

## นิพนธ์ต้นฉบับ

### การศึกษานำร่องคุณสมบัติการวัดเชิงจิตวิทยาของชุดเครื่องมือ

### Visual Object and Space Perception (VOSP) ในประชากรปกติวัยกลางคนและวัยสูงอายุไทย

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#### บทคัดย่อ

**ที่มาของปัญหา:** Visual Object and Space Perception battery (VOSP) เป็นชุดเครื่องมือทางประสาทจิตวิทยา ซึ่งประกอบด้วยแบบทดสอบการทำงานของสมองด้านการรับรู้วัตถุและการรับรู้มิติสัมพันธ์ แต่ยังไม่มีการศึกษาคูณสมบัติการวัดเชิงจิตวิทยาของชุดเครื่องมือนี้ในคนไทย

**วัตถุประสงค์:** การวิจัยนี้มีวัตถุประสงค์เพื่อทำการศึกษานำร่องศึกษาค่าคะแนนปกติ และปัจจัยที่ส่งผลต่อค่าคะแนนแต่ละทดสอบย่อยในชุดเครื่องมือ VOSP ในประชากรปกติวัยกลางคนและวัยสูงอายุไทย อีกทั้งต้องการศึกษาความสะดวกของการนำชุดเครื่องมือไปใช้จริง ในแง่ของเวลาที่ใช้ในการทดสอบ ความเหมาะสมของขนาดรูปภาพ ความชัดเจนของรูปภาพและคำสั่งการทดสอบ

**วิธีการศึกษา:** หลังได้รับอนุญาตจากบริษัท Pearson Education Ltd. เพื่อทำการแปลและปรับปรุงชุดเครื่องมือ VOSP เป็นภาษาไทย ผู้วิจัยได้สร้างแบบทดสอบย่อยตัวอักษรไม่สมบูรณ์ (incomplete letters) ด้วยพยัญชนะไทยและแปลคำสั่งการทดสอบเป็นภาษาไทย ผู้ร่วมวิจัยจำนวน 40 คน ซึ่งอยู่ในวัยกลางคนและวัยสูงอายุถูกคัดเลือกให้เข้าร่วมวิจัยโดยแบ่งเป็น 8 กลุ่มตามเกณฑ์อายุ เพศ และระดับการศึกษา ค่าคะแนนเฉลี่ยแต่ละแบบทดสอบย่อยในชุดเครื่องมือ VOSP เวลาที่ใช้ทดสอบ ความชัดเจนของรูปและคำสั่งการทดสอบถูกนำเสนอโดยสถิติเชิงบรรยาย การวิเคราะห์การถดถอย

พหุคูณถูกใช้ในการวิเคราะห์หาความสัมพันธ์ระหว่างตัวแปรทางประชากรศาสตร์กับค่าคะแนนแต่ละแบบทดสอบย่อยในชุดเครื่องมือ VOSP

**ผลการศึกษา:** ผลการศึกษานำร่องของค่าคะแนนแต่ละแบบทดสอบย่อยของชุดเครื่องมือ VOSP มีความใกล้เคียงกับการศึกษาการตรวจสอบคุณภาพของชุดเครื่องมือนี้ในประเทศอื่นๆ ยกเว้น แบบทดสอบภาพเงา (silhouettes) และ การตัดสินใจวัตถุ (object decision) เพศ ระดับชราวนีปัญหา ความคมชัดในการมองเห็นส่งผลต่อค่าคะแนนบางแบบทดสอบย่อยอย่างมีนัยสำคัญทางสถิติ ระยะเวลาที่ใช้ในการทดสอบรวม 18 นาที ค่าคะแนนที่บ่งถึงความเหมาะสมของขนาดรูปภาพ ความชัดเจนของรูปภาพและคำสั่งการทดสอบ ของแต่ละแบบทดสอบย่อยในชุดเครื่องมือ VOSP อยู่ในเกณฑ์ดีมาก

**สรุป:** ในภาพรวมค่าคะแนนของแต่ละแบบทดสอบย่อยของชุดเครื่องมือ VOSP ในประชากรปกติวัยกลางคนและวัยสูงอายุไทยมีความใกล้เคียงกับการศึกษาคูณสมบัติการวัดเชิงจิตวิทยาของชุดเครื่องมือนี้ในประเทศอื่นๆ ผลการศึกษานี้เป็นประโยชน์ต่อการวางแผนการศึกษาคุณสมบัติการวัดเชิงจิตวิทยาของชุดเครื่องมือ VOSP ระดับชาติในประเทศที่ไม่ได้ใช้ภาษาอังกฤษเป็นภาษาราชการ

**คำสำคัญ:** การรับรู้มิติสัมพันธ์, คูณสมบัติการวัดเชิงจิตวิทยา, ค่าปกติ

## ORIGINAL ARTICLE

**Psychometric Properties of Visual Object and Space Perception (VOSP)  
in Healthy, Older, Thai Adults: A Pilot Study****Bhumpaphop Sunsuk, M.D.<sup>1,3</sup>, Kankamol Jaisin, M.D.<sup>2,3</sup>**<sup>1</sup>Princess Mother National Institute on Drug Abuse Treatment (PMNIDAT), Department of Medical Services,  
Ministry of Public Health, Pathum Thani, Thailand<sup>2</sup>Department of Psychiatry, Faculty of Medicine, Siriraj Hospital, Mahidol University, Bangkok, Thailand<sup>3</sup>Department of Psychiatry, Faculty of Medicine, Thammasat University, Pathum Thani, Thailand**ABSTRACT**

**BACKGROUND:** Visual Object and Space Perception battery (VOSP) comprises a series of tasks comprehensively represent object and space perception abilities. However, VOSP has not been validated in Asian population.

**OBJECTIVES:** This study aimed to obtain preliminary normative data relating to VOSP for older Thai adults and to identify the demographic variables influencing their scoring performance on each VOSP subtest. Furthermore, the practicality and convenience of VOSP focusing on testing time, appropriateness of image size, and clarity of images and instructions was also investigated.

**METHODS:** After getting written permission from Pearson Education Ltd. to translate VOSP, the Incomplete Letters subtest in Thai alphabets was created and linguistic validation of VOSP instructions was done. Forty healthy, older, Thai adults were recruited and stratified into 8 groups by age, gender, and education. Performance of the participants on each VOSP subtest scores, testing time and clarity of each VOSP subtests stimuli and instructions were demonstrated by descriptive statistics. Multiple linear regression analyses were performed to identify potential significant contributions of demographic variables to the VOSP subtest scores performances.

**RESULTS:** The preliminary scores for each VOSP subtest were comparable with those from other normative studies, except the Silhouettes and Object Decision subtests. Gender, intelligence quotient, and visual acuity had significant effects on certain VOSP subtest scores. Mean total testing time was 18 minutes. Most rating scores of image size and clarity of images and instructions of each VOSP subtests were indicated good to excellent quality.

**CONCLUSIONS:** Overall, the preliminary scores of each VOSP subtests in healthy Thai older adults were comparable with the other normative studies. The findings of this study will benefit future national normative study planning in non-native English-speaking countries.

**KEYWORDS:** Visuospatial, Psychometrics; Norms

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## INTRODUCTION

The Visual Object and Space Perception battery (VOSP) comprises a series of tasks that comprehensively assess broad-ranging, visuospatial functions; namely object and space perception abilities, independently of the motor function<sup>1</sup>. VOSP has been used to characterize the clinical symptoms of various disease types, but predominantly neurocognitive disorders whose pathology involves the visuoperceptual function. Examples are posterior cortical atrophy<sup>2</sup>, or dementia of Alzheimer's disease<sup>3</sup>. Apart from clinical symptom evaluations, VOSP has also been used for driver-screening assessments for dementia<sup>4</sup>.

In the original British normative study, although two sample age groups (ranging from 20 to 69 years of age) the effects of gender and education on the test performances were not reported<sup>1</sup>. In the subsequent Spanish Multicenter Normative Studies (NEURONORMA project), VOSP was validated using a broader age group that ranged from 18 to above 80 years. Unfortunately, not all of the VOSP subtests were included<sup>5, 6</sup>. The validation study for VOSP in the American population specifically focused on older adults<sup>7</sup>. The only VOSP validation study in children was done with German-speaking children aged 8 to 12 years, this study showed that the instructions and aims of VOSP were well comprehended by children<sup>8</sup>.

Even though the visuoperceptual tasks in VOSP were considered impervious to cultural factors, given that the test approach is not verbal, the performances of the British, American, and Greek populations revealed differences in most of the VOSP subtests after matching for age<sup>9</sup>. The reported influences of age, gender, and education on the VOSP subtest scores have been mixed or inconsistent across different ethnic groups<sup>7, 10</sup>. While several

studies on the psychometric properties of VOSP have been carried out, VOSP has not yet been validated in Asian populations.

The objectives of the present research were to obtain preliminary normative data for each VOSP subtest in the Thai population, to identify the demographic variables influencing the scoring performance for each VOSP subtest; and to investigate the practicality and convenience of VOSP when administered to the Thai population, focusing on its testing time, the appropriateness of image sizes, and the clarity of images and instructions.

## METHODS

### Participants

A minimum of 40 participants were needed to obtain precision in the correlations between the VOSP subtest scores and the demographic variable parameters<sup>11</sup>. Therefore, the sample of this study consisted of 40, healthy, older adults, aged between 50 and 70 years recruited from the general practitioner outpatient unit of Thammasat University Hospital. The population was stratified into 8 groups by age (50–59, and 60–70 years), gender (males and females), and education level ( $\leq 12$  years, and  $> 12$  years of education). Five participants were chosen from each group by stratified random sampling.

All of the participants were cognitively normal, as indicated by having a Thai State Examination (TMSE) score of  $\geq 24$ <sup>12</sup>. The exclusion criteria were a personal history of neurological diseases; psychiatric disorders; current illegal substance usage; current usage of medications which debilitate cognition; a history of severe head injury; and severe sensorial deficit (loss of vision or hearing) which could not be corrected by instruments. Participants who failed the shape detection screening were also

excluded from this study. The participants received a small payment (equivalent to 9 US dollars) for their participation.

This study was approved by the Human Research Ethics Committee of Thammasat University No. 1 (MTU-EC-PS-1-089/60).

### **Materials**

VOSP Battery<sup>1</sup> contains three main subtests relating to shape detection screening, object perception, and space perception. The shape detection screening aims to check the visual sensory capacities. A score of 15 and lower indicates an impaired visual sensory capacity and suggests the remaining parts should be ceased.

The object perception part comprises four subtests. The Incomplete Letters subtest requires the participants to identify the letters. As most Thais are not familiar with English, this subtest was re-created using Thai letters; this is further described in the Procedures section of this paper. The Silhouettes subtest requires the participants to identify the drawing of animals and objects. The Object Decision subtest requires the participants to identify real object with three distracters. The Progressive Silhouettes subtest requires the participants to identify the objects in stimulus cards constructed by progressively rotating the silhouettes from an unusual view until they are presented in their usual view. In this subtest, a lower score signifies a better performance.

The Space Perception part comprises four subtests. The Dot Counting subtest requires the participants to identify the number of dots on each stimulus. The Position Discrimination subtest requires the participants to decide which square had the dot located at its center. The Number Location subtest requires the participants to identify which number is located in the position corresponding with that of the dot. The Cube Analysis subtest requires the

participant to determine the number of cubes displayed on each stimulus.

Thai Mental State Examination<sup>12</sup> is a bedside screening test for cognitive impairment which is equivalent to the Thai Mini Mental State Examination (MMSE)<sup>13</sup>. A score of 23 or lower indicates cognitive impairment, with a sensitivity of 82%, specificity of 70%, and positive predictive value of 73%.

Standard Progressive Matrices<sup>14</sup> are regarded as a non-verbal estimate of fluid intelligence.

Rosenbaum Pocket Vision Screener<sup>15</sup> is extensively used in clinical practice to assess visual acuity (VA). In this study, binocular VA was measured using the same method employed for monocular measures and was scaled accordingly. Corrective lenses can be used if needed

The questionnaire to assess the appropriateness of the image sizes and the clarity of the images and instructions assign rating scores for the image sizes and the clarity of the images and instructions as follow; 1 (terrible), 2 (somewhat terrible), 3 (fair), 4 (good), and 5 (excellent). The test completion time was recorded for each VOSP subtest.

### **Procedures**

**Linguistic Validation Procedure** One of the researchers (KJ) received written permission from Pearson Education Ltd. to translate VOSP. The agreement included adaptation of the Incomplete Letters subtest into Thai letters. The instructions were independently translated into Thai by two psychiatrists (KJ and BS), who have excellent proficiency in the English language. After evaluation by a local expert, the Thai instructions were back-translated to English by a psychologist who was not familiar with VOSP and was bilingual in Thai and English. The translated instructions were then compared with the original English instructions.

### Incomplete Letters Subtest Construction

The Thai letters which could be potentially confused after fragmentation owing to their similar orthography (e.g., ก-ค, ข-ฃ) were excluded. The remaining 35 out of 44 Thai letters were chosen and randomly fragmented into nine fragmentation levels ranging from 90 percent to 10 percent, with a 10 percent difference between successive levels. The set of Thai letters was administered to 10 normal participants, most of them were able to determine the letters at 60 to 80 percent fragmentation. The researchers chose 70 percent fragmentation because it harmonized with the original English version. The set of Thai letters was then sorted by frequency<sup>16</sup>, and the 22 most frequent out of the 35 letters from the previous step were chosen. The 2 letters that had the highest letter frequency (น, อ) were used as practice items. The practice items were set at 30 percent fragmentation to be consistent with the original test version. The remaining 20 letters were used as the stimuli and were arranged by graded difficulty level.

### Statistical Analysis

PASW Statistics for Windows (version 18; SPSS Inc., Chicago, Ill, USA) was used for the statistical analyses. Descriptive statistics were obtained for the demographic variables, the scoring performance of the participants for each VOSP subtest, the testing times, and the clarity of each VOSP subtest stimuli and instructions. The data were normally distributed for the Silhouette and Progressive Silhouette subtest scores, and for IQ. The independent-samples t-test were used with a  $p$  - value of less than 0.05 considered statistically significant. The other VOSP subtest scores and demographic characteristics, nonparametric statistics were performed using the Mann-Whitney U test and Spearman's correlation, as appropriate. Multiple

linear regression analyses were performed to identify potentially significant contributions by demographic variables to the VOSP subtest scoring performances. Variables were only included in the regression model for each VOSP subtest if they statistically significantly estimated the VOSP subtest scores, as designated in a goodness-of-fit ANOVA test. Consequently, the multiple linear regression model for each VOSP subtest score did not include similar demographic variables.

## RESULTS

The study cohort was comprised of 40 healthy controls, which 20 (50%) were men. Mean (standard deviation (SD)) of age years, education years and intelligence quotient (IQ) were 59.4 (6.0), 10.9 (5.7) and 87.9 (15.7), respectively. Binocular visual acuity of this cohort participants ranged from 20/20 to 20/50. A comparison of the descriptive statistics relating to the Thai VOSP subtest scores and the British<sup>1</sup>, American<sup>7</sup>, and Spanish<sup>10</sup> normative data is detailed (Table 1). The characteristics of the Thai VOSP subtest scores were comparable with the other national normative data, except for the Silhouettes and Object Decision subtests.

Univariate analysis of VOSP subtest scores and demographic characteristics were conducted. Silhouettes subtest score was statistical significant different between participant aged 50-59 ( $M = 19.1$ ,  $SD = 3.6$ ) and 60-69 years ( $M = 16.6$ ,  $SD = 3.8$ ),  $t(38) = 2.12$ ,  $p = 0.04$ . Performance on Silhouettes subtest of male ( $M = 19.6$ ,  $SD = 3.2$ ) were higher than female participants ( $M = 16.2$ ,  $SD = 3.8$ ),  $t(38) = 3.05$ ,  $p < 0.01$ , but performance on Progressive Silhouettes subtest score of male ( $M = 9.7$ ,  $SD = 2.9$ ) were lower than female participants ( $M = 12.2$ ,  $SD = 2.6$ ),  $t(38) = 3.05$ ,  $p < 0.01$ . Please note that lower scores for Progressive Silhouettes

subtest indicated better performance. A Mann-Whitney test indicated that participants who have education years more than 12 years performed better on Cube analysis subtest ( $Mdn = 10$ ) than participants who have education years less or equal to 12 years ( $Mdn = 9$ ), Mann-Whitney  $U = 128$ ,  $p = 0.03$ ,  $r = -0.34$ . The effects of the IQ, cognitive performance as indicated by TMSE score and VA on the VOSP subtest scores are presented (Table 2). Significant effects of age and education are evident for the Silhouettes and Cube Analysis subtests, respectively, while gender had a significant influence on the Silhouettes and Progressive Silhouettes subtests. VA had a significant effect only on the Shape Detection and Position Discrimination subtests. Obviously, IQ score had a strong effect on most of the VOSP subtests, except for Dot counting, Position Discrimination, and Number Location. Cognitive function, assessed by the TMSE, demonstrated no significant effects on any VOSP subtest; as a result, the TMSE scores were not included in the multiple linear regression.

The multiple linear regression analyses were performed to control for interactions between the variables, as illustrated in Table 3. Significant demographic variable effects on the VOSP subtest scores remained for gender, IQ, and VA. Significant effects were found for gender on the Silhouettes and Progressive Silhouettes subtests; for IQ on the Silhouettes, Object Decision subtests; and for VA on the Shape Detection and Position Discrimination subtests.

The testing times and the rating scores for image size, clarity of images, and clarity of instructions for each VOSP subtest are displayed (Table 4) The total VOSP testing time was 18 minutes (mean, 18.0; SD, 4.7; min, 10.4; max, 29.8). Most of

the rating scores for image size and the clarity of the images and instructions for each VOSP subtest were more than 4, which indicates a good quality; the exceptions were the rating scores for image clarity for the Silhouettes and Object Decision subtests.

## DISCUSSION

It is possible that there was a ceiling effect on the Incomplete Letters, Dot Counting, and Position Discrimination subtests. These were consistent with the results of the British normative data, which indicated that the Dot Counting and Position Discrimination subtests had very high mean scores<sup>1</sup>. Moreover, the results of the American normative data also revealed a ceiling effect for the Incomplete Letters subtest in the population aged less than 70 years<sup>7</sup>. The Silhouettes and Object Decision subtests had lower means and fifth percentile cut-off scores. This finding, while preliminary, suggests that the cut-off score of the original British normative study may not be applicable to the Thai population. A low score may not necessarily reflect a low performance because a number of objects in the Silhouettes and Object Decision subtests are uncommon for the Thai culture and context<sup>17</sup> for example, a kangaroo and a seal. Some pictures may need to be replaced with more common objects for the Thai population; otherwise, lower cut-off scores need to be indicated.

Education has been reported to have marginally significant associations with the scoring performances for the Silhouettes. Gender had significant effects on the Silhouettes and Progressive Silhouettes subtest scores. These findings were consistent with the Spanish normative study<sup>10</sup>. Therefore, it is important to control for education and gender in cognitive measures using visually-based tasks.

Table 1 Descriptive Statistics for each VOSP subtest scores comparing to British, American, and Spanish normative data

VOSP subtests (score)	Thai data (n = 40)		British data <sup>7</sup> (n = 160)		American data <sup>18</sup> (n = 111)		Spanish data <sup>21</sup> (n = 90)	
	Min-max	Median (IQR)	Mean (SD)	5 <sup>th</sup> percentile cut-off	Mean (SD)	5 <sup>th</sup> percentile cut-off	Mean (SD)	Mean (SD)
Shape Detection (20)	18-20	20 (20-20)	19.9 (0.4)	-	19.92 (0.3)	-	-	-
Object Perception								
Incomplete Letters (20)	15-20	20 (18-20)	19.1 (1.2)	17	18.8 (1.4)	16	19.5 (0.7)	19.1 (1.0)
Silhouettes (30)	8-26	18 (16-21)	17.9 (3.9)	11	22.2 (4.0)	15	20.4 (3.8)	19.7 (4.3)
Object Decision (20)	7-20	16 (14-17)	15.1 (2.6)	9	17.7 (1.9)	14	17.5 (1.9)	16.4 (2.5)
Progressive Silhouettes* (20)	5-16	11 (9-13)	11.0 (2.9)	15	10.8 (2.5)	15	9.6 (2.2)	10.9 (2.6)
Space Perception								
Dot Counting (10)	9-10	10 (9-10)	9.8 (0.4)	9	9.9 (0.2)	8	9.8 (0.6)	9.8 (0.5)
Position Discrimination (20)	18-20	20 (19-20)	19.6 (0.7)	18	19.6 (0.9)	18	19.5 (1.3)	19.1 (2.0)
Number Location (10)	3-10	10 (9-10)	9.2 (1.4)	6	9.4 (1.1)	7	9.1 (1.3)	8.6 (1.8)
Cube Analysis (10)	7-10	9 (9-10)	9.3 (0.8)	8	9.2 (1.2)	6	9.5 (0.8)	8.6 (1.9)

Note. \* Lower scores for Progressive Silhouettes indicate better performance. IQR, interquartile range; SD, standard deviation

Table 2 Summary of univariate analysis of VOSP subtest scores and IQ, TMSE, and VA

VOSP subtests	IQ		TMSE		VA	
	Spearman's rho	p - value	Spearman's rho	p - value	Spearman's rho	p - value
Shape Detection	0.23	0.16	0.18	0.27	0.34	0.03
Object Perception						
Incomplete Letters	0.39	0.01	0.02	0.88	0.19	0.25
Silhouettes	0.46	< 0.01	0.20	0.23	0.07	0.67
Object Decision	0.45	< 0.01	0.11	0.51	0.01	0.95
Progressive Silhouettes*	-0.41	< 0.01	0.02	0.91	-0.24	0.13
Space Perception						
Dot Counting	-0.09	0.60	0.12	0.47	0.21	0.20
Position Discrimination	0.24	0.13	0.21	0.20	0.35	0.03
Number Location	0.29	0.07	0.29	0.07	-0.02	0.91
Cube Analysis	0.38	0.01	0.31	0.05	0.26	0.11

Note. \* Lower scores for Progressive Silhouettes indicate better performance.

Table 3 Summary of multivariate analysis of VOSP subtest scores and demographic characteristics

VOSP subtests	Age (years)		Gender (male)		Education (years)		IQ		VA		R - squared
	$\beta$ (95% CI)	p - value	$\beta$ (95% CI)	p - value	$\beta$ (95% CI)	p - value	$\beta$ (95% CI)	p - value	$\beta$ (95% CI)	p - value	
Shape Detection	0.02 (-0.01, 0.04)	0.18	-0.14 (-0.39, 0.11)	0.27			0.01 (-0.01, 0.02)	0.12	0.14 (0.03, 0.26)	0.02	0.24
Object Perception											
Incomplete Letters			-0.38 (-1.11, 0.35)	0.30			0.02 (-0.01, 0.05)	0.07			0.14
Silhouettes	-0.11 (-0.30, 0.07)	0.22	-2.70 (-4.79, -0.60)	0.01	-0.21 (0.43, 0.00)	0.05	0.13 (0.05, 0.21)	0.002	0.23 (-0.72, 1.19)	0.63	0.44
Object Decision	0.07 (-0.07, 0.21)	0.33	-0.37 (-1.96, 1.21)	0.64	-0.02 (-0.02, 0.14)	0.78	0.09 (0.03, 0.15)	0.004	0.14 (-0.59, 0.86)	0.70	0.29
Progressive Silhouettes	0.06 (-0.08, 0.20)	0.39	2.45 (0.85, 4.04)	0.004	-0.08 (-0.25, 0.08)	0.31	-0.02 (-0.08, 0.04)	0.43	-0.65 (-1.38, 0.07)	0.07	0.40
Space Perception											
Dot Counting											
Position					0.03 (-0.01, 0.06)	0.18			0.19 (0.01, 0.37)	0.04	0.16
Discrimination											
Number Location											
Cube Analysis					0.02 (-0.03, 0.07)	0.38	0.01 (-0.01, 0.03)	0.11			0.16

Note. Dot Counting and Number Location subtest scores were refrained from multivariate analysis because there was no statistically significant result in the univariate analysis with any demographic variable. The black elements indicate the variables which were not included in multiple linear regression analyses because the variables did not statistically significantly predict the VOSP subtest scores, as designated in a good-fit ANOVA test. The grey elements indicate the variables which had shown significant associations with the VOSP subtest scores in the univariate analysis.

**Table 4** Testing time, rating score of image size, and clarity of images and instructions of each VOSP subtest

VOSP subtest	Time (min)	Image clarity	Image size	Instruction clarity
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
<b>Shape Detection</b>	1.0 (0.3)	4.5 (0.7)	4.8 (0.4)	4.9 (0.3)
<b>Object Perception</b>				
<b>Incomplete Letters</b>	1.0 (0.4)	4.2 (0.8)	4.4 (0.7)	5.0 (0.2)
<b>Silhouettes</b>	5.0 (1.6)	3.9 (1.0)	4.6 (0.8)	4.9 (0.3)
<b>Object Decision</b>	4.8 (1.8)	3.9 (1.0)	4.6 (0.7)	4.7 (0.5)
<b>Progressive Silhouettes</b>	2.2 (0.9)	4.5 (0.8)	4.8 (0.5)	4.4 (0.6)
<b>Space Perception</b>				
<b>Dot Counting</b>	0.6 (0.1)	4.9 (0.3)	4.8 (0.5)	5.0 (0.0)
<b>Position Discrimination</b>	1.2 (0.4)	4.9 (0.4)	4.7 (0.5)	4.9 (0.3)
<b>Number Location</b>	1.2 (0.6)	4.8 (0.4)	4.4 (0.7)	4.8 (0.5)
<b>Cube Analysis</b>	1.1 (0.5)	4.9 (0.4)	4.8 (0.5)	4.9 (0.3)

Note. Rating scores for image size and clarity of images and instructions were classified as 1 (terrible), 2 (somewhat terrible), 3 (fair), 4 (good), and 5 (excellent). SD, standard deviation.

Although IQ demonstrated significant effects on various VOSP subtests in the univariate analysis, the effects remained significant only for the Silhouettes and Object Decision subtests in the multivariate analysis. This rather contradictory result might be a result of a multi-collinearity problem in this pilot data. Unsurprisingly, VA had significant effects on Shape Detection and Position Discrimination because these two subtests most require a high VA<sup>1</sup>. The only VOSP subtest which was not influenced by demographic factors in this Thai pilot sample was Incomplete Letters. This is significant as it means that the Incomplete Letters subtest is a neuropsychological test for the assessment of object perception abilities which is neutral to demographic variables.

The total testing time of the original British normative VOSP study was not reported<sup>1</sup>, but it was estimated to be approximately 40 - 80 minutes<sup>18</sup>. The mean total testing time for the normal Thai participants was 18 minutes which is apparently shorter than the estimated testing time. This informa-

tion will be beneficial when planning the data collection for a future, large-scale, national normative study. The scores for image clarity in the Silhouettes and Object Decision subtests were lower than those for the other subtests. This discrepancy could be attributed to the reason previously discussed, which is that the objects in the Silhouettes and Object Decision subtests are uncommon for the Thai culture and context. The rating scores for image size and for clarity of the images and instructions for each VOSP subtest indicated that the quality of the images was good and that the instructions were comprehensible.

This study provided the preliminary normative results for the VOSP in healthy Thai older adult population. However, sample size of this pilot study was quite small resulting in limitation to identify the demographic variables influencing the scoring performance for each VOSP subtest. The national normative study should be further conducted with larger number of sample size, broader age group and including pathological population.

**Conflict of Interest:** Bhumpaphop Sunsuk and Kankamol Jaisin certify that they have no affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

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