

# Positive Effects of Ska Game Practice on Cognitive Function among Older Adults

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**Background:** Ska is a traditional board game in Thailand that involves high levels of cognition, planning, and decision-making. There have been no previous studies on the benefits of the Ska game as a cognitive function aid for older adults.

**Objective:** To examine the effects of Ska game practice on improving cognitive functioning among older adults.

**Material and Method:** Forty older adults living in the municipality of Phetchabun province, volunteered to take part in the present study. They were randomly selected and arranged into two intervention groups, an experiment and a control group (20 participants each group; 10 females and 10 males). Each group was repeatedly trained as planned for at least 50 minutes per day, three sessions per week for the continuous duration of 16 weeks. The cognitive function measured in term of memory, Verbal Pair Association I and II (VPA I; VPA II), Visual Reproduction I and II (VR I; VR II), the attention used of Trail Making Test part A (TMT-A), and the executive function used by means of the Wisconsin Card Sorting Test (WCST). The examination was done by a clinical psychologist and a medical technologist using neurotransmitter to measure Acetylcholinesterase (AChE) activity, before and after the intervention. The independent variables were measured with t-test to compare the mean scores of two different groups and between males and females of the Ska group. The level of significance considered was  $p < 0.05$ .

**Results:** The findings revealed that those who joined the Ska group reported statistically significant better scores of cognitive function in memory, attention, executive function from VPA I, VPA II, VR I, VR II, TMT-A, and WCST compared to those who were in the control group ( $p < 0.05$ ). However, there was no significant difference of AChE activity between the Ska and the control group ( $p > 0.05$ ). In addition, there was no significant difference mean in cognitive function between male and female Ska group ( $p \geq 0.05$ ).

**Conclusion:** Finding shows that the Ska game could enhance the cognitive functioning in terms of memory, attention, and executive function in older adults.

**Keywords:** Ska, Cognitive function, Older adults

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Aging is associated with a decrease in brain size and plasticity, especially in the cerebral cortex and the limbic system, which are directly related to cognition. Moreover, there is a decrease in the amount of neurotransmitters, especially Acetylcholine or Ach, which is vital for the central nervous system and the peripheral nervous system<sup>(1)</sup>. It is found that there is a decrease in AChE activity in the temporal lobe of the cerebral cortex, hippocampus, and mammillary body in the brain of older persons and persons with Alzheimer's disease (AD). The decrease of this enzyme

has a relationship with cognitive loss in AD patients<sup>(2)</sup>. In addition, there is evidence of attention deficit disorder that results in a decrease in memory and attention to information. Learning requires more time and declines in memory, especially new memories<sup>(3)</sup>. It was also found that there is a relationship between the older adults of over 60 years and cognitive impairment<sup>(4)</sup>, indicating that the decline of brain functions has resulted in a lower quality of life.

With regard to these issues, methods to slow down or decrease the rate of these problems are important. Some research suggested from MRI that more activities were found in the parietal lobe, temporal lobe, occipital lobe, and around left cerebral hemisphere while playing Chess, but Go would cause more activities in the right cerebral hemisphere

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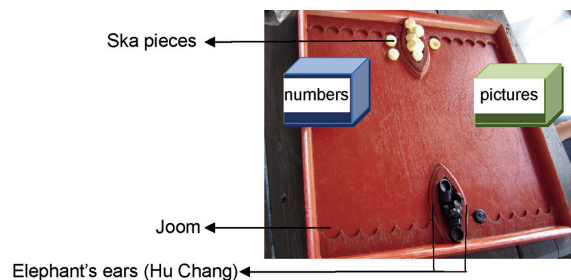
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instead of the left cerebral hemisphere<sup>(5,6)</sup>. The results of the studies illustrate a better functioning of the forebrain and the limbic system, which have cognitive functions. The result here provides a research interest that led to the present study where the researcher would like to examine Ska, a traditional Thai board game similar to Chess and Go in terms of thought process i.e. number and picture relation, language, planning method, and defending strategy<sup>(7)</sup>. In terms of the principles of play, the players move the pieces in the holes provided on the board. These holes are called 'Jooms'. Each side of the board contains 1 to 12 Jooms (left to right of each player) (Fig. 1).

Each side will hold 15 Ska pieces of different colors. They are black and white. At the beginning of the game, the players will place one Ska piece called the city governor or 'Tua Kerd' or 'Chao Muang' upside down in the twelfth Jooms (Each player will have only one piece of Tua Kerd/Chao Muang and he/she may not move this piece. The only time the player can turn the side of the piece up is when one of his/her own pieces moves across). The other 14 pieces will be placed in the middle area called elephant's ears or 'Hu Chang'. Afterwards, each player will take turns in drawing card numbers (number 1 to 6) and pictures, the players will receive the score that will be used to move the Ska pieces from the Hu Chang to the Jooms. In moving each Ska piece, the player will count from Joom 1 to Jooms 12 of the opponent's side. Then, he/she will move all the Ska pieces back to Jooms 7 to 12 of his/her own side so as to win. The player who can take all the pieces back first will win. In this scenario of play, the thought process is used through the stages of counting the scores, relating thoughts between numbers and pictures, language, planning method, as well as defending opponents. However, there are no research studies about the Ska game to enhance cognitive function. The present study applied the Ska game in order to investigate its effect in decelerate or decrease the rate of the cognitive decline among the older adults.

### Material and Method

The experimental protocol was approved by the Ethics Committee for Research Involving Human Research Subjects Health Science Group, Chulalongkorn University, Thailand (Study Title No. 128.1/53). All participants gave their written informed consent. The sample group consisted of 40 volunteers who were male and female elderly living in the municipal area of Phetchabun province. The participants



**Fig. 1** Ska board game and its equipment.

were divided into the Ska group and the control group (20 participants each group; 10 females and 10 males) by using the randomized assignment into two groups. In defining the size of the sample group at the significance level 0.05 with effect size 0.80 and power 0.70, a researcher used Cohen's<sup>(8)</sup> (1988) table with the inclusion criteria as follows: Thai literate participants with at least primary education who are in a healthy mental state, with no cognitive impairment, depression problems, hearing impairment, visual impairment or speech impairment, and medical history related to drug taking or alcoholism. Moreover, the participants must be those who do not exercise regularly. If they do, the exercise must not exceed two days a week. They must not have any experience of playing or practicing Ska or any other games that require cognitive practice. One week prior to the research as well as during the research, the participants must not take any psychotropic drugs. Finally, they must be without any congenital or chronic diseases that may present an obstacle in practicing the board game. To evaluate the participant's cognitive impairment, the Mini-Mental State Examination Thai 2002 (MMSE-Thai 2002)<sup>(9)</sup> was adopted with a score of between more than 17 and 30 points among the elderly with primary education and more than 22 and 30 points for those with education higher than the primary. On the other hand, the Thai Geriatric Depression Scale (TGDS)<sup>(10)</sup> is used to assess depression, with a target score of less than 13 points out of the total score of 30 points. The participants would be excluded if they did not join the planned activity due to illnesses or time constraints.

Research design of the pretest-posttest control group: The duration of the practice was 50 minutes per day, three sessions per week for the continuous duration of 16 weeks. The measurements of dependent variables were tested twice, once before and once after the experiments. These two groups practiced the programs within public yard at different locations in Phetchabun province on the same day according to the Ska program

activities. As for the experiment group, the topics for discussion are 1) Knowledge about Ska, 2) Practice playing Ska, 3) Competition in the game, 4) Strategies in playing Ska, 5) Competition in terms of thoughts and speed, and 6) Practice for mastering in the game. For the control group, the activities include 1) Self-introduction, 2) Background telling, 3) Changes in older age, 4) Our body, 5) Food pyramid, 6) Watching television, 7) Listening to the radio, 8) Watering trees, 9) Parties, 10) Cleaning, 11) Listening to dhamma talks, 12) Diseases in the elderly, and 13) Your own health.

The baseline characteristics were measured by a researcher. Cognitive measurement using four domains of cognitive functioning was assessed, memory, attention, executive function, and Acetylcholinesterase (AChE) activity. This measurement was approved by a clinical psychologist. A medical technologist performed the test before and after the experiment.

1. Memory test using Wechsler Memory Scale III<sup>(11)</sup>, which consists of the following subtests:

1.1 Verbal Paired Associates I (VPA I) including eight word pairs. The test invigilator first reads all these word in pairs. The test invigilator then reads one word of one word pair. Afterwards, the test taker must say the other word of that particular pair. If the test taker answers it correctly, he/she receives 1 point.

1.2 Verbal Paired Associates II (VPA II). The test taker says the word pairs from his/her memory 25-30 minutes after the Verbal Paired Associates I subtest is complete.

1.3 Visual Reproduction I (VR I). This subtest includes five geometric figures. The test taker is given 10 seconds to look at the figures and he/she is allowed to look at them only once. Afterwards, he/she draws the geometric figures from his/her memory.

1.4 Visual Reproduction II (VR II). The test taker draws geometric figures from his/her memory 25-30 minutes after the Visual Reproduction I subtest is complete.

2. Attention test using the Trail Making Test part A (TMT-A)<sup>(12)</sup>. The test taker draws a line following the dots numbered 1 to 25. The time spent in doing the test is recorded in seconds.

3. Executive function test using the Wisconsin Card Sorting Test (WCST)<sup>(13)</sup>. The WCST consists of four stimulus cards and 128 response cards that depict figures of varying forms (crosses, circles, triangles, or stars), colors (red, blue, yellow, or green), and numbers of figures (one, two, three, or four). In the processes of the four stimulus cards, the client is then handed a

deck of 64 response cards and instructed to match each consecutive card from the deck with one of the four stimulus cards, whichever one he or she thinks it matches. The client is told only whether each response is right or wrong and is never told the correct sorting principle (or category).

4. Test for the level of Acetylcholinesterase (AChE) activity<sup>(14)</sup>. The 2 cc of venous blood sample was collected in the morning after 10-hour overnight fast. The analysis of AChE activity; The Amplite™ Colorimetric Acetylcholinesterase Assay Kit is used in the analysis at the Molecular Biology Laboratory for Neurological Disease at King Chulalongkorn Memorial Hospital, Bangkok Thailand. The measurement unit is mU/ml.

### **Statistical analyses**

Baseline characteristics of Ska and control groups were compared using independent t-tests. The t-tests were performed to determine whether cognitive test scores changed between Ska and control groups and between the males and the females of Ska group. Mean change scores were calculated by subtracting pre-intervention from post-intervention scores in Ska and control groups, males and females of Ska group.

### **Results**

The participants of the two groups had similar baseline characteristics (Table 1). In terms of demographic variables, most differences between the groups were not statistically significant. Only the mean pulse of control group was higher than the Ska group and between males and females of the Ska group ( $p < 0.05$ ), but this did not affect cognitive training.

For cognitive scores, mean change between the groups were statistically significant ( $p < 0.05$ ) but AChE activity was not significantly different ( $p > 0.05$ ) (Table 2).

In the Ska group, the comparison of cognitive mean among males and females showed no difference with a statistical significance of 0.05 as seen in Table 3.

### **Discussion**

From the present study, after participating in the training program, the Ska group had a higher cognitive mean score change than the control group, in the aspects of better memory, attention, as well as executive function, with a statistical difference ( $p < 0.05$ ). When considering the game of Ska, it covered the cognitive functions in terms of memory, attention,

**Table 1.** Baseline characteristics of Ska group and control group

Characteristics	Control group (n = 20)			Ska group (n = 20)		
	Males (n = 10) (mean±SD)	Females (n = 10) (mean±SD)	Total (mean±SD)	Males (n = 10) (mean±SD)	Females (n = 10) (mean±SD)	Total (mean±SD)
Age (years)	65.00±2.62	65.30±3.83	65.15±3.19	64.20±3.71	64.20±2.86	64.20±3.22
Height (cm)	161.80±6.55	153.70±4.47 <sup>+</sup>	157.75±6.85	162.50±6.22	152.40±3.37 <sup>#</sup>	157.45±7.11
Weight (kg)	61.00±12.54	60.20±17.45	60.60±14.79	58.00±5.91	54.00±8.18	56.00±7.24
Pulse (beats per minute)	76.70±7.47	82.90±10.29	79.80±9.31	67.90±7.67	75.20±7.74 <sup>#</sup>	71.55±8.38*
Systolic (mm Hg)	137.60±21.45	144.40±24.05	141.00±22.45	128.10±15.81	136.90±22.19	132.50±19.28
Diastolic (mmHg )	69.90±8.29	83.10±13.57 <sup>+</sup>	76.50±12.86	75.30±10.92	79.80±9.85	77.55±10.38
MMSE-Thai 2002 (score)	27.10±2.85	28.70±1.57	27.90±2.38	26.90±2.92	28.70±1.49	27.80±2.44
TGDS (score)	5.60±3.13	2.10±1.60 <sup>+</sup>	3.85±3.01	3.50±2.88	2.60±1.90	3.05±2.42

MMSE-Thai 2002 = The Mini-Mental State Examination Thai 2002; TGDS = The Thai Geriatric Depression Scale

\* Ska group significant difference control group at p<0.05

<sup>+</sup> Males and females of control group significant difference at p<0.05

<sup>#</sup> Males and females of Ska group significant difference at p<0.05

and executive function. Ska also stimulated learning and thought process i.e. relationship linking among number 1 to 6 and the pictures, counting scores in a numerical order, language use of words such as Chang, Sad, Ble, Hoochang, Joong, Karnkerd, Karntodkin, Chaomuang, Joom, and Peapod. These practices would stimulate brain functioning, the limbic system, hippocampal formation, and entorhinal cortex. Moreover, thoughts were used in planning and decision-making in moving Ska pieces as well as in defending strategy. All of which stimulated the functioning of prefrontal association cortex. This was conjunction with a prior study which illustrated that playing chess requires the functions of the parietal lobe, the temporal lobe, the occipital lobe and the area around the left cerebral hemisphere<sup>(5)</sup> and another study which showed that Go taxed more of the right cerebral hemisphere than the left cerebral hemisphere<sup>(6)</sup>. This research was also in line with a number of studies stating that cognitive training had been a traditional approach to improve cognitive functioning in older adults. It consisted of learning and practicing skills and techniques to manage cognitively demanding situations<sup>(15,16)</sup>.

The schedule of practicing Ska, which took 50 minutes per session, three sessions per week for 16 weeks, also resulted in repetitive learning and thus better cognitive results. The present study was also consistent with other researches investigating cognitive training in which several cognitive training programs

were shown to be effective at improving healthy older adults' memory, reasoning<sup>(17)</sup>, verbal memory and executive function<sup>(18)</sup>, attention/working memory, and executive function<sup>(19)</sup>.

On the other hand, in terms of the results of the study the level of enzyme acetylcholinesterase (AChE) activity, it was found that mean difference of the Ska group was not different from that of the control group, with a statistical significance (p = 0.758). However, there was a tendency of an increased mean change, AChE activity of the Ska group increased 155.03 whereas that of the control group rose by 52.08. However, the Ska group had increased tendency of AChE activity level more than the control group. Future study may be needed to elucidate the AChE activity.

In practicing Ska, it was found that there was no statistical difference in the cognitive mean of most elements between genders. In research the level of AChE activity found that there was not significantly different between males and females (p = 0.05), which agreed with the findings that there was no difference in the quantity of AChE activity between males and females, with a statistical difference<sup>(20)</sup>. The cognitive function in attention, memory, and executive function was not consistent with the research that found some difference between the genders affected attention, working memory<sup>(21)</sup>. However, when looking at the results of the test it showed that the difference was

**Table 2.** Summarizes the comparison of cognitive functions between the control group (CG) and the Ska group (SG)

Cognitive function test	CG (n = 20)			SG (n = 20)			Difference (95% CI)	p-value
	Pre-test (mean±SD)	Post-test (mean±SD)	Mean change	Pre-test (mean±SD)	Post-test (mean±SD)	Mean change		
VPA I (score)	10.80±8.42	6.50±6.39	-4.30	12.05±6.18	25.15±6.45	13.10	-17.40 (-21.01 to -13.79)	0.000*
VPA II (score)	3.45±2.64	2.10±2.12	-1.35	3.55±1.82	7.45±1.09	3.90	-5.25 (-6.55 to -3.95)	0.000*
VR I (score)	69.95±17.16	51.15±25.18	-18.80	72.15±20.10	95.20±6.84	23.05	-41.85 (-51.59 to -32.11)	0.000*
VR II (score)	46.10±25.67	29.35±25.04	-16.75	59.00±27.77	95.85±6.72	36.85	-53.60 (-65.58 to -41.62)	0.000*
TMT-A (sec)	58.24±35.85	76.49±31.57	18.25	47.08±26.40	27.50±6.86	-19.58	37.83 (23.01 to 52.65)	0.000*
WCST (variable total number of errors) (score)	63.90±24.38	70.20±22.12	6.30	63.85±22.49	37.85±23.17	-26.00	32.30 (18.70 to 45.90)	0.000*
AChE (mU/ml)	6,548.24±1,650.53	6,600.37±1,690.45	52.08	6,614.65±1,571.99	6,769.68±1,775.75	155.03	-102.96 (-773.16 to 567.24)	0.758

\* p&lt;0.05, difference is mean change Ska-control

CI = confidence interval

**Table 3.** Summarizes the comparison of cognitive function between males (MSG) and females (FSG) of the Ska group

Cognitive function test	MSG (n = 10)			FSG (n = 10)			Difference (95% CI)	p-value
	Pre-test (mean±SD)	Post-test (mean±SD)	Mean change	Pre-test (mean±SD)	Post-test (mean±SD)	Mean change		
VPA I (score)	11.90±5.13	25.10±6.29	13.20	12.20±7.37	25.20±6.94	13.00	0.20 (-5.65 to 6.05)	0.944
VPA II (score)	3.10±1.28	7.50±0.84	4.40	4.00±2.21	7.40±1.34	3.40	1.00 (-0.67 to 2.67)	0.224
VR I (score)	67.80±21.83	93.50±8.20	25.70	76.50±18.28	96.90±5.02	20.40	5.30 (-10.92 to 21.52)	0.501
VR II (score)	52.90±29.45	94.10±8.10	41.20	65.10±26.04	97.60±4.78	32.50	8.70 (-14.31 to 31.71)	0.437
TMT-A (sec)	46.68±13.89	28.80±6.43	-17.88	47.48±35.75	26.20±7.36	-21.28	3.40 (-18.08 to 24.88)	0.743
WCST (variable total number of errors) (score)	68.40±20.99	39.50±23.82	-28.90	59.30±24.10	36.20±23.67	-23.10	-5.80 (-28.62 to 17.02)	0.600
AChE (mU/ml)	6,469.79±1,412.12	6,099.94±1,025.66	-369.86	6,759.50±1,782.19	7,439.42±2,146.15	679.92	-1,049.78 (-2,097.45 to -2.11)	0.050

p≥0.05

CI = confidence interval

found females had much more attention and executive function than males. Nevertheless, some studies did find that gender had a significant effect on the verbal fluency. Females seemed to be better in semantic fluency for fruit-related words while males were better in semantic fluency for tool-related words<sup>(21)</sup>. At present, there is still not clear evidence in terms of cognitive training in relation to gender. Whereas some studies have reported significant differences between genders, some have not. This is due to socio-cultural, educational factors<sup>(22)</sup>, and occupations in which the number of males engaged in mental work is always larger than that of females<sup>(23)</sup>.

### Conclusion

Playing Ska is considered a practice in cognitive training that benefits cognitive functions of the older adults. It helps to increase memory, attention, and executive function in both males and females. A lack of memory, attention, and executive function contributes to the deceleration of cognitive decline in the elderly.

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### Potential conflicts of interest

None.

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## ผลดีของการฝึกเกมสกาที่มีต่อพุทธิปัญญาในผู้สูงอายุ

สมศรี ปานพันธุ์โพธิ์, นันทิกา ทวิชาชาติ, ถนอมวงศ์ กฤษณ์เพชร

**ภูมิหลัง:** สกาเป็นเกมหมากกระดานของไทยที่ใช้กระบวนการคิดทางปัญญาระดับสูง, การวางแผนและการตัดสินใจ ซึ่งยังไม่ค่อยมีการศึกษาถึงประโยชน์ของการฝึกเกมสกาต่อพุทธิปัญญาในผู้สูงอายุ

**วัตถุประสงค์:** เพื่อศึกษาถึงผลของโปรแกรมการฝึกสกาที่มีต่อการพัฒนาพุทธิปัญญาในผู้สูงอายุ

**วัสดุและวิธีการ:** กลุ่มตัวอย่างเป็นอาสาสมัครผู้สูงอายุจำนวน 40 ราย อาศัยอยู่ในเขตเทศบาล จังหวัดเพชรบูรณ์ แบ่งออกเป็น 2 กลุ่ม คือ กลุ่มฝึกสกาและกลุ่มควบคุม กลุ่มละ 20 ราย เป็นเพศชาย 10 ราย และเพศหญิง 10 ราย ผู้นิพนธ์ทำการฝึกตามโปรแกรมที่กำหนดในแต่ละกลุ่มในวันเดียวกันเป็นเวลา 16 สัปดาห์ ๆ ละ 3 วัน ๆ ละ 50 นาที การวัดพุทธิปัญญาประกอบด้วย ความจำในทันทีที่เห็นและจำจากการระลึกได้ โดยใช้แบบทดสอบความจำจากการเชื่อมโยงภาษาและความจำในการระลึกได้จากการเชื่อมโยงภาษา ความจำจากการมองเห็นภาพ และความจำในการระลึกได้จากภาพ ด้านสมาธิใช้แบบทดสอบ "Trail Making Test part A" ด้านการใช้เหตุผลในการตัดสินใจใช้แบบทดสอบ "The Wisconsin Card Sorting Test" ซึ่งวัดโดยผู้เชี่ยวชาญด้านจิตวิทยาคลินิก และสารสื่อประสาทใช้การวัดปริมาณเอนไซม์อะซิติลโคลีน เอสเทอร์เรส แอคทีวิตี โดยผู้เชี่ยวชาญด้านการตรวจวิเคราะห์ทางวิทยาศาสตร์การแพทย์ มีการทดสอบพุทธิปัญญาก่อนและหลังการทดลอง โดยเปรียบเทียบผลต่างของค่าเฉลี่ยระหว่างกลุ่มฝึกสกากับกลุ่มควบคุม และระหว่างเพศชายและหญิงในกลุ่มฝึกสกาที่ระดับความมีนัยสำคัญ 0.05

**ผลการศึกษา:** กลุ่มฝึกสกาที่มีค่าเฉลี่ยของพุทธิปัญญาในด้านความจำ ด้านสมาธิ และด้านการใช้เหตุผลในการตัดสินใจจากการวัดความจำจากการเชื่อมโยงภาษา, ความจำในการระลึกได้จากการเชื่อมโยงภาษา, ความจำจากการมองเห็นภาพ, ความจำในการระลึกได้จากภาพ, "Trail Making Test part A", "The Wisconsin Card Sorting Test" ดีกว่ากลุ่มควบคุม ( $p < 0.05$ ) ยกเว้นปริมาณเอนไซม์อะซิติลโคลีน เอสเทอร์เรส แอคทีวิตี นอกจากนี้ค่าเฉลี่ยพุทธิปัญญาไม่แตกต่างกันในระหว่างเพศชายและหญิงของกลุ่มฝึกสกา ( $p \geq 0.05$ )

**สรุป:** การฝึกเกมสกาที่มีประโยชน์ต่อการเพิ่มพุทธิปัญญาในด้านความจำ สมาธิ และการใช้เหตุผลในการตัดสินใจของผู้สูงอายุ