UTILIZATION OF FIGURES DURING PROOF READING AMONG HIGH- AND LOW-PRIOR KNOWLEDGE READERS

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Introduction

- The average ratio of total fixation duration in segments of figures was about 50% while college students reading a geometric proof (Lin, Wu, & Sommers, 2012). This average ratio of geometry proof was higher than the ratio of advertisements which was 20% (Rayner, Rotello, Stewart, Keir, & Duffy, 2001). The results suggested:
  - -Working memory limitations of spatial image increased the regression time for figures.
  - -The reading of geometry proofs highly depended on figures that organized the statements using a specific status and provided cues for the geometry proof properties compared to text.
- Are there any differences on utilization of figures among low and high prior knowledge (PK) readers?
- Whether PK degree influent comprehension of geometric proof?

Method

Participant

- All 51participants were non-math related background and had normal or corrected vision.
- Their average age was 22 yrs. The ratio of male and female is 2:3.
- Based on prior knowledge test (PK test), high PK group (scores ≧ 8) had 26 participants and low PK group (≦ 6) had 15 participants.

Apparatus

- Eye movements were recorded by the Eyelink 1000 with a sampling rate of 1000 Hz. (show as Fig. 1).
- Texts were displayed on the 24-inch LCD monitor.
- Visual angle of a Chinese character was about 0.8 degree.

Materials

- Reading materials were three geometric proofs which were adapted from junior high school textbooks. Each geometric proof included text segment and figure segment (show as Fig. 2).
- The prior knowledge of geometry was evaluated by a PK test (full mark, 10 points).
- The reading comprehension of proofs was assessed by comprehensive tests (7 yes/no items each proof) and transformative-recall tests.

Figure 1. Laboratory setting

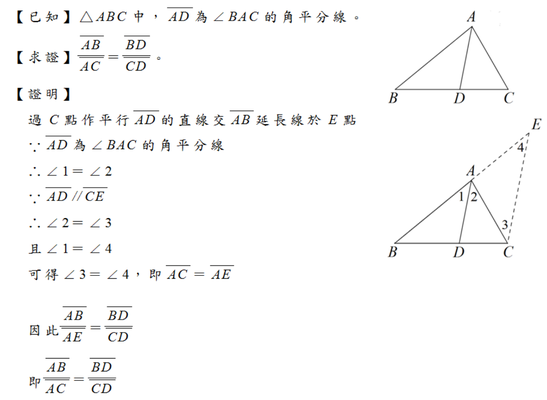

Figure 2. Layout of geometric proof

Procedure

- Participants were asked to follow the instruction and completed 9 points calibration before reading each geometric proof.
- The presentation order of geometric proof as below: triangle angle bisector theorem, median of a trapezoid, and intersecting chords theorem.
- After reading each geometric proof, participants were required to complete comprehensive test in computer.
- After finishing comprehensive test, three items of transformative-recall test were presented with the same order of geometric proof.
- Finally, PK test and background questionnaire would be completed.

Results

- All descriptive data of three proofs indicated that high PK had higher total fixation duration in figure segment than text segment, and low PK was inverted (see Fig. 3). But only item 1 had a significant interaction effect in two-way ANOVA of PK group × segment, $F(1, 38) = 4.658$, $p = .037$, eta = .109.

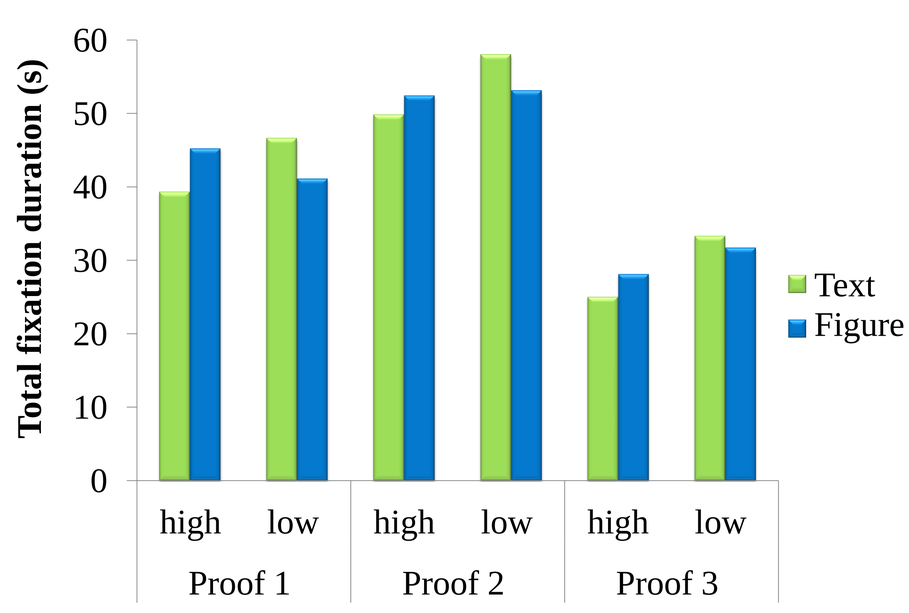

Figure 3. Total fixation duration of high and low PK in geometry proof

- For both PK group, the ratio of total fixation duration in segment of figure was about 50%.
- Even without significant PK effect in comprehensive test, the result showed high PK has higher accuracy than low PK.
- PK effect from accuracy of 3 transformative-recall items indicated that high PK group had better comprehension than low PK, $t(39) = 2.36, 2.57, 2.72$, $ps < .05$, $d = .77, .85, .86$ (show as Fig. 4).

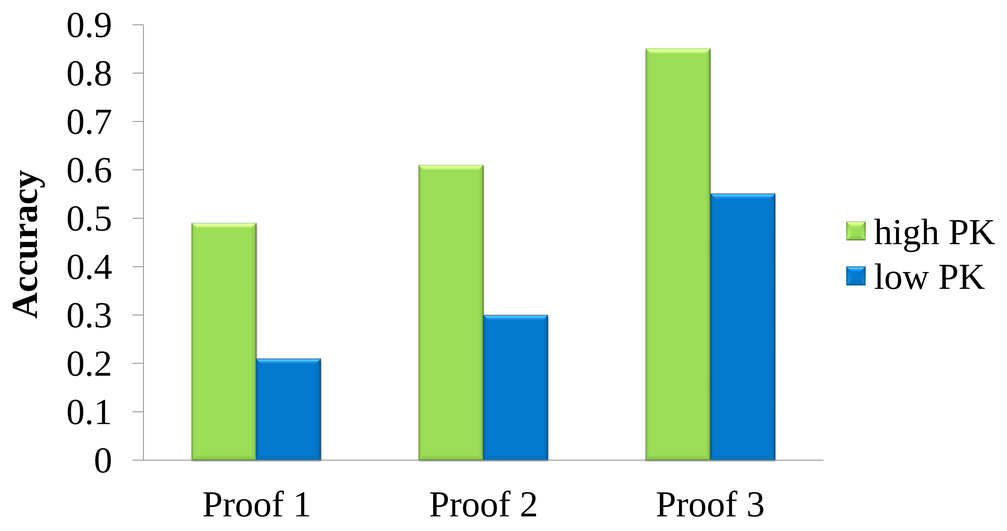

Figure 4. Accuracy of high and low PK in transformative-recall test

Discussion

- Total fixation duration in segment of figure was longer than text in high PK. On the contrary, total fixation duration in segment of figure was shorter in low PK.
- The result suggested that low PK readers were unable to capture implicit properties from geometric figure, their reading and comprehension were more dependent on text. Instead, high PK readers had more geometric knowledge and better strategic to process implicit properties of figure.

Acknowledgments
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References

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Rayner, K., Rotello, C. M., Stewart, A. J., Keir, J., & Duffy, S. A. (2001). Integrating text and pictorial information: Eye movements when looking at print advertisements. *Journal of Experimental Psychology: Applied, 7*, 219-226.