



## A research study using CKPT on what kind of changes were brought about in the development process of the frontal lobe due to the national system change given to elementary school students (6-12 years old)

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### Article Info

**Received:** December 13, 2023

**Accepted:** December 19, 2023

**Published:** December 22, 2023

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**Citation:** Takaki Shimura, Hironori Ohsigi. (2023) "A research study using CKPT on what kind of changes were brought about in the development process of the frontal lobe due to the national system change given to elementary school students (6-12 years old).", *Clinical Case Reports and Clinical Study*, 10(1); DOI: 10.61148/2766-8614/JCCRCS/162

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### Abstract:

In August 1945, Japan's national system changed from an imperial system to democracy. We investigated the influence of Japanese people who faced this change during their elementary school years (6-12 years old), which is an important period in the growth process of frontal lobe function. The study was conducted using the CKPT (Japanese version of CWPT: Color Words Pick-out Test), which measures frontal lobe function, and examined whether the values of index 1 of the CKPT were normally distributed. Among males, the generation that faced the change showed a normal distribution similar to other generations, so it was assumed that the effect of the change during elementary school was not significant. On the other hand, among female, there was a generation that did not exhibit normality, not only among those who faced change during their elementary school days, but also among those who faced change before and after that time. Furthermore, it was found that the generations that did not show normality were related to the examined age group. This study shows that when people are faced with the most significant stimulus, the state system changing, during the growth process of their frontal lobe functions, it affects female more than male.

**Key words:** the development process of the frontal lobe, CKPT, an imperial system, democracy

### Introduction:

In August 1945, Japan's national system changed from an imperial system to democracy, forcing a change in the behavior of the Japanese people. The following considerations were made from the perspective that changes in national systems may affect the growth of cognitive function. In the imperial dictatorship system, the prefrontal cortex function, which allows people to make decisions and act on their own, was not allowed to activate, and subordinates from upper to lower were at the center of action in Japan. After the country was forced to change to democracy, the freedom of individual action that demonstrated the functions of the prefrontal cortex came to be respected. In other words, the norms of behavior have changed 180 degrees.

Japanese people who encountered the changes described above were shocked in their thinking process. I thought that this shock might have affected the development of the prefrontal cortex in elementary school students who were 6 to 12 year's old, through previous many research<sup>1-6</sup>). So, I conducted an investigation using the CKPT, which largely reflects the function of the prefrontal cortex<sup>7</sup>).

## Methods

### 1. CKPT

CKPT (Japanese version of CWPT) was devised in 2003 as a test method that can classify cognitive function at PCSD (Preclinical Stage of Dementia)<sup>8)</sup> before the onset of dementia. For the first time in 2019, it was announced at an international conference<sup>9)</sup> that there is a correlation with WCST as criterion-related validity, sensitivity = 1, specificity = 0.963, and in the same year it was published as a paper in the HOSA Journal of Alzheimer's and Neurodegenerative Disease<sup>10)</sup>. Furthermore, we presented a study that derived diagnostic criteria from large-scale data of 1325 people using CKPT at an international conference in 2019<sup>11)</sup>, and in 2020 we published the diagnostic criteria for CKPT in the same journal<sup>12)</sup>. Since then, we has published research results such as the results of using CKPT on healthy elderly people<sup>13)</sup> and a report on comparing the normality of large-scale data over 15 years<sup>14)</sup>.

The feature of CWPT is described following:

**Story**  
Last Sunday, Renate went swimming with her red bag alone. She went up the hill and could see a long gray sandy beach below. There were red, pink, blue and yellow umbrellas like flowers.

Fig.1 Sample of CWPT (Story)

**Questions (select one)**  
What was Renata going for ?  
(shopping, surfing, swimming, forget)  
What color was her bag ?  
(red, pink, yellow, forget).

Fig.2 Sample of CWPT (Questions)

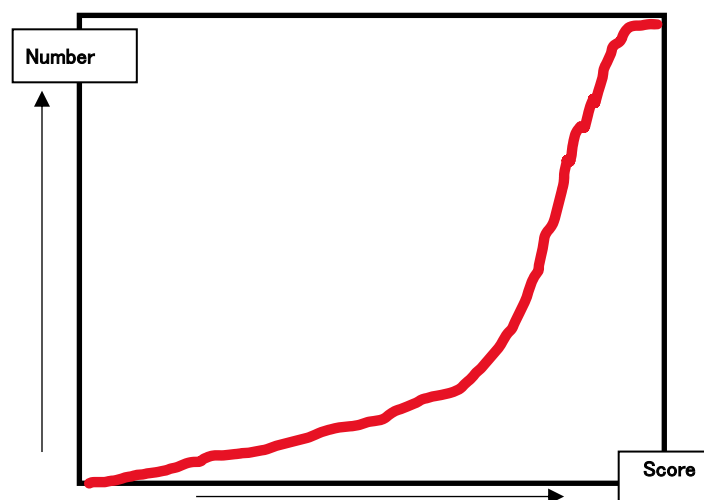
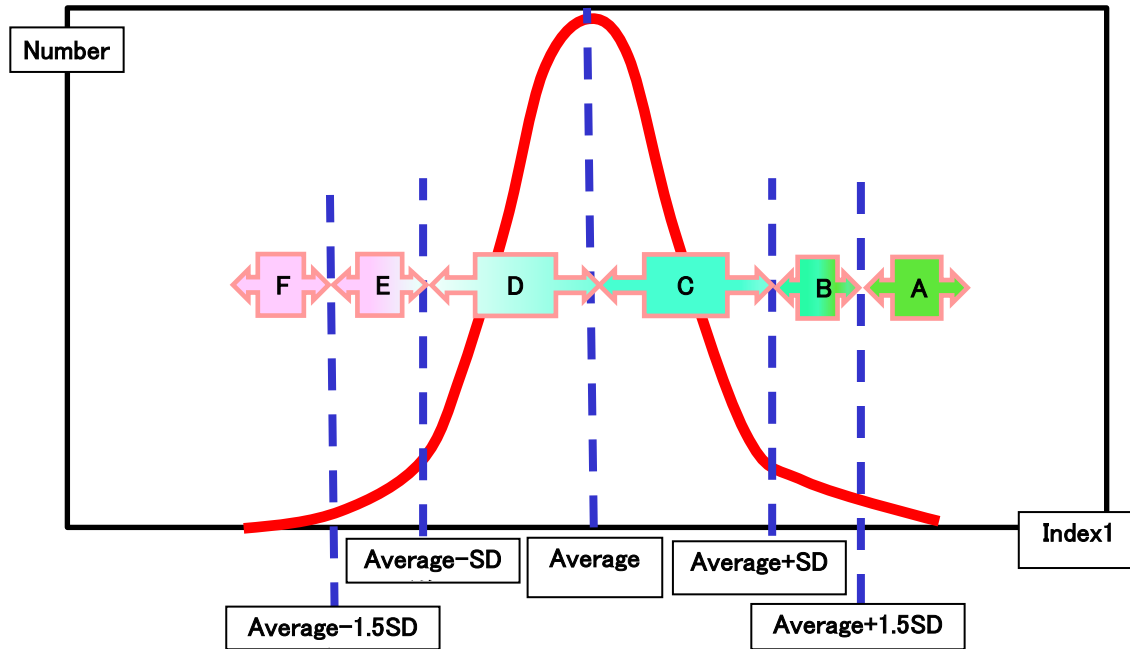


Fig.3 The histogram of MMSE, FAB, etc. before MCI

When a subject encounters color words (Fig.1) picked-out reading the story, he determines whether the meaning matches the printed color of the color word and picks-out as many color words as possible, by marking ○ (match) and × (mismatch). One feature is a test that measures work ability and attention distribution ability, and the other feature is a test that measures memory ability of answering to questions (Fig.2) about the episodes written in the story without looking at the story after 2 minutes. The score of CWPT named Index1 is a product of them. In other words, it can be said to be a test that not only reflects the function of the frontal lobe, but also can comprehensively judge a person's cognitive function, including the ability to understand and execute complex test methods.

When MMSE<sup>15)</sup>, CDR<sup>16)</sup>, FAB<sup>17)</sup>, etc., which are conventionally known as neuropsychological tests for dementia, are applied to people before MCI, the histograms of those scores are biased towards high scores (Fig. 3). On the other hand, the CKPT score (Index 1) shows a normal distribution, so a feature of this test is that it is possible to classify cognitive function using the mean value, mean value  $\pm$  SD, and mean value  $\pm$ 1.5SD (Fig.4).



**Fig.4** The histogram of CKPT before MCI  
 A:Excellent, B:Good, C and D:Normal, E:Slight disorder, F:Doctor’s diagnosis is needed

**2. Subjects**

The large-scale data of 2555 subjects that had already been collected during about 10 years was divided into three groups shown on Table 1. They are B:1st to 6th grade elementary school age groups (6 to 11 years old), A:older age groups, and C:younger age groups on August 15, 1945. A comparative study will be conducted by age group. Table 1 shows the entire group. Table 2 shows the numbers of grouping subjects from large-scale data according to the rules in Table 1. The vertical items indicate the age when the test was taken for each gender, and the numbers indicate the number of subjects in each group.

**Table1:** Subjects grouping by age in 1945

Grouping	A	B	C
Condition in 1945	Elementary school graduate or above	Elementary school grades 1-6	Before entering elementary school
Age in 1945	12 years and older	6-12 years old	Under 5 years old or before birth
year of birth	before 1934	1935-1940	After 1941

**Table2:** Subjects in each group

Sex	The age at which CKPT was taken	A	B	C
Male	60s (60-69 years old)	0	15	336
	70s (70-79 years old)	64	138	81
	80s (80-89years old)	67	5	0
Female	60s (60-69 years old)	0	64	816
	70s (70-79 years old)	193	394	234
	80s (80-89years old)	142	6	0

**Results**

Table 3 shows normality examination of CKPT Score index1 using Shapiro-Wilk test. If significance p value is 0.05 or more, it follows normal distribution. If significance p value is less than 0.05, it is given a yellow line. It is found that every condition has normal distribution for male, but there are three conditions which don’t have normal distribution. They are group A and 80’s, group B and 80’s, and group C and 80’s.

**3. Analysis**

In past research, we divided large-scale data by gender and age and tested the histogram of each CKPT score (Index 1), and it was found that the results showed normality<sup>12)</sup>. In this research, I decided to consider the same procedure for each group Table 2.

**Table3:** Normality examination of index1 using Shapiro-Wilk test

Conditions		Statistics	Degrees of freedom	Significance probability p	
Male	Group A	70's	0.986	64	0.661
		80's	0.973	67	0.158
	Group B	70's	0.974	15	0.916
		80's	0.990	138	0.467
		90's	0.952	5	0.751
	Group C	80's	0.992	336	0.063
90's		0.980	81	0.229	
Female	Group A	70's	0.991	193	0.270
		80's	0.980	142	0.036
	Group B	70's	0.978	64	0.296
		80's	0.989	394	0.005
		90's	0.865	6	0.208
	Group C	80's	0.995	816	0.007
		90's	0.991	234	0.188

### Considerations

1. The fact that male showed a normal distribution under all conditions suggests that the development of cognitive functions in all male was unperturbed by changes in the national system and adapted to them. We speculate that the reason was that all of the male were forced to focus on finding food to survive as they suffered from extreme starvation.
2. Previous research has shown that for female, the histogram by age shows a normal distribution<sup>12)</sup>. However, in order to examine the effects of changes in the national system, we divided into groups before and after ages 6 to 12, who were elementary school students at the time of the change in the national system, and found that in all groups, those in their 80s did not show a normal distribution. It means that there was a dispersion. Although further analysis is required, these results seem to suggest that there are factors that make female more sensitive to changes in the national system than male.

### Summerly

Previous studies have investigated the development of the frontal lobe from multiple angles, showing that it is most pronounced between the ages of 8 and 15, but we attempted to verify this using the CKPT, which strongly reflects the functions of the frontal lobe. Specifically, we assumed that development might be hindered by changes in Japan's national system. As shown in the results, men were not affected, but women became affected.

It is said that the frontal lobe continues to develop after the age of 8 to 15. This analysis shows that even if a large shock is given to children between the ages of 6 and 12, when their frontal lobes are still developing, they have the ability to overcome them.

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