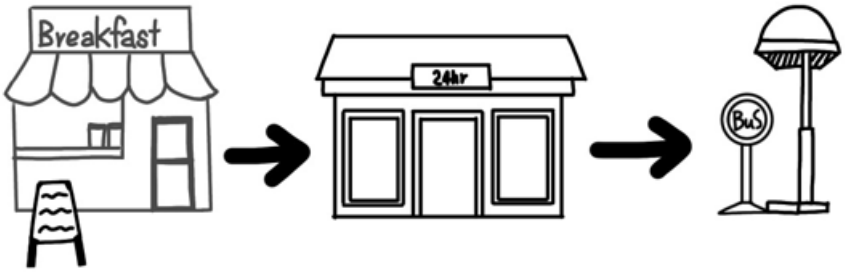
但小花卻說:我現在是泥菩薩過江，怎麼借你呢?

請問，小花說的「泥菩薩過江」是什麼意思?

1	2	3
		

小宇跟小英說:我的手機不見了，怎麼辦?

小英問:你今天經過什麼地方?
小宇說:我今天早上去早餐店、超商、再搭公車到學校



小英說:好多地方!簡直<u>大海撈針</u>
小宇回答:怎麼辦?
小英說:沒關係，我陪你去找找看

請問，小名哥哥說的「大海撈針」是什麼意思?

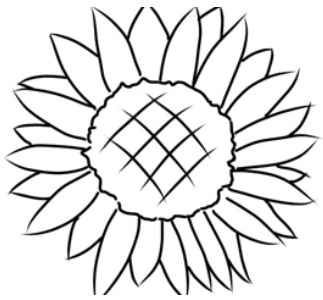
1	2	3
		

今天輪到小花當值日生，
但她已經很多次都先回家沒有打掃了

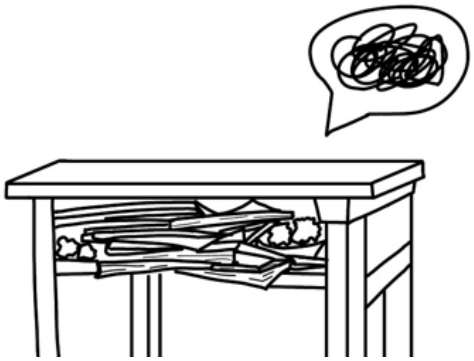
最後都是班長負責留下來打掃，

同學紛紛都說:班長真是唐僧的心腸，
小花應該向班長說謝謝。

請問，同學們說的「唐僧的心腸」是什麼意思?

1	2	3
		

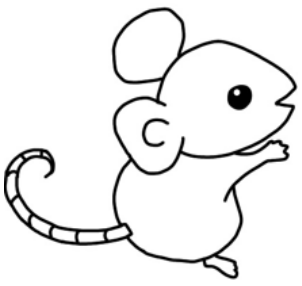
小鑫總是把抽屜弄得很亂，



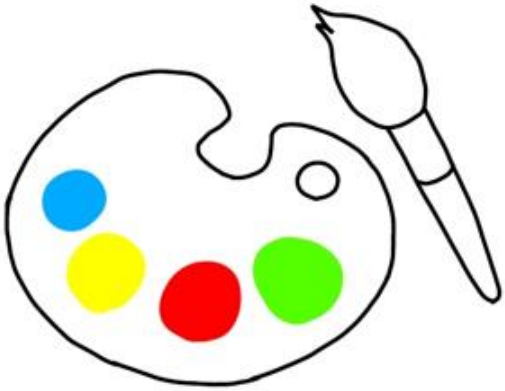
經常不打掃座位，因此位置附近都散發臭味，

因此大家都不想跟他做在一起，
在班上，他彷彿是過街的老鼠。

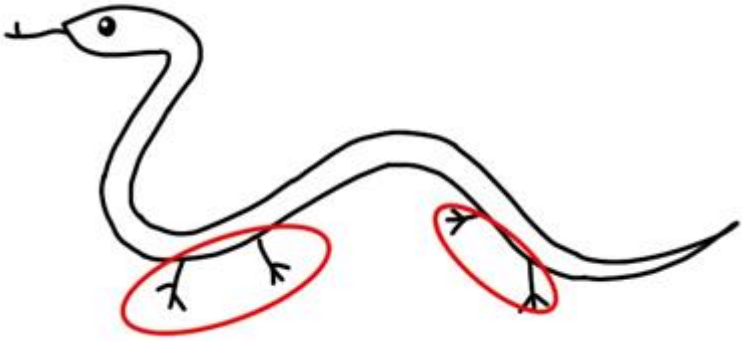
請問，文章中說的「過街的老鼠」是什麼意思?

1	2	3
		

今天上美術課的時候，
大家畫各自喜歡的動物，
小美畫了她最喜歡的卡通蛇，



最後，她竟然在畫上添了一雙腳，



旁邊的小霖看了說:小美，妳這樣是畫蛇添足耶。

請問故事中:「畫蛇添足」什麼意思?

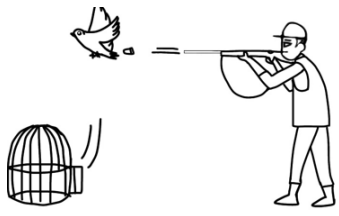
1	2	3
		

今天是同樂會，老師允許大家帶零食來學校。
小藍就把平常採購的一大堆零食都帶到了學校來。

一到學校，小藍就破不期待地大吃大喝，
正當他覺得很開心的同時，
肚子突然絞痛!

小洪說:雖然今天吃零食很開心，但是今天你是<u>塞翁失馬</u>。

請問小洪說的「塞翁失馬」是什麼意思?

1	2	3
		

小芳以為今天有數學考試，
一到學校，她認真地複習了課本

也很專心地訂正習作，
又向隔壁同學小美借筆記複習，
小美說:小芳，你不知道明天才考數學小考嗎?

小美天又說:妳今天是猴子打水了。

請問小美說的「猴子打水」是什麼意思?

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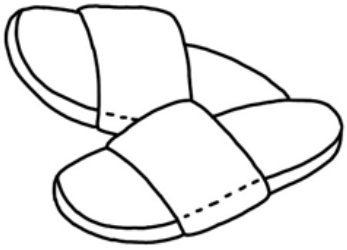
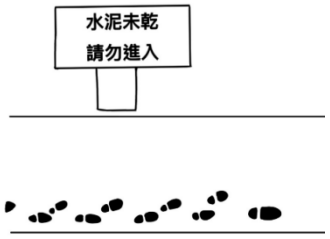
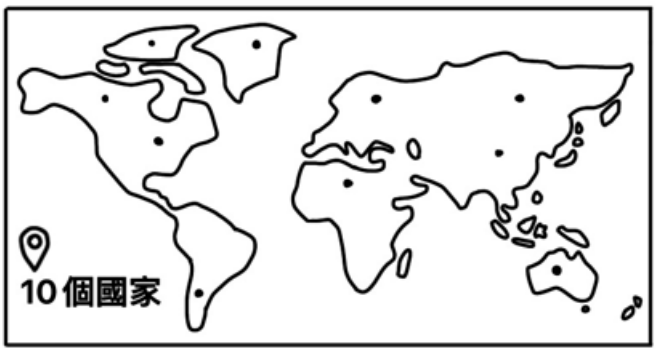
		

今天上地理課，今天上課主題是國家，
老師問同學:大家知道世界上有幾個國家?
小勳搶著回答:世界上就只有十個國家



坐在旁邊的小欣說:怎麼可能! 我出國旅行過，
世界上有超過兩百多個國家

小欣又說:妳真是個井底之蛙。
請問小欣說的「井底之蛙」是什麼意思?

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	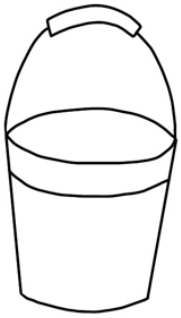	

今天放學回家時，
小梅看到一隻溺水的貓咪，

小梅看到後，竟直接跳下河中，
不會游泳的她就跟貓咪一起困在河中，

最後由路人伯伯把小梅和貓咪一起就上來，

路人伯伯說:雖然救貓咪很重要，但是可以找別人幫忙，
妳今天是<u>飛蛾撲火</u>的行為，下次務必注意。

請問小洪說的「飛蛾撲火」是什麼意思?

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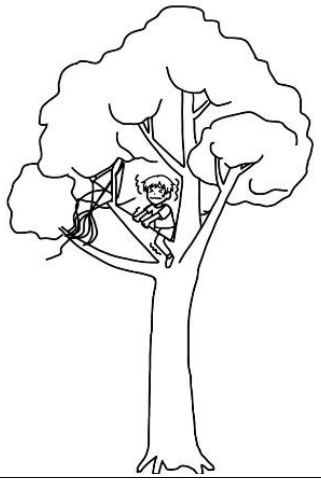
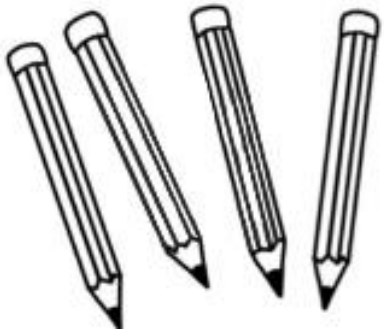
		

遊園會快到了，
老師請同學每人都準備一件商品到學校，

小楷帶了幾件衣服來學校來賣，
並且說:我帶來的衣服是全世界最耐穿的衣服，可以穿五十年



老師說:少誇張了，小楷你這是<u>老王賣瓜</u>的行為。

請問老師說的「老王賣瓜」是什麼意思?

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	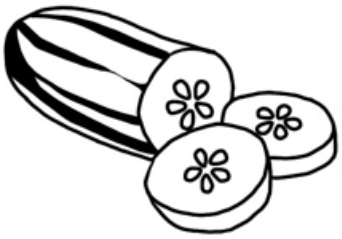	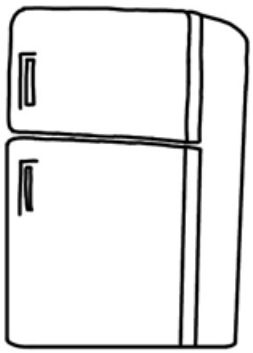

今天上國文課時，
小強遲到了，從大搖大擺地從後門走進來，

後來又在課堂中大聲講話，

老師請他到教室後面罰站，
並說小強是<u>和尚打傘</u>的行為。

請問老師說的「和尚打傘」是什麼意思?

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		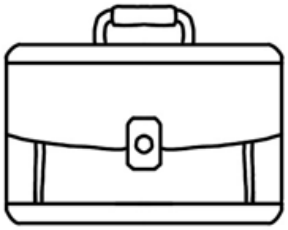

小欣這次英文小考的結果不太好，
於是放話下次考試要考滿分，
期許自己認真讀書，

過程中，發現英文單字常常背不起來，
想放棄了，

坐在隔壁的小可說:你說的話已經是<u>潑出去的水</u>了。

請問，小可說的「潑出去的水」是什麼意思?

1	2	3
		

小明第一天向小花借了一枝筆，
但沒還給小花

第二天向小華借了一把尺，
但也沒還給小華，

這時，同學紛紛說:借小明的東西都肉包子打狗了
不想再借東西給他了

請問，同學說的「肉包子打狗」是什麼意思?

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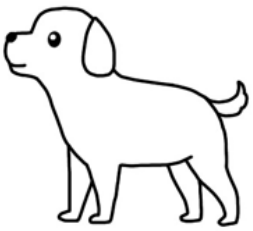
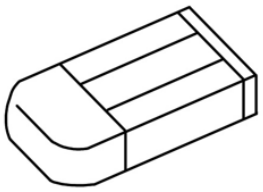
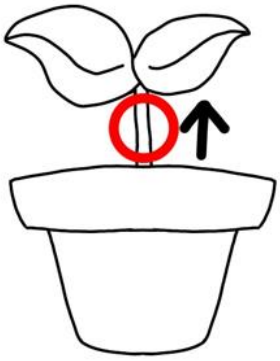
		

今天上自然實驗課時，
老師要大家觀察自己種植的盆栽，
小威發現自己的植物只有長出一些，

其他好朋友的食物都長很高，
於是小威就偷偷把植物拔起來一點，



老師看到後，趕快阻止小威，並說:這是揠苗助長行為。
會害植物枯萎掉的。
請問老師說的「揠苗助長 」是什麼意思?

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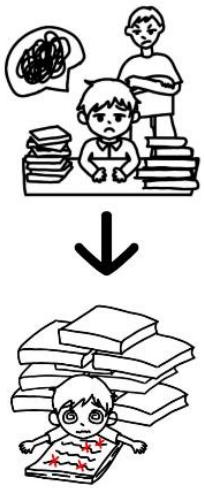	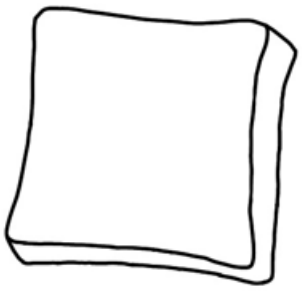	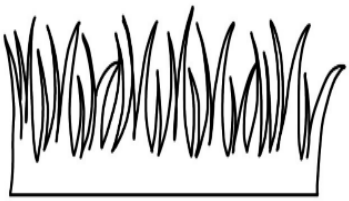

小淨昨天打電動了一個晚上，
昨天的功課請小明代寫

老師批改完後請小淨去辦公室一趟，

老師說:小淨，妳這是餃子破皮的行為，
妳的字跡跟平常完全不同，請回去重寫一次。

請問老師說的「餃子破皮」是什麼意思?

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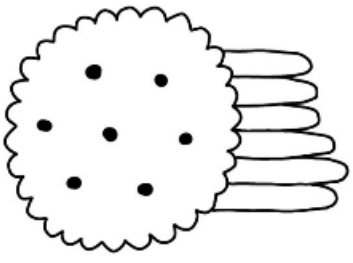		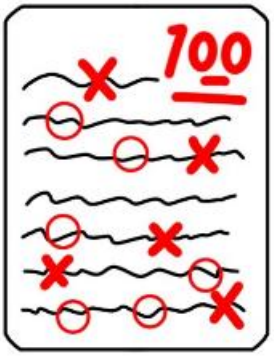

Appendix C　Parent Informed Consent Form (Typically Developmental Group)

親愛的家長:

您好。

語言的發展是相當複雜的認知活動。但目前國內有關輕度/疑似自閉症學童的語言發展的研究非常少，我們研究的目的，就是希望透過語言實驗，來探究輕度/疑似自閉症學童的語言所面臨的問題和設計相關語言訓練來提升他們語言理解。

我是國立嘉義大學外語系的龔書萍老師，在系上教授語言與認知、語言與大腦、認知神經語言學等科目，主要的學術專長為了解人類是如何理解語言。目前我所指導的大學生正在進行研究主題為「高功能自閉症學童對現代華語諺語處理之研究」，本研究主要目的，是希望透過故事方式解釋圖片內容測驗了解輕度/疑似自閉症學童與典型發展學童在非字面意義語言能力上的理解程度差異。

為了要與輕度/疑似自閉症小朋友的語言發展特徵做比較，我們也將了解語言發展正常的國小學生語言特徵。本研究的實驗活動，活動內容包含二個語言測驗和一個諺語故事測驗。二個語言測驗為畢保德測驗及錯誤信念測驗，我們會呈現一些圖片給學生，並請學生指認圖片的內容。然後，我們再進行一個諺語故事測驗。共二十四組材料，每一組為約 150 字內的短篇貼近日常生活故事，我們會以圖片和口語敘述故事，並於故事後面詢問學生一個與故事相關問題。以上每一個語言測驗約 40 分鐘，所以三個測驗約一個小時半。地點將會由學校安排提供，預計將會在輔導室或閒置的空教室內，而時間將配合學生的課後時間或輔導時間。

這些研究資料純為研究所需分析，除了學術用途外，不會有商業的用途，這些資料只用在期刊論文、研討會或研習會議上，但是不會有任何販售的商業行為，請您放心。再者，研究報告或論文的撰寫和發表，這些學生的資料呈現皆以**匿名**處理，我們一定會謹守研究倫理，保護學生隱私且善盡資料保密。研究過程中，若您覺得想要中途退出，也可以隨時提出來，我們會立即中止研究，並將已收集的資料銷毀。

為了謝謝各位研究參與者的參與，研究結束後我們將致贈一張便利商店商品卡及小禮物。若家長對貴子弟研究結果有興趣，我們也非常樂意提供書面資料給家長參考。

非常高興認識您和您的孩子，並誠摯地邀請您參與本研究。我希望透過這份知情同意書徵求您的孩子參與此研究、同意我們利用研究過程中的所收集的語料資料作為論文發表。

若您同意您的孩子參與本研究，請您勾選您的參與意見，並請簽名如下，表示您已了解本研究，並且清楚本研究之事項與權利。本同意函一式兩份，一份由您保存，一份由研究者持有，以保障您的權益。以下為我的聯繫方式，歡

迎與我聯繫。

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電話： 05-2263411—8422 / 09222802787
聯絡人： 林嘉珅 國立嘉義大學外語系 0928838967

☐我同意我的孩子參與本研究，並且在實驗結束後請提供我的孩子的研究結果

☐我同意我的孩子參與本研究，但不需要提供我的孩子的研究成果

☐我不同意我的孩子參與本研究。

家長簽名:_____日期:_____

Appendix C　Parent Informed Consent Form (High Functioning Autism Group)

親愛的家長:

您好。

語言的發展是相當複雜的認知活動。但目前國內關於高功能自閉症學童的語言發展的研究非常少，我們研究的目的，就是希望透過語言的測驗和治療，來探究高功能自閉症學童的語言所面臨的問題和如何透過訓練來提升他們語言理解。

我是國立嘉義大學外語系的龔書萍老師，在系上教授語言與認知、語言與大腦、認知神經語言學等科目，主要的學術專長為了解人類是如何理解語言。目前我所指導的大學生正在進行研究主題為「高功能自閉症學童對現代華語諺語處理之研究」，本研究主要目的，是希望透過故事方式解釋圖片內容測驗了解高功能自閉症學童與典型發展學童在預測非字面意義語言能力上的理解程度差異。

本研究的實驗活動，活動內容包含二個語言測驗和一個諺語故事測驗。二個語言測驗為畢保德測驗及錯誤信念測驗，我們會呈現一些圖片給學生，並請學生指認圖片的內容。然後，我們進行一個諺語故事測驗。共二十四組材料，每一組為約 150 字內的短篇貼近日常生活故事，我們會以圖片和口語敘述故事，並於故事後面詢問學生一個與故事相關問題。以上每一個語言測驗約 40 分鐘，所以三個測驗約一個小時半。地點將會由學校安排提供，預計將會在輔導室或閒置的空教室內，而時間將配合學生的課後時間或輔導時間。

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家長簽名:_____日期:_____