

Functional role of environmental perception of motor performance under pressure

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Introduction

Athletes often experience that their motor performance is affected by psychological pressure. Recent studies have increased our understanding of performance under pressure through new insights regarding the perception of the external environment. However, more evidence needs to be accumulated because of the limited number of studies on perception and actions under pressure. This study investigated **the effects of pressure on the perception of the target size before executing a dart-throwing task and examined how intra-individual size perception bias under pressure was related to performance in the dart-throwing task.**

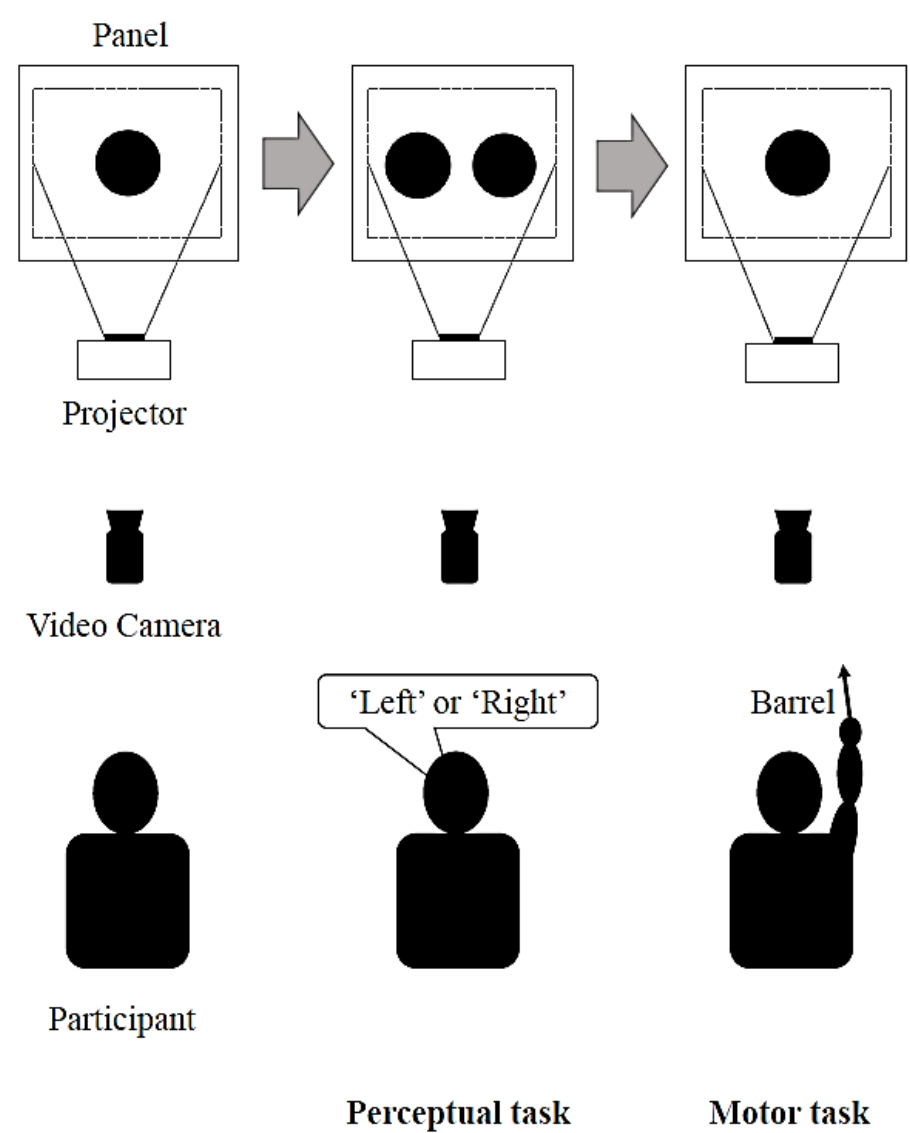
Methods

Participants Healthy novice university students (N = 33)

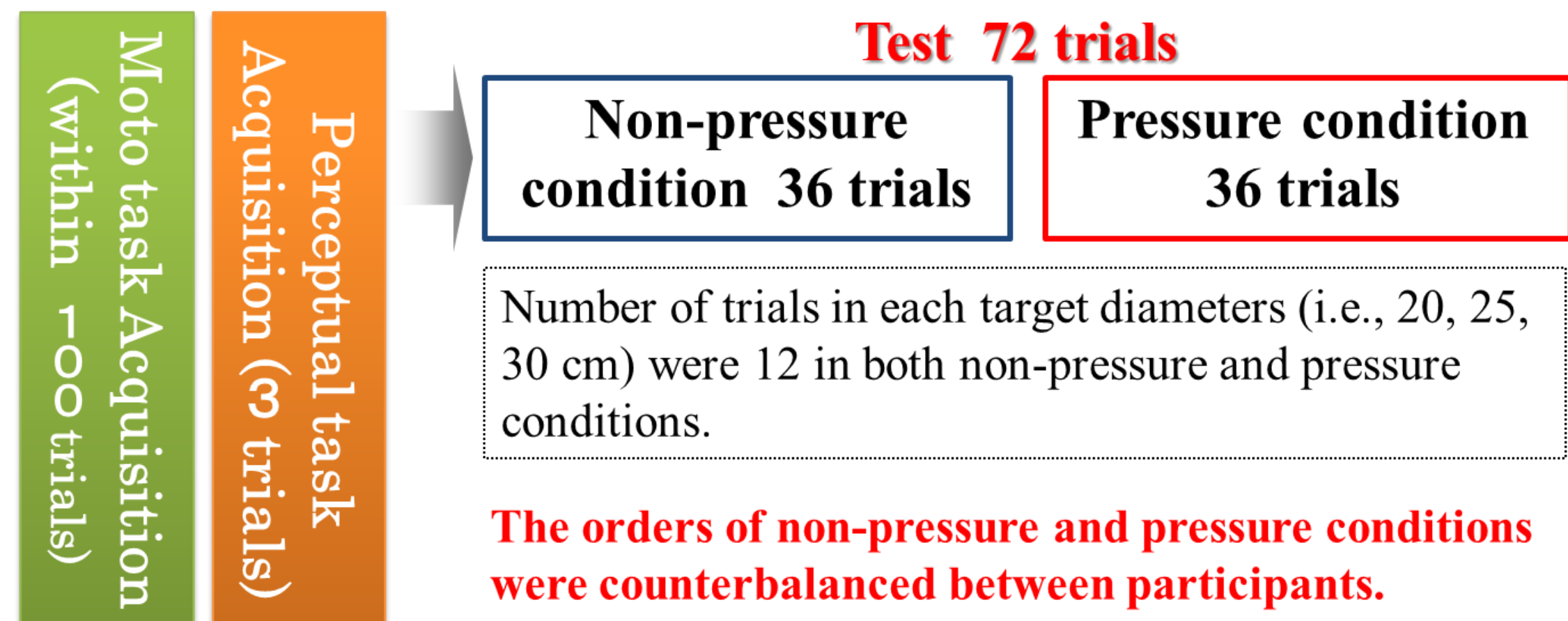
Perceptual and motor tasks A target was presented on a screen for three seconds. The diameters of the targets were 20, 25, and 30 cm, which were randomly presented in each trial. Immediately after the target was removed, a circle with a 2% smaller or a 2% larger diameter were presented. Participants judged which circle was similar in size to the real target by responding 'left' or 'right.' Finally, the actual target was presented again. Then, the participants performed the motor task of throwing the dart towards the target.

Pressure manipulations

Competitive cash rewards and comparative others: Numbers of the darts inside the target during 36 trials in the pressure condition were ranked (all participants). The top 3 participants could receive 10,000 (about 100 USD), 5,000, 3,000 JPY.



Procedure



- ✓ The target had a diameter of 35 cm in the acquisition phase.
- ✓ The acquisition phase was continued until the participant succeeded (i.e., go the barrel into the target) ten trials in a row.
- ✓ They answered the STAI Y-1 prior to starting each condition.
- ✓ ECG was also recorded during the both conditions.

Results

Manipulation check of pressure

	Non-pressure	Pressure
State anxiety score	43.09±1.33	48.52±1.35***
Heart rate (bpm)	78.10±1.94	79.62±1.86**
LF/HF ratio	2.67±.27	3.43±.42**

*** $p < .001$, ** $p < .01$

- ✓ The state anxiety, heart rate, and LF/HF ratio of HRV increased from the non-pressure to pressure conditions.
- ✓ Psychological and physiological stress responses were successfully induced.
- ✓ The mean increase in state anxiety and heart rate was approximately 5 points and 2 bpm.
- ✓ The stress induced in this study was at a relatively moderate level.

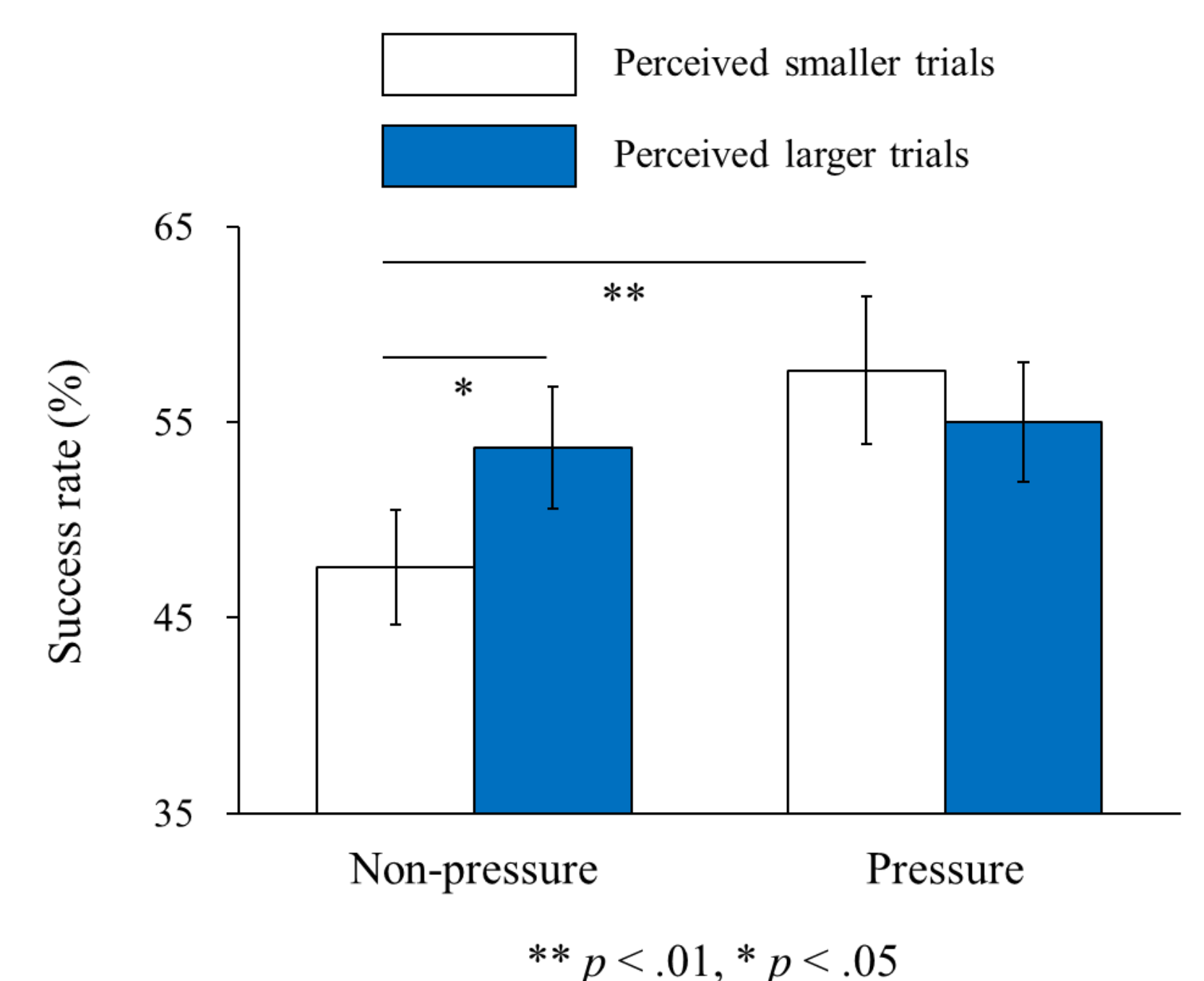
Size perception and performance

	Non-pressure	Pressure
Smaller circle judgement ratio	49.49±4.10	50.17±3.89
Success rate	52.19±2.46	57.83±2.30**
MRE (cm)	15.71±.64	14.72±.51
SRE (cm)	9.43±.71	8.46±.60
BVE (cm)	22.32±1.22	20.47±.94†

** $p < .01$, † $p < .10$

- ✓ There were no significant differences in size perception between pressure and non-pressure conditions.
- ✓ Success rate of the dart-throwing task in the pressure condition was superior significantly compared to the non-pressure condition.
- ✓ Marginally significant decrement of BVE from the non-pressure to pressure conditions contributed performance enhancement under pressure.

Relationship between bias of intra-individual size perception and performance



- ✓ The ANOVA showed a marginal significant Condition x Perceived Size interaction ($F(1, 31) = 3.03, p = .092, \eta^2 = .09, 1-\beta = .80$). Success rate in the perceived larger trials was superior compared to the perceived smaller trials during the non-pressure condition. Furthermore, the success rate in the perceived smaller trials increased significantly from the non-pressure to the pressure conditions.

Discussion

- One reason for not observing dynamic perception under pressure in this experiment could be related to the relative lack of changes in attention, emotions, and physiological states due to the moderate level of the stress response.
- Many previous studies have demonstrated that several aspects of motor control, such as the central nervous system, eye movements, muscular activities, kinematics, and postural control were modified despite moderate levels of the stress response induced by pressure manipulations in laboratory settings. It is possible that factors related to environmental perception are difficult to be influenced by pressure, whereas such factors are easily influenced.
- The smaller size perception under pressure observed in this experiment might have a functional role in performance.
- The result of this experiment suggests that the dorsal stream function might play a key role in clutch performance under pressure.

Conclusion

This research suggests two novel insights for studies on perceptual and motor skills under pressure.

- **It is possible that changes in perceptions are not observed for moderate stress responses under pressure.**
- **Intra-individual perception bias that makes motor tasks to appear more difficult might play a functional role in the performance of tasks under moderate stress responses.** Therefore, athletes should not interpret changes in perceptions under pressure as having a negative influence on performance outcomes if the stress responses that are induced remain moderate.