Development of an interactive system using color for analysis and acquisition of balance skills

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ABSTRACT

Dynamic balance ability evaluation is difficult. Therefore, we configured an experiment to investigate the effect of vision on balance and discuss a method to evaluate dynamic balance ability. We found that detrended fluctuation analysis (DFA) scaling exponents of center of pressure (CoP) changed when there was a visual influence, suggesting that there is an influence on the way we balance. We consider that it will lead to the construction of an interactive system using CoP sway and visual feedback.

1. INTRODUCTION

Static balance ability can be evaluated by capturing the movement of the center of pressure (CoP). However, dynamic balance ability evaluation is difficult, and there is currently no gold standard evaluation method. Therefore, we configured an experiment to investigate the effect of vision on balance and discuss a method to evaluate dynamic balance ability. We also discuss how to construct an interactive system for dynamic balance ability.

2. METHOD

We used a stabilometer manufactured by TAOS Institute (Fig. 1) to measure CoP for experiment participants (20Hz) [1]. The stabilometer is placed 1 m in front of a 42-inch full high-definition monitor (Fig. 2). The direction toward the monitor is the Y-axis of the stabilometer, and the horizontal direction is the X-axis. The monitor shows a pattern of red dots, as shown in Fig. 3. We conducted two types of experiments with static dots and moving dots. In the moving dots experiment, the dots moved to the right at a speed of about 0.6 m/s.

Fig. 1 Stabilometer (TAOS Institute, Inc.)

The experiment participants were 3 males (A, B, and C) in their 20s. We gave the participants the task of standing on the stabilometer with one dominant foot for 2 seconds. If a participant cannot stand up for 2 seconds, the data is recorded while he did stand up. We asked them to respond to the question, "Was it easy for you to maintain balance?" by hitting a dot on a line with the two ends indicating Easy and Hard.

The obtained data were evaluated in terms of dynamic stability using detrended fluctuation analysis (DFA) [2].

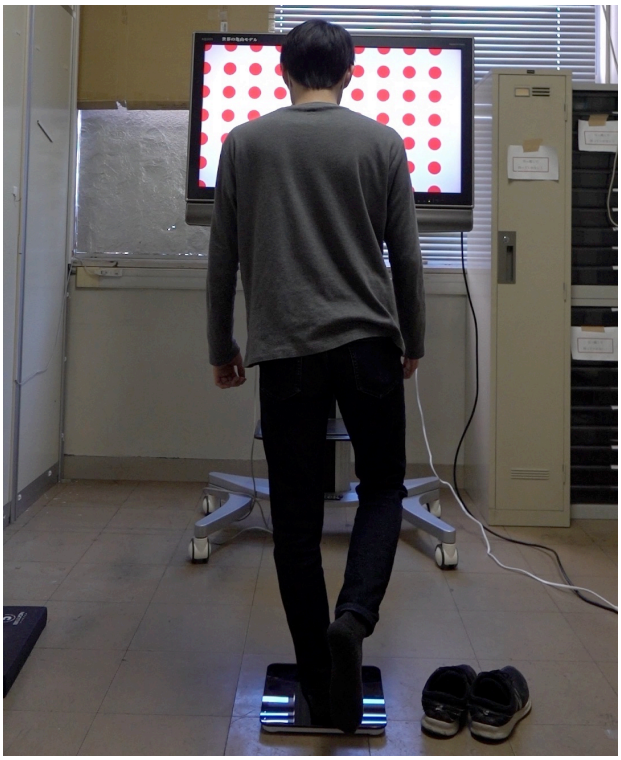

Fig. 2 The scene of the experiment.

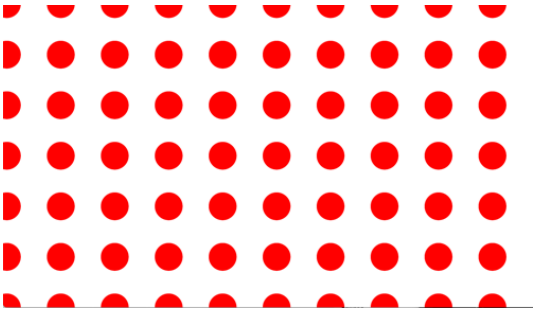

Fig. 3 Pattern of red dots shown on the monitor.

3. RESULTS

The question results are shown in Fig. 4. The data are processed on a scale from 1 to -1, with *Easy* being 1 and *Hard* being -1. The result of Participant A for static dots is shown as A(Static), and the result for moving dots is shown as A(Moving). All participants answered that the experiment with the moving dots was more difficult than the static dots.

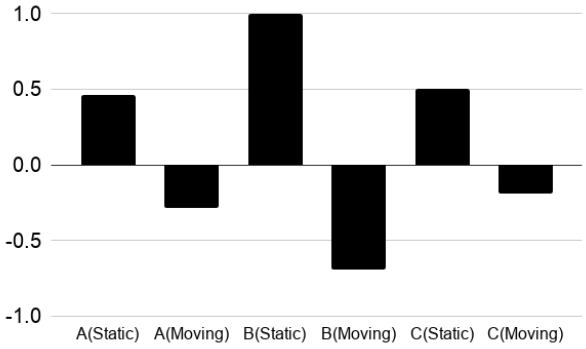

Fig. 4 The results of the question, "Was it easy for you to maintain balance?"

The result of DFA of CoP in the X-axis direction is shown in Fig. 5, where DFA1 means fast-scale, and DFA2 means slow-scale. Although DFA1 and DFA2 are lower for moving dots than static dots for all participants, the DFA scaling exponents should be carefully interpreted in future studies with more data.

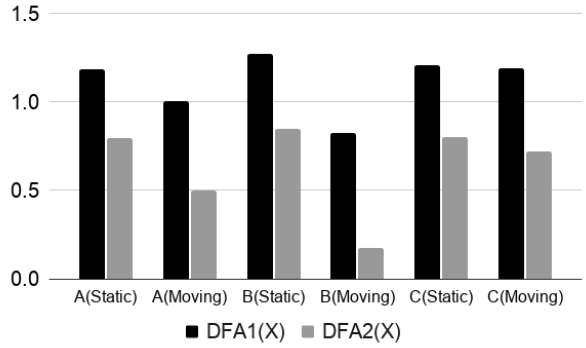

Fig. 5 The result of DFA of CoP in the X-axis direction.

4. DISCUSSION

The results of the questionnaire indicate that this one-legged balancing task is influenced by vision. Results of DFA suggested that dynamic visual information might affect the postural control strategy and it could be shown in the structure of CoP. Thus, using DFA scaling exponents, it is possible to quantitatively evaluate the effect of vision and color on balance ability. However, we still need to increase the number of participants and the number of experiments.

For future work, we think that by using a screen to provide visual feedback on CoP sway information, we can construct an interactive system in which the user interacts in front of the screen like Chaotic Video Feedback [3], as shown in Fig. 6.

Fig. 6 *Chaotic Video Feedback*: Example of an interactive system using a screen [4].

5. CONCLUSION

We constructed an experimental environment to study the effect of vision on CoP sway and conducted an experiment. We found that the DFA scaling exponents change when there was a visual influence, suggesting that there is an influence on the way we balance. We consider that this result will lead to the construction of an interactive system using CoP sway and visual feedback.

6. REFERENCES

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