The effect of solution method on skill acquisition:
Transition from declarative to procedural memory

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Abstract

We examined the effect of both exposures of visual stimuli and training methods using episodic memory encoding on skill acquisition. Traditional and usual perspective includes that skill is only related with procedural memory but not with episodic and declarative memory. In the other hand, Logan's instance theory says that transition from episodic memory-encoding to automatic memory-retrieval occurs during processes of skill acquisition. We carried out the experiments using CG animation in order to give participants to instruct methods of detailed solution. The participants made concrete action at each steps based on visual representation and got feedback from computer. We obtained the evidence of facilitation of skill acquisition through experience based on declarative and episodic representation. It suggested that distinction between declarative and procedural memory is not complete and static rather dynamic varied from transition of encoding.

Skill acquisition is the gradual learning of new skills such as cognitive and motor skills. Skill is generally represented as implicit memory, or procedural memory (Tulving, E. 1983). This statement is based on a modal view of skill from memory. This view considers that procedural memory is contrast to declarative memory. According to Tulving's view, skill is related with implicit memory, which stored in the long-term memory. Skill is related with procedural knowledge. Procedural knowledge is tacit knowledge, which one cannot explain the content of knowledge sufficiently (e.g. tennis playing, type writing, etc.). This is contrast to declarative knowledge. Declarative memory includes semantic and episodic memory. Both forms of memory have been studied in detail. However there are not enough arguments about difference between declarative and procedural memory. Furthermore there are lacks of arguments about progress or development of procedural memory.

With the retirement of skilled workers, the skill learning becomes a problem. So, tacit knowledge education videos came into being. However, academic studies seldom show concern about skills thus acquired. Therefore, in order to promote the effectiveness of skill learning, and analyze the mechanism of skill acquisition, this paper first tries to explain the information processing mechanism in skill learning. For a

long time, declarative memory and procedural memory were believed to be formed separately. At the initial stage of learning, deposit of declarative memory is believed to be an important pre-condition for procedural memory formation. We tried to explain the information processing mechanism by analyzing the process of skill learning in "rope work program".

Methods

We designed a CG animation of rope work for subject to learn, as experimental subjects, 8 college students without knowledge about the program were divided into 2 groups: control group and experimental group, though comparing the cost time and error times, we tried to found the mechanism of memory transition in skill acquisition.

Procedure: The experiment was carried out one by one in a darkroom. Steps of rope work were shown to each group via teaching animation by computer from 6 angles: front, front left, front right, conversed front, conversed front left and conversed front right. After watching the animation, control group directly moved to the operation while members of the experiment group were required to make their judgment for each step before they started.The following 4 pictures of Fig.1 showed the key step actions of rope work in CG animation , according these major step actions, we collected the error times and cost time of the subject from the video of the experiment.

Fig.1 major steps of rope work in CG animation
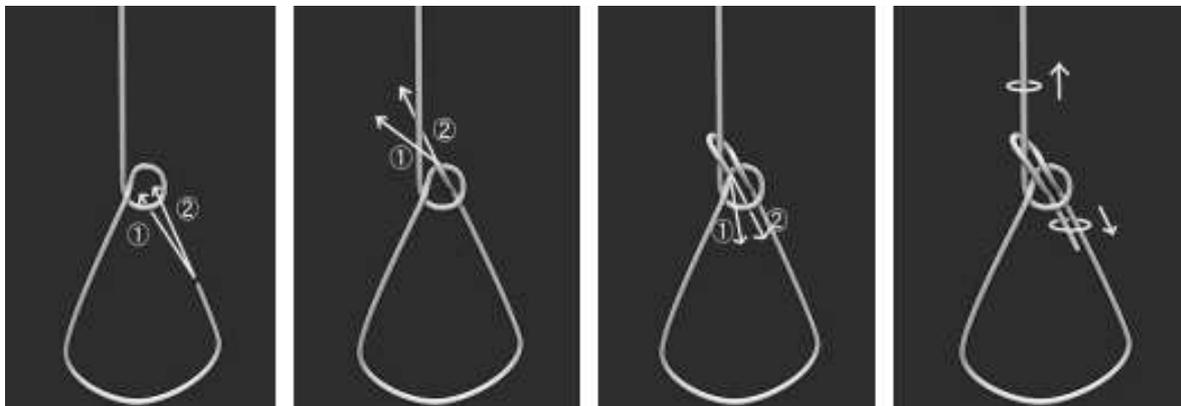
Subjects did the rope work under the instruction of the teaching animation in the dark-laboratory. From screenshots of the surveillance video we collected the times of the errors and the data of the times of two groups separately.

Results

By analyzing unsmoothness and errors in continuous actions in the video of the experiment,

we collected data of the number of probable errors and trial errors. Also the cost time of rope work is considered. Fig.2 as following shows 8 subjects's results and cost time separately. Only one subject in experiment group was failed, contrary only one subject in control group was succeeded. It means that only episode memory is not enough to accomplish the skill of rope work, procedural memory was required by control group.

Fig 2 the data collection of the subjects

subject	results	error times	cost time(second)
1(Ex group)	yes	2	285
2(Ex group)	yes	2	36
3(Ex group)	no	24	2712
4(Ex group)	yes	2	645
1(Ctrl group)	no	26	2571
2(Ctrl group)	yes	17	2159
3(Ctrl group)	no	23	2219
4(Ctrl group)	no	7	1285

From following Fig.3 and Fig.4, we can distinguish the experiment group and control group observably. Control group accomplished the rope work cost superfluous time than experiment group which depends on declarative memory merely. Episodic memory encoding on skill acquisition is shown in experiment group. Transition from episodic memory-encoding to automatic memory-retrieval occurs during processes of skill acquisition.

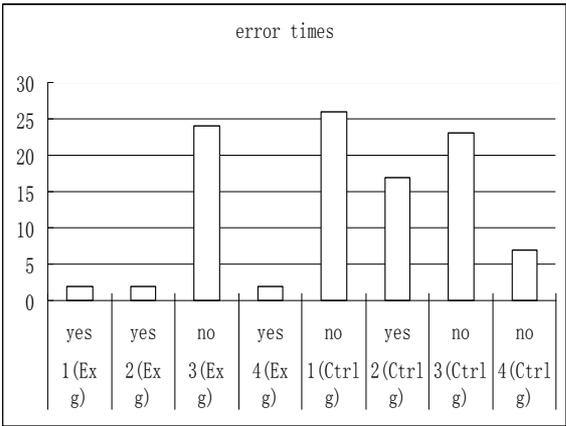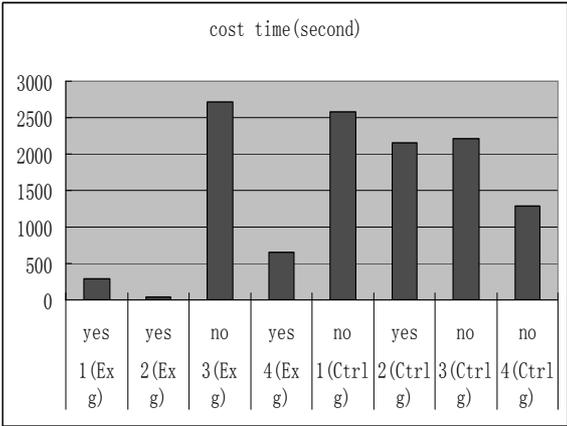Fig 3 error times of the subjects　　　　　Fig 4 cost time of the subjects

Through U test, we found a distinctive 5% average times of error difference between the 2 groups statistical. We think the examination is resultful, because there is remarkable

difference between the two groups.

Fig 5 Analysis of correlations at each group in the rope work task

	Average trial number of errors	Error times	Cost time(second)
Control group	18.25	73	8234
Experimental group	7.5	30	3678

Conclusion and Discussion

From the view of psychology, skill acquisition is different from people each other. According to cognitive psychology, cognitive psychologists have made great progress of skill learning. We assume that the transfer of declarative memory to procedural memory should be through progress of learning. Such as control group to experiment group. The research suggested that distinction between declarative and procedural memory is not complete and static rather dynamic varied from transition of encoding.

Solution method on skill acquisition is important issue in Japanese education. We now tried to make research on rope work in maritime training, so we carried one experiment of skill acquisition of rope work training. Subjects as beginners of training were presented through CG animation, after presentation the subjects have to make rope work by themselves. The findings of experiment showed that judgment in each major step during rope work can help to promote the effectiveness of skill learning, which ordinary teaching videos without judgment failed to do so. The insufficiency of this research is that the number of subject is scarcity; in the further research it will be complemented.

Stepping further, this kind of research might be able to discover the information processing mechanism of human being in skill acquisition.

References

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