

Examining the Predictors of Naming Speed among Thai Preschoolers: Confirming the Important Roles of Visual Perception and Sustained Attention

Watthanaree Ammawat Apichaya Boonsirirrot Sorasak Suwan Patcharika Srijan
Mahidol University

Attapol Attanak Pattrawadee Makmee Wanvipha Hongnaphadol¹⁾
Khon Kaen University Burapha University Kasetsart University¹⁾

ABSTRACT

Investigations of reading readiness among early preschool children in Thailand have revealed contextual language and social elements that are different from speakers of other languages. The goal of this study was to further understand important variables that predict future reading readiness among Thai children, namely, the influence of visual perception and attention on naming ability. There were 158 preschoolers aged 5 -6.8 years of age, who performed the following tests: Coloured Progressive Matrices (CPM), Attention Sustained (AS), Visual Perception (VP), and Rapid Automatized Naming (RAN) tests. A cross-sectional correlational research design was conducted in this study. The results, which were examined using multiple regression, revealed a strong association among sustained attention, visual perception, intelligence, and naming speed. Sustained attention and visual perception were found to be strongly associated with rapid naming ability. There was a relationship between intelligence and attention. However, intelligence did not appear to be associated with naming speed. Sustained attention and general visual perception were shown to predict the speed of color naming up to 12.2% (Adjust $R^2 = .12, p < .05$) and the speed of digit naming up to 14.1% (Adjust $R^2 = .14, p < .05$). In conclusion, the visual perception and sustained attention abilities of Thai preschool children can predict their rapid naming ability. During early childhood, the importance of developing attentiveness and visual perception is indicated since it offers a positive reading acquisition ability.

Keywords : rapid naming, visual perception, sustained attention, Thai preschoolers

Corresponding author, ¹⁾ wanvipha.h@ku.th

Introduction

Learning to read requires advanced brain processing and multiple cognitive abilities, such as visual perception and auditory processing, encoding, interpretation, and information retrieval (Dehaene et al., 2010; Gibson et al., 2006; Hood & Conlon, 2004). Vocabulary learning skills, auditory discrimination, working memory, inhibition, and attention are initially developed in preschool children and during early childhood years, as proficiency in these skills is said to be a predictor of reading abilities in later periods (Majzub & Kurnia, 2010; McCandliss et al., 2003; Walcott et al., 2010). In Thailand, the vision, which informs educational management, describes a balance of developmental components, which are based on children's learning processes, individual differences, and the range of lifestyles informed by the Thai linguistic and social context. The Thai language has a distinctive orthographic system. Among the 44 consonants, some consonants are almost identical, such as ป /p^h/ and ฟ /f^h/, ด /d/ and ต /t^h/, and ม /m/ and น /n/ (Winskel, 2009). This factor requires readers to pay attention to the position of the circle in each of the consonants. Thai consonants are linearly written, but Thai vowels appear above, below, to each side of, or to both sides of a consonant. Moreover, Thai is a tonal language with five tones: high, mid, low, rising, and falling. Tone markers can be placed above a consonant, or a vowel. Due to the complexities of reading Thai, preschoolers should be equipped with essential cognitive skills. However, 99.8%, 0.2%, and 0.1% of children aged 4 years old were determined to have normal, suspected-delayed, and delayed development, accordingly. Furthermore, 89.3% and 10.7% of those aged 5 years old had normal and delayed development, accordingly (Kue-iad et al., 2019). Children, particularly those aged between 4 and 5, need to be supported and stimulated by appropriate nurturing and environment to reach a normal level of development. Due to the fact that Thailand has the third-fastest-aging population in the world (Economic Research Institute for ASEAN and East Asia, 2021), such social factors may be criticized for this downward tendency in child development.

Older Thai citizens often take care of their grandchildren, whose parents work in Thailand's big cities. The children's primary caretakers play an important role in preparing and making them ready to receive a primary education. Caretaking that is inappropriate might

be expected to delayed development. The presence of primary caregivers who are not the children's parents, such as grandparents, relatives, or neighbors, is linked to a higher risk of developmental delay (Kumraksa et al., 2014). This might be because there is not enough interaction and communication between some children and elderly caretakers. Both linguistic and social challenges affect children's development. Cognitive development is considered to be an important aspect of nurturing children's readiness to learn, along with good performance and competency. Individual differences are confirmed by the fact that people behave, learn, and develop in unique ways, revealing patterns within the person-context interaction to learn (Rose et al., 2013). Within the specific context of Thailand, this paper examines skills that are related to early reading acquisition, particularly rapid naming, visual perception, attention, and IQ.

Developing naming skills during early learning is crucial to the extent that children's learning trajectories are informed by individual differences in cognitive abilities. Increased efficiency in the performance of speech and eye movement and improved coordination in both spatial and temporal domains should occur throughout a child's development. Moreover, rapid naming performance has been shown to influence a person's ability to read in the future (Georgiou et al., 2016; Ozernov-Palchik et al., 2017). Several scholars have attempted to describe naming abilities by using the complex conceptual framework of attention, perception, concept, memory, pronunciation, meaning, and motoric sub-processes. Through this framework, naming abilities have been measured by focusing on the precise timing requirements for each individual component (Easson et al., 2020; Wolf et al., 2000), by evaluating the symbolic speech speed for various visual stimuli (Vukovic & Siegel, 2006), or by determining the ability to state the names of different objects as quickly as possible by using familiar stimuli (i.e., digits, letters, colors, and pictures). Given that research has supported the significant role that rapid naming plays in its association with reading ability, spelling, word recognition, and word identification skills (Georgiou et al., 2016; Savage et al., 2008). Therefore, the observation of naming speed is of great importance for preschoolers to put together children's capabilities to start mastering a process to read. It is interesting to investigate the predictability that sustained attention and visual perception have on naming speed. Little is known about the relationship between IQ and naming speed, founded from preschoolers.

Attention, in terms of its relationship to the processes of speech, visual word recognition,

and reading aloud, has been shown to facilitate reading readiness and to promote reading fluency. Attention should be considered, especially for the role that it may play in identifying dyslexia and Attention-Deficit Hyperactivity Disorder (ADHD; Knivsberg & Andreassen, 2008; Willcutt & Pennington, 2000). The topic has piqued the interest of researchers as they have attempted to describe the relationship between attention and reading readiness (Ammawat et al., 2019; Pham et al., 2011; Shaywitz & Shaywitz, 2008). Many, who have an interest in the element of attention and the role it plays in studying and learning, have been ultimately striving to improve evaluations and provisions to support children with special needs.

Attention in children has a remarkable effect on their ability to read later in their lives. Specifically, focused attention arises from learning, which is based on the analysis of stimuli and storing and remembering received content and information (Hitch et al., 2020). A child's ability to control attention and to suppress irrelevant information encourages the ability to concentrate and to participate in classroom activities without distraction, which leads to better academic performance (Fantuzzo et al., 2007; Romano et al., 2010). Sustained attention has been shown to be significantly correlated with the number of correct answers and duration of silent reading, as well as with the capacity to alter from attention to visual perception, which is another factor that has been shown to influence a child's reading ability (Franceschini et al., 2012).

Receipt of visual information results from a process of visual perception that requires obtaining the information through sensory stimuli, processing the information, and then translating those stimuli into meaningful views based on the environment (Adaval et al., 2019). Visual perception skills directly contribute to the identification of letters, words, and written punctuation and are considered to be an important mechanism that is relevant to reading ability (Bellocchi et al., 2017; Memiş & Sivri, 2016). Although visual perception is a key factor that has been investigated in terms of reading performance in many regions, research on this topic has not yet been adequately researched using diverse languages.

Aside from the aforementioned factors contributing to reading, IQ has been categorized as a primary learner characteristic and has been shown to have a moderate influence on the initial stages of a child's learning processes. Previous studies on a child's ability to spell have relegated IQ's relationship to reading to a later stage (Caravolas & Volín, 2001). It has been further highlighted that a child with a standard to lower IQ is likely to develop reading

problems and to have rapid naming deficiencies (Catts et al., 2002). The role that cognitive skills, such as non-verbal IQ, sustained attention, and visual perception, play in predicting naming abilities in different social and linguistical contexts remains unclear. Therefore, this research aimed at determining the extent to which these cognitive processes predict naming speed among preschoolers within a Thai context.

Methods

This research was approved by the institutional review boards of the College of Research Methodology and Cognitive Science (RMCS) of Burapha University (Approved No. 055/2018). The committees granted ethical approval to conduct this study with human beings. Prior to the data collection written permission was given by the parents/legal guardians of the participating children. The test subjects were asked for their willingness to participate in the study. Prior to beginning the data collection, the instruments used in the study and the methodological details were discussed, and at the end of the session, all participants were given refreshments and gifts. A cross-sectional correlational research design was conducted.

Participants

The participants were 158 preschool children aged 5 years to 6.8 years of age (78 boys and 80 girls with a mean age of 5.7) from public schools in the central region of Thailand. Participating children were reportedly free of language, hearing, and learning disabilities (e.g., autism, ADHD, dyslexia diagnosis, and color blindness). Regarding the socio-economic status of the participants, most of the parents held a bachelor's degree or higher (among two-parent households, 56 of the fathers (35.4%) and 71 of the mothers (45.0%), and among single-parent households, 51.3%). The percentage of families earning more than 50,000 THB (approximately \$1,654 US), between 30,001 and 50,000 THB, between 30,000 and 10,001 THB, and less than 10,000 THB (\$330 US) were 20.9%, 18.4%, 48.7%, and 5.7 %, respectively.

Instruments

1. The Colored Progressive Matrices Test (CPM) (Raven et al., 1998) is a non-language intelligence test. This instrument measures a person's learning ability in terms of the capacity to understand perceptual relationships and logical comparisons. It was created for use with children aged 5 years to 11 years and older, and the task takes each individual approximately 15-30 minutes to complete. The CPM has been shown to have high reliability, with a split half reliability of .90 and a Cronbach's alpha reliability coefficient of .90. The present study examined the reliability of CPM and found a Cronbach's alpha reliability coefficient of .62. Reliability of the test tends to increase with age, with a coefficient of .64 for children at age 5 and .89 for children at age 11 (Kazem et al., 2007).

2. The Rapid Automatized Naming test (RAN) (Wolf & Denckla, 2005) measures the ability to perceive symbolic visibility rapidly and accurately: letters, digits, colors, or images of objects. This can indicate if the child has a good or impaired reading tendency and is used to evaluate children aged 5 years to 18 years and 11 months. The assessment has an alpha coefficient of Cronbach of .90, and an inter-rater reliability of .98 - .99. The RAN assessments employed in the present study consisted of three sub-tests: RAN objects, colors, and digits. Time was recorded in seconds, and the raw scores were converted to standard scores according to the age range. Standard scores of less than 90 indicate difficulties in naming.

3. The Developmental Test of Visual Perception-Third Edition (DTVP-3) (Brown & Murdolo, 2015; Hammill et al., 2014) was designed to evaluate visual perception and visual-motor integration, regardless of a child's race, gender, or dominant hand. This is a paper-and-pencil test that is employed as an individual assessment for subjects in the age range of 4 years to 12 years and 11 months. The DTVP-3 consists of five sub-topics: eye-hand coordination, copying, figure-ground, visual closure, and form constancy. This assessment has a Cronbach's alpha coefficient of .90 and has a test-retest reliability ranging from 0.87-0.90.

4. The Leiter International Performance Scale-Revised test (Leiter-R) (Roid & Miller, 1997) is a standardized test that is widely used to measure the aspects of attention, cognition, and memory. In the present study, the Attention Sustained (AS) test series was used. The AS test is an assessment of the ability to look around in order to fulfill a task that requires

concentration. The test requires glancing at images and marking symbols on the target images in a fast and repetitive manner. It involves searching for and crossing out squares inside a collection of geometric shapes. The AS test has been shown to have a high intrinsic coherence of .87. The AS booklet B test, which has a total score of 74, was the only one selected for use in this study.

Procedures

Each child was tested individually at school, and the test was conducted in three different sections. During the first section, CPM and RAN were tested, which was followed by DTVP-3, and then finally, AS. The total testing time per child was around 60 minutes. In 60 minutes, three preschoolers were tested by two of a researcher team in each section, at three different sections consecutively. Six preschoolers finished the test rotation in an hour. Therefore, it took approximately 27 hours in 6 days to complete the data collection. Additionally, the questionnaires were completed by the children's parents.

Statistical Analysis

The children's scores were placed into the Statistical Package of Social Science (SPSS) version 17. Statistical analysis was performed using the measures of descriptive statistics. The data was reviewed for normal distribution using the values for asymmetry and kurtosis between -2 and +2, which are considered to be acceptable for normal univariate distribution (Seltman, 2018; Trochim & Donnelly, 2001). The test outcomes were input in order to determine the strength of predictors, the effect forecasting, and the trend forecasting. The model used in this study was as follows:

$$y_i = \beta_0 + \beta_i x_i + \varepsilon_i, i = 1, \dots, n,$$

Y represents a test outcome and x represents an explanatory variable. The structural model can then be expressed by using the equation (Seltman, 2018), in which β_0 represents a "parameter times x-variable" term if the x-variable that is multiplied by β_0 is the constant function of "1".

Results

In the present study, the raw scores from the CPM were interpreted into percentile ranks. Accordingly, only 158 preschoolers, who had ranked in the 25th percentile and higher, were included in the study. One preschooler, whose score was in the 5th percentile, was excluded from the study. For the CPM and Attention sustained test, the raw scores have been represented. DTVP-3 and RAN values have been shown as standardized scores. The results indicated that the number of children encountering difficulties in naming objects, colors, and digits had been 36 (22.8%), 73 (46.2%), and 39 (24.7%), respectively. Table 1 summarizes the children's performance in the tasks that were used in this study: CPM, AS, DTVP-3, and RAN. The means, standard deviations (SDs), minimum, maximum, skewness, and kurtosis are also included.

Table 1. *Descriptive Statistics of All the Study Variables (N=158)*

Variables	Means	SDs	Min	Max	Skewness	Kurtosis
CPM (/36)	18.02	3.55	12.00	29.00	.87	.34
Attention sustained (/74)	48.52	9.54	23.00	66.00	-.32	-.47
DTVP-3						
Eye-hand coordination	8.58	2.50	1.00	13.00	-.83	.64
Copying	13.01	3.61	5.00	20.00	.26	-.57
Figure-ground	9.69	2.57	4.00	17.00	-.25	-.13
Visual closure	9.80	2.60	4.00	16.00	.24	.04
Form constancy	9.20	2.40	1.00	19.00	.19	2.01
VMI	104.79	14.32	67.00	139.00	-.05	-.17
MR-VP	97.16	9.64	71.00	120.00	-.03	-.24
GVP	100.73	10.27	72.00	127.00	-.15	.03
Automatization						
RAN objects	98.43	13.16	67.00	137.00	.11	.22
RAN colors	90.85	13.71	55.00	126.00	-.25	.26
RAN digits	97.67	15.43	55.00	138.00	-.66	.26

Note: The means, standard deviations (SD), and minimum (Min) and maximum (Max) among the 158 children are shown. CPM= Coloured Progressive Matrices; RAN = Rapid Automatized Naming; DTVP-3= Developmental Test of Visual Perception-Third Edition; VMI=Visual-Motor Integration; MR-VP= Motor-Reduced Visual Perception; and GVP=General Visual Perception.

Examining the Predictors of Naming Speed among Thai Preschoolers:
Confirming the Important Roles of Visual Perception and Sustained Attention

Table 2 indicates that all of the tests measuring the cognitive abilities had been significantly correlated. CPM had correlated with AS and GVP ($p < .01$), while AS had been significantly associated with GVP and all three of the RANs ($p < .01$). Conversely, the naming sets of objects, colors, and digits did not show a statistically significant correlation with CPM. This may be due to the fact that the CPM of the Thai preschoolers had been calculated from their total raw scores.

Table 2. *The Correlation Matrix of RAN and Independent Variables*

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
1. CPM	1.00	.42**	-.13	.28**	.27**	.21**	.06	.12	.28**	.28**	.02	.10	.09
2. AS		1.00	-.08	.18*	.23**	.17*	.10	.06	.25**	.21**	.17*	.32**	.25**
3. EH			1.00	.23**	.08	.24**	.13	.64**	.23**	.53**	.14	.09	.10
4. CO				1.00	.23**	.34**	.04	.86**	.31**	.72**	.19*	.25**	.31**
5. FG					1.00	.28**	.09	.21**	.69**	.55**	.11	.12	.19*
6. VC						1.00	.06	.36**	.69**	.64**	.17*	.12	.29**
7. FC							1.00	.10	.50**	.36**	.08	.11	.07
8. VMI								1.00	.34**	.81**	.17*	.18*	.26**
9. MR-VP									1.00	.82**	.20*	.18*	.29**
10. GVP										1.00	.24**	.24**	.34**
11. RAN Objects											1.00	.70**	.71**
12. RAN Colors												1.00	.69**
13. RAN Digits													1.00

ABBREVIATIONS LIST: Coloured Progressive Matrices (CPM), Attention Sustained (AS), Developmental Test of Visual Perception–Third edition (DTVP-3) Copying (CO), Eye-Hand coordination (EH), Figure-Ground (FG), Form Constancy (FC), Visual Closure (VC), Visual-Motor Integration (VMI), General Visual Perception (GVP), Motor-Reduced Visual Perception (MR-VP), Rapid Automatized Naming (RAN)

Our main prediction was that CPM, AS, and GVP would predict RAN. To test this hypothesis, three hierarchical multiple regression analyses were computed as shown in Table 3. The first regression model revealed that only GVP had significantly predicted the RAN Objects. The full model marginally explained 5% of the variance in the RAN objects. Thus, this model was: $Y (\text{RAN objects}) = \beta_0 + \beta_1 (\text{GVP})$.

The second regression model using the hypothesized criterion revealed that AS had predicted RAN colors, but GVP and CPM had not. Subsequently, however, the addition of GVP in Step 2 had significantly explained the 12.2% of variance in the RAN colors. Thus, the model included: $Y (\text{RAN colors}) = \beta_0 + \beta_1 (\text{AS}) + \beta_2 (\text{GVP})$.

Finally, the model predicting the residual RAN Digits was investigated. As expected, GVP had been associated with RAN digits. The addition of AS in Step 2 contributed significant variance to the prediction of the residual RAN digits, which was similar to the RAN colors. The full model described a 14.1% of variance in the RAN digits. Therefore, according to this analysis, the most suitable model for predicting RAN had been the linear combination of the constant, AS, and GVP. This model could be expressed as: $Y \text{ (RAN digits)} = \beta_0 + \beta_1(\text{GVP}) + \beta_2(\text{AS})$. In summary, AS and GVP had performed with incremental predictive validity in naming sets of objects, colors, and digits.

Table 3. *A Summary of the Hierarchical Multiple Regression Analysis Variables*

	Predictors	B	Beta	T	sig	Mult. R	R Square	Adjusted R Square	F change
RAN Objects									
Step 1	(Constant)	67.82		6.72	.000				
	GVP	.30	.24	3.05	.003	.24	.06	.05	$F(1, 156) = 9.29$
RAN Colors									
Step 1	(Constant)	68.69		12.72	.000				
	AS	.46	.32	4.18	.000	.32	.10	.10	$F(1, 156) = 17.51$
Step 2	(Constant)	46.59		4.39	.000				
	AS	.40	.28	3.67	.000	.37	.13	.12	$F(1, 155) = 5.78$
	GVP	.25	.18	2.40	.017				
RAN Digits									
Step 1	(Constant)	45.87		4.01	.000				
	GVP	.51	.34	4.55	.000	.34	.12	.11	$F(1, 156) = 20.69$
Step 2	(Constant)	36.85		3.12	.002				
	GVP	.46	.30	4.01	.000	.39	.15	.14	$F(1, 155) = 6.31$
	AS	.31	.19	2.51	.013				

ABBREVIATIONS LIST: Attention sustained (AS), General Visual Perception (GVP), Motor-Reduced Visual Perception (MR-VP)

Discussion

In this study, the aim was to investigate the relevance of the cognitive abilities to reading

readiness among preschoolers given that IQ, attention, visual perception, and naming skills are partially correlated and to establish the predictability of IQ, attention, and visual perception on naming speed. The research findings indicated that the children had been facing difficulties in naming. This may be due to their lack of familiarity with the symbols used on the test, such as the pictures, colors, and digits. Being unfamiliar with the relevance between a symbol and sound can have a remarkable effect on reading readiness and can indicate deficiencies. Symbols are important constituents of everyday language, with distinctive and unique characteristics for each particular culture or social context (Akubuilu et al., 2015). Numerous studies have demonstrated the relevance of visual perception (Macchi et al., 2003), attention (Decker et al., 2013; Neuhaus & Swank, 2002), and non-verbal reasoning (Savage et al., 2008) as predictors of reading achievement.

The key elements of visual perception, copying, figure ground, and visual closure have been shown to be associated with rapid naming and spatial relationships, while figure ground perception is shown to be associated with reading ability performance (McCandliss et al., 2003). The findings from our study support this trend, given that the aforementioned three elements had strongly correlated with naming digits. Motor-reduced perception and visual-motor coordination are said to lead to potential reading readiness (Çayır, 2017). The visual perception theory describes the root cause of reading problems, especially mistakenly reading alternative characters, such as the letter 'b' or 'ม /m/' instead of 'd' or 'น /n/', respectively, or the word 'was' or 'กบ' /kob/ 'frog' instead of 'saw' or 'บก' /bök/ 'land', respectively (Winskel, 2009). This kind of confusion occurs when the mirror neurons in the brain are developing in the early stages of reading.

In a similar vein as the visual naming model, the early stages of RAN performance require visual processing capabilities, particularly object pattern recognition. Individuals, who can recognize simple visual features well, will be able to give names faster and more effectively, whereas having difficulty in distinguishing simple visual features results in slower naming (Stainthorp et al., 2010; Wolf et al., 2000). The right posterior parietal region of the brain is related to visuomotor and visuospatial functions and controls eye movements, which assists with concentrating on images and symbols and also contributes to rapid naming ability (Green & Bavelier, 2012). In terms of visual motor coordination, eye-hand coordination skills

were not correlated with all RAN tasks, representing a finding that was determined not to be in line with previous studies (Çayir, 2017). Regarding RAN performance and its reliance on sustained attention and continuous response, sustained attention was found to be associated with rapid naming. Perhaps, this is due to its role in achieving concentration, and consequently, speed during picture naming. According to a previous study on visual-spatial searching, standard errors in reaction time of sustained attention are associated with naming times (Mabbott et al., 2006). Delayed naming speed occurs when children have difficulties in reading and concentrating (slower processing speeds; Catts et al., 2002; Jongman et al., 2017; Willcutt & Pennington, 2000), which results in naming colors in particular, less quickly. The present study confirms evidence indicating that Thai preschoolers encounter difficulties in naming colors, which can be predicted by sustained attention. This implies that prior to reading, attention should first be nurtured in children and then should be followed by rapid naming abilities.

The next factor contributing to reading readiness, IQ scores, was found to be associated with sustained attention and general visual perception but did not correlate with RAN. IQ scores are not correlated with non-alphanumeric naming speed, meaning that they are not relevant to future reading readiness or deficiencies (Jiménez et al., 2009). Rapid naming problems may occur without IQ problems (Catts et al., 2002). In these cases, nonverbal IQ tests may not be correlated with RAN or reading ability. Likewise, some children with below average IQ scores can be good readers. Therefore, this score may not necessarily signify poor reading (Peng et al., 2019). Intelligence level is shown to influence learning, indicating that children with below average IQs may find it difficult to outperform their higher IQ counterparts (Siegel, 1989; Tanaka et al., 2011). Similar to CPM, IQ was not found to be significantly related to reading or RAN but it was associated with attention in the visual search activity.

General visual perception and sustained attention are two unique cognitive predictors of non-alphanumeric and alphanumeric RAN in preschool children. Our findings revealed that general visual perception had shown the ability to predict the rapid naming of pictured objects, colors, and digits, in which both visual-motor integration and motor-reduced visual perception components corresponding to visual complexity are involved. The complexity of a drawing or picture can affect the time needed to recognize the image. The representation of

a familiar object makes major independent contributions toward predicting naming abilities that are related to visual perception, and thereby, has a profound influence on naming speed performance (Alario et al., 2004; Ammawat et al., 2019).

Sustained attention combined with general visual perception was also found to predict rapid naming ability for both colors and digits. This is consistent with findings, which have shown that reading abilities can be predicted by attention, which can also influence the prediction of both word attack and word identification skills (Stage et al., 2003). As the key causative factor of RAN, attention has been confirmed by in-depth performance analyses of Event-Related Potentials (ERPs), wherein children with attention deficit showed lower performance, not only in the target-evoked N2pc component, but also in their RAN capacity (Wang et al., 2017). It has been argued that RAN requires conceptual processing. Nevertheless, attention must first become established in children and must be followed by the ability to quickly retrieve the name of a symbol. Otherwise, they may struggle to make progress in fluency, which contributes to word or passage reading and even to reading ability in the future (Franceschini et al., 2012). This clearly explains why children with difficulties in reading are affected by attention since it impacts their learning of the alphabetic features of the Thai language. As RAN is a predictor of reading performance, sustained attention and visual perception are of the interplay between reading and RAN. The findings broadly contribute to multisensory Sluggish Attentional Shifting (SAS) hypothesis (Hari & Renvall, 2001) which is related to developmental dyslexia (DD). Cortical networks which are involved in visual and auditory representations are possibly interfered. This hypothesis insists that when children with DD are confronted with rapid sensory sequences, their automatic attention mechanism is unable to disengage rapidly enough from one thing to the other, resulting in slow and sluggish processing. The evidence from children with comorbid deficits has illustrated the role of attention and visual perception in predicting RAN. Specifically, children with DD who are comorbid with attentional deficits, specific language impairment, and autism spectrum disorder, exhibit the inefficient process of visual noise exclusion (Dispaldro et al., 2013; Ronconi et al., 2013). Likewise, in this study the preschoolers who took longer time in identifying visual stimuli and pronouncing them orally might be affected by the lack of visual noise exclusion resulting in distorted visual perception. On the other hand, non-verbal IQ had been unable to predict RAN ability, which is in line with previous

research on verbal IQ standard scores showing their ability to predict word identification skills, but an inability to predict word attack skills. Furthermore, IQ has been shown to be a less effective predictor than attention (Stage et al., 2003).

The limitation of the study was its use of CPM scale to measure IQ. The scale was appropriate to collect data in children who were relatively young and with limited attention span. For this reason, the CPM scale, which is non-restricted language and requires less time to complete it, corresponds to the nature of subjects. This may, however, lead to a lack of perspective on measuring intelligence related to language (i.e., verbal IQ), such as storytelling and word meaning. Therefore, further research can be investigated on other components of preparation for reading readiness such as working memory, picture recognition, and phonological awareness. A more comprehensive study of the relationship between naming speed and verbal IQ, or children's cognitive abilities and predictors of naming speed should be further explored. Children's reading readiness in a later period can be also monitored across time span or in a longitudinal study

Moreover, the findings contribute to the pivotal elements of pre-reading skill for teachers and parents to understand that visual perception and sustained attention skills, in relation to naming speed, should be promoted. Visual perception and sustained attention are also associated with IQ. Therefore, activities to enhance visual perception and sustained attention skills including life skills promotion, which are based on elements of visual perception and sustained attention, will help prepare children to focus on naming speed and to be more prepared for reading. In practice, teachers could enhance preschoolers' naming speeds by deploying attention and visual perception in order to develop functions and skills that would lead to a more effective combination of sound and vision components in order to identify specific objects, colors, or digit stimuli. Children, who are capable of reading, are likely to excel in writing, since the more they read, the better they can perceive how the letters are combined into words that are meaningful. The findings also shed light on policymaking direction as school directors and course designers should take into account the elements of reading preparation more thoroughly. In so doing, when it is time for children to develop their reading skills, they will be able to read and understand the subject being read more quickly.

In conclusion, naming speed is, theoretically, one of the major precursors to reading

readiness among preschoolers, and it is associated with sustained attention, visual perception, except IQ. In this study, IQ was measured by a non-verbal test which may have resulted in its inability to predict naming speed. As a result of our findings, we suggest that assessing attention and visual perception development in a variety of social contexts should be monitored in order to prevent reading problems.

References

- Adaval, R., Saluja, G., & Jiang, Y. (2019). Seeing and thinking in pictures: A review of visual information processing. *Consumer Psychology Review*, 2(1), 50-69.
<https://doi.org/10.1002/arcp.1049>
- Akubuilu, F., Okorie, E. U., Onwuka, G., & Uloh-Bethels, A. C. (2015). Reading readiness deficiency in children: Causes and ways of improvement. *Journal of Education and Practice*, 6(24), 38-43. <https://files.eric.ed.gov/fulltext/EJ1078814.pdf>
- Alario, F. X., Ferrand, L., Laganaro, M., New, B., Frauenfelder, U. H., & Segui, J. (2004). Predictors of picture naming speed. *Behavior Research Methods, Instruments, & Computers*, 36, 140-155. <https://doi.org/10.3758/BF03195559>
- Ammawat, W., Attanak, A., Kornpetpanee, S., & Wongupparaj, P. (2019). Pre-schoolers' visual perception and attention networks influencing naming speed: An individual difference perspective. *Heliyon*, 5(10), e02587.
<https://doi.org/10.1016/j.heliyon.2019.e02587>
- Bellocchi, S., Muneaux, M., Huau, A., Lévêque, Y., Jover, M., & Ducrot, S. (2017). Exploring the link between visual perception, visual-motor integration, and reading in normal developing and impaired children using DTVP-2. *Dyslexia*, 23(3), 296-315.
<https://doi.org/10.1002/dys.1561>
- Brown, T. & Murdolo, Y. (2015). The developmental test of visual perception-third edition (dtpv-3): A review, critique, and practice implications. *Journal of Occupational Therapy, Schools, & Early Intervention*, 8(4), 336-354.
<https://doi.org/10.1080/19411243.2015.1108259>
- Caravolas, M., & Volín, J. (2001). Phonological spelling errors among dyslexic children

- learning a transparent orthography: The case of Czech. *Dyslexia*, 7(4), 229-245.
<https://doi.org/10.1002/dys.206>
- Catts, H. W., Gillispie, M., Leonard, L. B., Kail, R. V., & Miller, C. A. (2002). The role of speed of processing, rapid naming, and phonological awareness in reading achievement. *Journal of Learning Disabilities*, 35(6), 510-525.
<https://doi.org/10.1177/00222194020350060301>
- Çayir, A. (2017). Analyzing the reading skills and visual perception levels of first grade students. *Universal Journal of Educational Research*, 5(7), 1113-1116.
<https://doi.org/10.13189/ujer.2017.050704>
- Decker, S. L., Roberts, A. M., & Englund, J. A. (2013). Cognitive predictors of rapid picture naming. *Learning and Individual Differences*, 25, 141-149.
<https://doi.org/10.1016/j.lindif.2013.03.009>
- Dehaene, S., Pegado, F., Braga, L. W., Ventura, P., Nunes Filho, G., Jobert, A., Dehaene-Lambertz, G., Kolinsky, R., Morais, J., & Cohen, L. (2010). How learning to read changes the cortical networks for vision and language. *Science*, 330(6009), 1359-1364.
<https://doi.org/10.1126/science.1194140>
- Dispaldro, M., Laurence, L. B., Corradi, N., Ruffino, M., Bronte, T., & Facoetti, A. (2013). Visual attentional engagement deficits in children with specific language impairment and their role in real-time language processing. *Cortex*, 49(8), 2126-2139.
<https://doi.org/10.1016/j.cortex.2012.09.012>
- Easson, K., Al Dahhan, N. Z., Brien, D. C., Kirby, J. R., & Munoz, D. P. (2020). Developmental trends of visual processing of letters and objects using naming speed tasks. *Frontiers in Human Neuroscience*, 14, 1-14.
<https://doi.org/10.3389/fnhum.2020.562712>
- Economic Research Institute for ASEAN and East Asia. (2021, June 25). *Population aging in Thailand*. Retrieved April 13, 2022, from
<https://www.eria.org/publications/population-ageing-in-thailand/?fbclid=IwAR102toZtyTptfYYZ1xOZdUXlYvhlncVtyCFTUfDSwk4rHHktSiuVrW-NI0>
- Fantuzzo, J., Bulotsky-Shearer, R., McDermott, P. A., McWayne, C., Frye, D., & Perlman, S. (2007). Investigation of dimensions of social-emotional classroom behavior and school readiness for low-income urban preschool children. *School Psychology Review*,

- 36(1), 44-62. <https://doi.org/10.1080/02796015.2007.12087951>
- Franceschini, S., Gori, S., Ruffino, M., Pedrolli, K., & Facoetti, A. (2012). A causal link between visual spatial attention and reading acquisition. *Current Biology*, 22(9), 814-819. <https://doi.org/10.1016/j.cub.2012.03.013>
- Georgiou, G. K., Aro, M., Liao, C.-H., & Parrila, R. (2016). Modeling the relationship between rapid automatized naming and literacy skills across languages varying in orthographic consistency. *Journal of Experimental Child Psychology*, 143, 48-64. <https://doi.org/10.1016/j.jecp.2015.10.017>
- Gibson, L. Y., Hogben, J. H., & Fletcher, J. (2006). Visual and auditory processing and component reading skills in developmental dyslexia. *Cognitive Neuropsychology*, 23(4), 621-642. <https://doi.org/10.1080/02643290500412545>
- Green, C. S., & Bavelier, D. (2012). Learning, attentional control, and action video games. *Current Biology*, 22(6), PR197-R206. <https://doi.org/10.1016/j.cub.2012.02.012>
- Hammill D. D., Pearson N. A., & Voress J. K. (2014). *Developmental test of visual perception* (3rd ed.). Pro-Ed.
- Hari, R., & Renvall, H. (2001). Impaired processing of rapid stimulus sequences in dyslexia. *Trends in Cognitive Sciences*, 5(12), 525-532. [https://doi.org/10.1016/S1364-6613\(00\)01801-5](https://doi.org/10.1016/S1364-6613(00)01801-5)
- Hitch, G. J., Allen, R. J., & Baddeley, A. D. (2020). Attention and binding in visual working memory: Two forms of attention and two kinds of buffer storage. *Attention, Perception, & Psychophysics*, 82, 280-293. <https://doi.org/10.3758/s13414-019-01837-x>
- Hood, M., & Conlon, E. (2004). Visual and auditory temporal processing and early reading development. *Dyslexia*, 10(3), 234-252. <https://doi.org/10.1002/dys.273>
- Jiménez, J. E., Siegel, L., O'Shanahan, I., & Ford, L. (2009). The relative roles of IQ and cognitive processes in reading disability. *Educational Psychology*, 29(1), 27-43. <https://doi.org/10.1080/01443410802459226>
- Jongman, S. R., Roelofs, A., Scheper, A. R., & Meyer, A. S. (2017). Picture naming in typically developing and language-impaired children: The role of sustained attention. *International Journal of Language & Communication Disorders*, 52(3), 323-333. <https://doi.org/10.1111/1460-6984.12275>
- Kazem, A. M., Alzubiadi, A. S., Yousif, Y. H., Aljamali, F. A., Al-Mashdany, S. I., Alkharusi,

- H., Omayma. B., Al-Bulushi, S. S, Al-Bahrani, W. A., & Al-Fori, S. M. (2007). Psychometric properties of Raven's Colored Progressive Matrices for Omani children aged 5 through 11 years. *Social Behavior and Personality: An International Journal*, 35(10), 1385-1398. <https://doi.org/10.2224/sbp.2007.35.10.1385>
- Knivsberg, A.-M., & Andreassen, A. B. (2008). Behaviour, attention and cognition in severe dyslexia. *Nordic Journal of Psychiatry*, 62(1), 59-65. <https://doi.org/10.1080/08039480801970098>
- Kue-iad, N., Sangthong, J., Chaimay, B., & Woradet, S. (2019). Khwam chuk khong phathanakan lacha nai dek ayu tamkwa 5 pi changwat phatthalung [Prevalence of child development delay among children aged under 5 years old in Phatthalung province]. *Journal of Health Science*, 28(2), 215-223. <https://thaidj.org/index.php/JHS/article/view/6413>
- Kumraksa, N., Theeranan, P., Srihirunrussame, S., Keodsawas, A., & Kuhapun, B. (2014). Saphawakan songsoem phathanakan dek [Situation of child development promotion]. *Journal of Mental Health of Thailand*, 22(2), 76-83. https://th.ajanukul.go.th/_admin/file-research/190-0-1611719463.pdf
- Mabbott, D. J., Noseworthy, M., Bouffet, E., Laughlin, S., & Rockel, C. (2006). White matter growth as a mechanism of cognitive development in children. *NeuroImage*, 33(3), 936-946. <https://doi.org/10.1016/j.neuroimage.2006.07.024>
- Macchi, M., Rossi, L. N., Cortinovis, I., Menegazzo, L., Burri, S. M., Piller, M., . . . Vassella, F. (2003). Development of visual perception and attention, assessed by backward masking and application in children with epilepsy. *Developmental Medicine & Child Neurology*, 45(8), 562-567. <https://doi.org/10.1111/j.1469-8749.2003.tb00957.x>
- Majzub, R., & Kurnia, R. (2010). Reading readiness amongst preschool children in Pekanbaru Riau. *Procedia - Social and Behavioral Sciences*, 9, 589-594. <https://doi.org/10.1016/j.sbspro.2010.12.202>
- McCandliss, B. D., Cohen, L., & Dehaene, S. (2003). The visual word form area: Expertise for reading in the fusiform gyrus. *Trends in Cognitive Sciences*, 7(7), 293-299. [https://doi.org/10.1016/S1364-6613\(03\)00134-7](https://doi.org/10.1016/S1364-6613(03)00134-7)
- Memiş, A., & Sivri, D. A. (2016). The analysis of reading skills and visual perception levels of first grade Turkish students. *Journal of Education and Training Studies*, 4(8), 161-

166. <https://doi.org/10.11114/jets.v4i8.1663>
- Neuhaus, G. F., & Swank, P. R. (2002). Understanding the relations between RAN letter subtest components and word reading in first-grade students. *Journal of Learning Disabilities, 35*(2), 158-174. <https://doi.org/10.1177/002221940203500206>
- Ozernov-Palchik, O., Norton, E. S., Sideridis, G., Beach, S. D., Wolf, M., Gabrieli, J. D. E., & Gaab, N. (2017). Longitudinal stability of pre-reading skill profiles of kindergarten children: Implications for early screening and theories of reading. *Developmental Science, 20*(5), e12471. <https://doi.org/10.1111/desc.12471>
- Peng, P., Wang, T., Wang, C., & Lin, X. (2019). A meta-analysis on the relation between fluid intelligence and reading/mathematics: Effects of tasks, age, and social economics status. *Psychological Bulletin, 145*(2), 189-236. <https://doi.org/10.1037/bul0000182>
- Pham, A. V., Fine, J. G., & Semrud-Clikeman, M. (2011). The Influence of inattention and rapid automatized naming on reading performance. *Archives of Clinical Neuropsychology, 26*(3), 214-224. <https://doi.org/10.1093/arclin/acr014>
- Raven, J., Raven, J. C. & Court, J. H. (1998). *Manual for Raven's Progressive Matrices and Vocabulary Scales, Section 3: The Standard Progressive Matrices*. Psychologists Press
- Roid, G. H., & Miller, L. J. (1997). *Leiter international performance scale-revised (Leiter-R)*. Stoelting.
- Romano, E., Babchishin, L., Pagani, L. S., & Kohen, D. (2010). School readiness and later achievement: Replication and extension using a nationwide Canadian survey. *Developmental Psychology, 46*(5), 995-1007. <https://doi.org/10.1037/a0018880>
- Ronconi, L., Gori, S., Giora, E., Ruffino, M., Molteni, M., & Facoetti, A. (2013). Deeper attentional masking by lateral objects in children with autism. *Brain and Cognition, 82*(2), 213-218. <https://doi.org/10.1016/j.bandc.2013.04.006>
- Rose, T., Rouhani, P., & Fischer, K. W. (2013). The science of the individual. *Mind, Brain, and Education, 7*(3), 152–158. <https://doi.org/10.1111/mbe.12021>
- Savage, R., Pillay, V., & Melidona, S. (2008). Rapid serial naming is a unique predictor of spelling in children. *Journal of Learning Disabilities, 41*(3), 235-250. <https://doi.org/10.1177/0022219408315814>
- Seltman, H. J. (2018). *Experimental Design and Analysis*. Carnegie Mellon University.
- Shaywitz, S. E., & Shaywitz, B. A. (2008). Paying attention to reading: The neurobiology

- of reading and dyslexia. *Development and Psychopathology*, 20(4), 1329-1349.
<https://doi.org/10.1017/s0954579408000631>
- Siegel, L. S. (1989). IQ is irrelevant to the definition of learning disabilities. *Journal of Learning Disabilities*, 22(8), 469-478. <https://doi.org/10.1177/002221948902200803>
- Stage, S. A., Abbott, R. D., Jenkins, J. R., & Berninger, V. W. (2003). Predicting response to early reading intervention from verbal IQ, reading-related language abilities, attention ratings, and verbal IQ-word reading discrepancy: Failure to validate discrepancy method. *Journal of Learning Disabilities*, 36(1), 24-33.
<https://doi.org/10.1177/00222194030360010401>
- Stainthorp, R., Stuart, M., Powell, D., Quinlan, P., & Garwood, H. (2010). Visual processing deficits in children with slow RAN performance. *Scientific Studies of Reading*, 14(3), 266-292. <https://doi.org/10.1080/10888431003724070>
- Tanaka, H., Black, J. M., Hulme, C., Stanley, L. M., Kesler, S. R., Whitfield-Gabrieli, S., Reiss, A. L., Gabrieli, J. D. E., & Hoeft, F. (2011). The brain basis of the phonological deficit in dyslexia is independent of IQ. *Psychological Science*, 22(11), 1442-1451.
<https://doi.org/10.1177/0956797611419521>
- Trochim, W. M., & Donnelly, J. P. (2001). *The research methods knowledge base* (2nd ed.). Atomic Dog Publishers.
- Vukovic, R. K., & Siegel, L. S. (2006). The double-deficit hypothesis: A comprehensive analysis of the evidence. *Journal of Learning Disabilities*, 39(1), 25-47.
<https://doi.org/10.1177/00222194060390010401>
- Walcott, C. M., Scheemaker, A., & Bielski, K. (2010). A longitudinal investigation of inattention and preliteracy development. *Journal of Attention Disorders*, 14(1), 79-85.
<https://doi.org/10.1177/1087054709333330>
- Wang, E., Sun, M., Tao, Y., Gao, X., Guo, J., Zhao, C., Li, H., Qian, Q., Wu, Z., Wang, Y., Sun, L., & Song, Y. (2017). Attentional selection predicts rapid automatized naming ability in Chinese-speaking children with ADHD. *Scientific Reports*, 7, 1-9.
<https://doi.org/10.1038/s41598-017-01075-x>
- Willcutt, E. G., & Pennington, B. F. (2000). Comorbidity of reading disability and attention-deficit/hyperactivity disorder: Differences by gender and subtype. *Journal of Learning Disabilities*, 33(2), 179-191. <https://doi.org/10.1177/002221940003300206>

Examining the Predictors of Naming Speed among Thai Preschoolers:
Confirming the Important Roles of Visual Perception and Sustained Attention

- Winskel, H. (2009). Reading in Thai: The case of misaligned vowels. *Reading and Writing*, 22(1), 1-24. <https://doi.org/10.1007/s11145-007-9100-z>
- Wolf, M., Bowers, P. G., & Biddle, K. (2000). Naming-speed processes, timing, and reading: A conceptual review. *Journal of Learning Disabilities*, 33(4), 387-407. <https://doi.org/10.1177/002221940003300409>
- Wolf, M., & Denckla, M. B. (2005). *RAN/RAS: Rapid Automatized Naming and Rapid Alternating Stimulus Tests*. Pro-Ed.