

Pseudo-haptic feedback on softness induced by squeezing action

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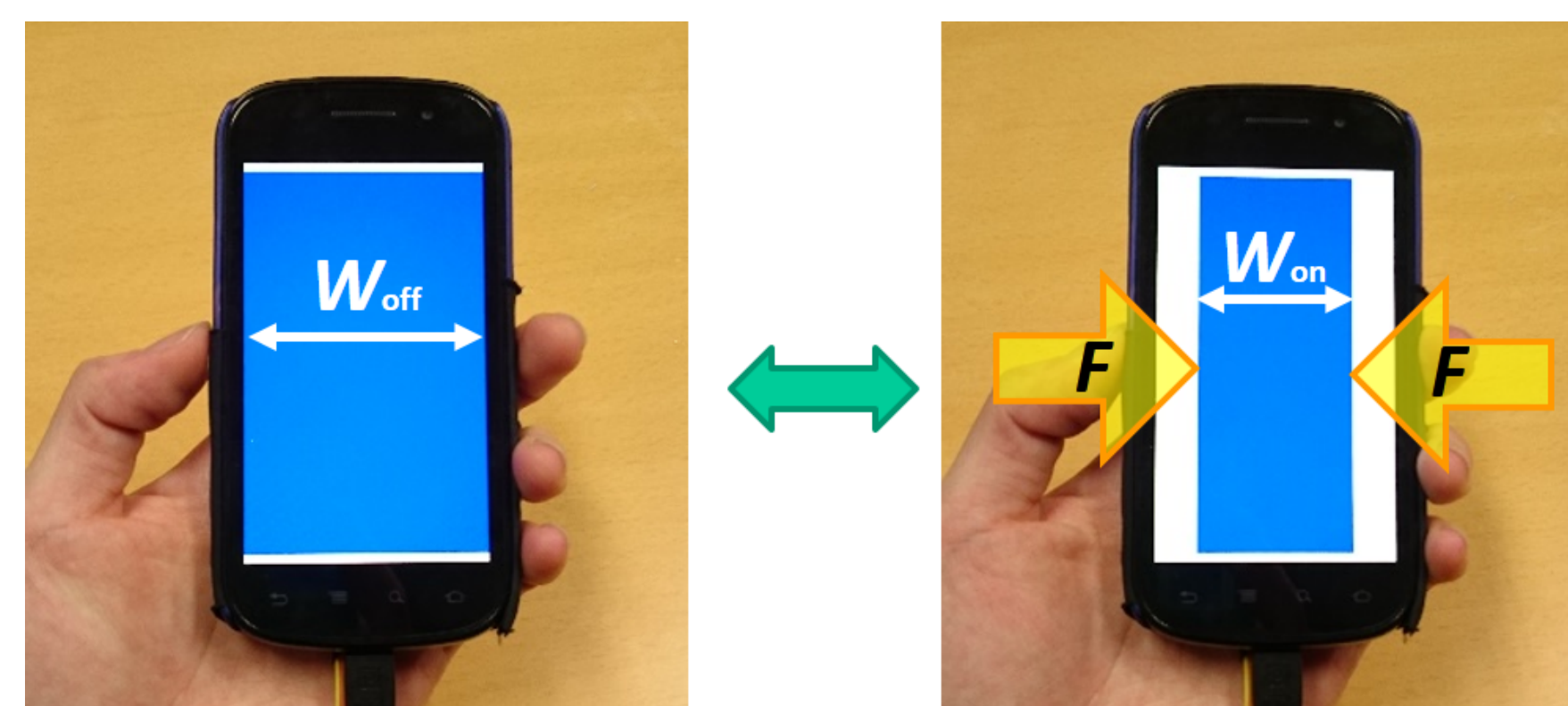
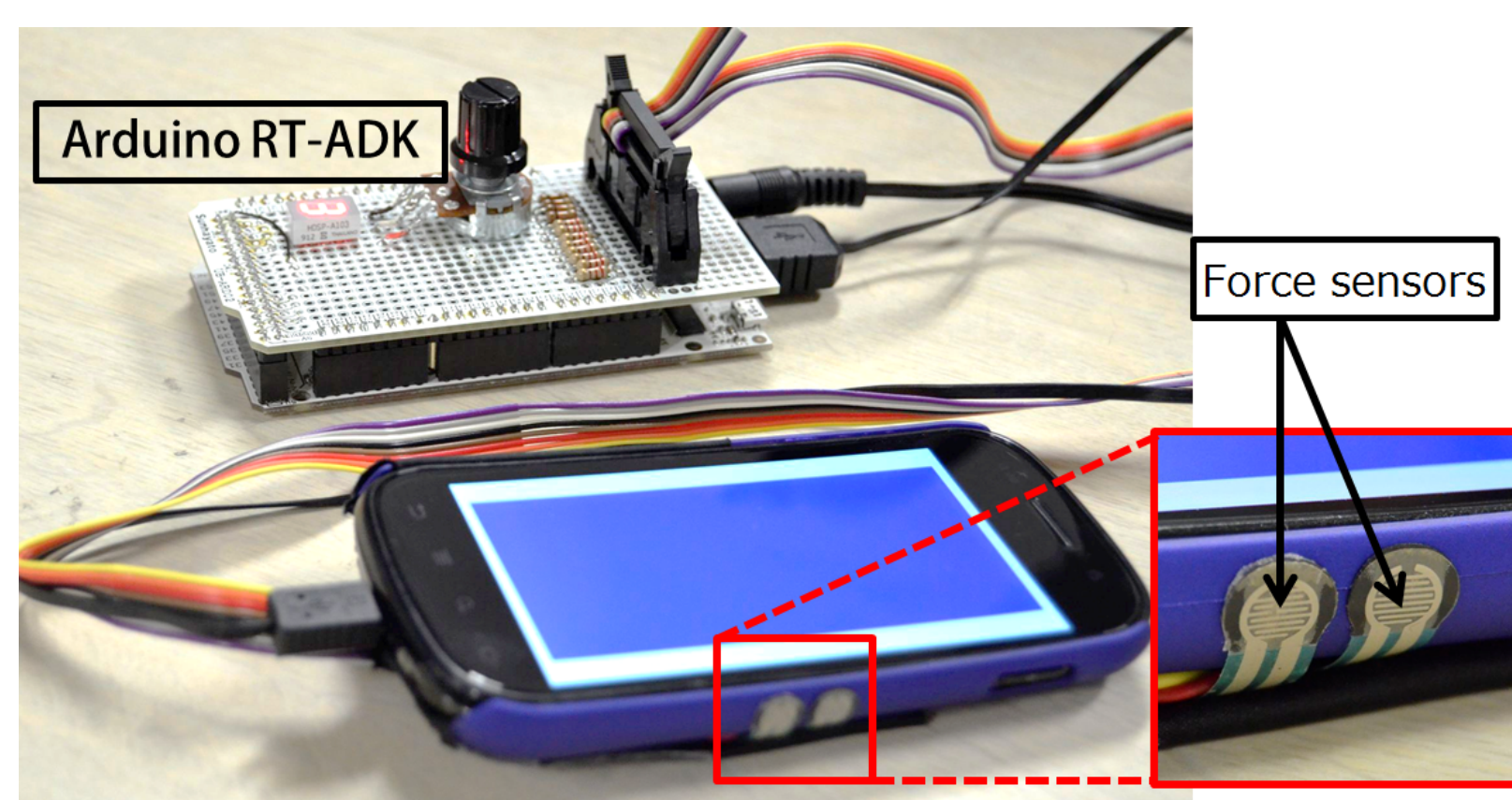
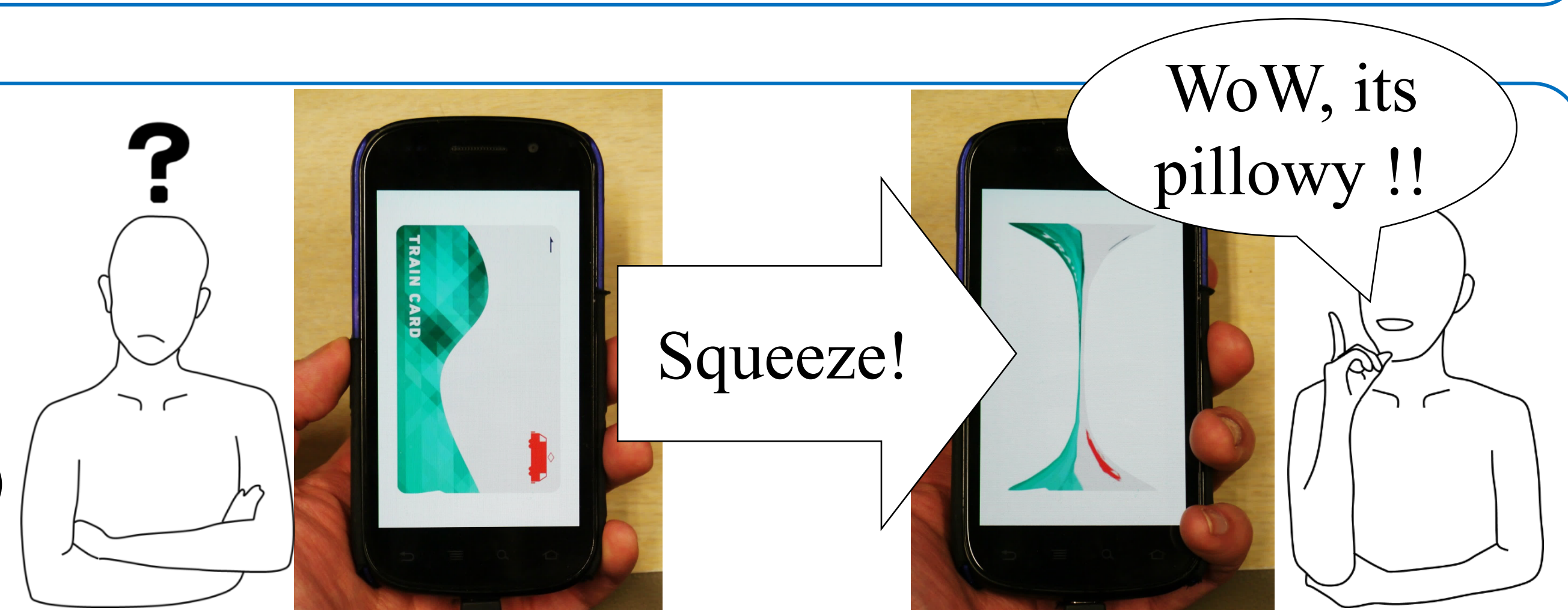
Abstract

The pseudo-haptic feedback is a method to represent illusion of haptic sensation, induced by non-haptic stimuli, such as vision and acoustics[1]. This is a prospective method that enables us to develop haptic display without using any actuators. That considered to be a benefit for composing a small, light weighted haptic display. However quantitative control of haptic representation is often difficult because the method uses illusion. In this research, we propose a novel method to induce illusion of haptic sensation on softness, by using a pressure sensor integrated smartphone and squeezing action. In this paper, a prototype system to induce the pseudo-haptic phenomenon is described. Then, two experiments were conducted. The first experiment was conducted to confirm that the device has enough capability to induce the pseudo-haptic phenomenon. The second experiment was for quantitative analyzation of the relationship between the visual stimulus and the induced pseudo-haptic feeling on softness.

Basic Method

The basic procedures of the method are as follows:

- ✦ Preparing an image display device that can be grasped with one hand(Fig.1)
- ✦ The user grasps the device while observing the image on it(Fig.2)
- ✦ An image that deforms according to squeezing action based on Eq.1.



Eq.1:

$$W_{on} = W_{off} - \frac{F}{k}$$

Fig1. The prototype system based on a smart phone. Fig.2 The basic principle of the visual stimulus.

Experiment

✦ Purpose:

To create a psychometric function to combine visual stimulus and induced illusion on softness

✦ Method:

The constant method was used.

- * Three physical(standard) stimulus (physical springs)
- * Seven visual(comparison) stimulus
- * 2 Alternative Forced Choice(Which is harder)

✦ Conditions:

Number of participants: 7 (all of them were right-handed, in their twenties)

Eq.2: $k_{V-both} = 0.609 \ln(k_{R-either}) + 1.357$

$k_{R-either}$ (N/mm) :the spring constant of the PS (standard stimulus),
 k_{V-both} (N/mm) :the spring constant of the VS felt equivalent.

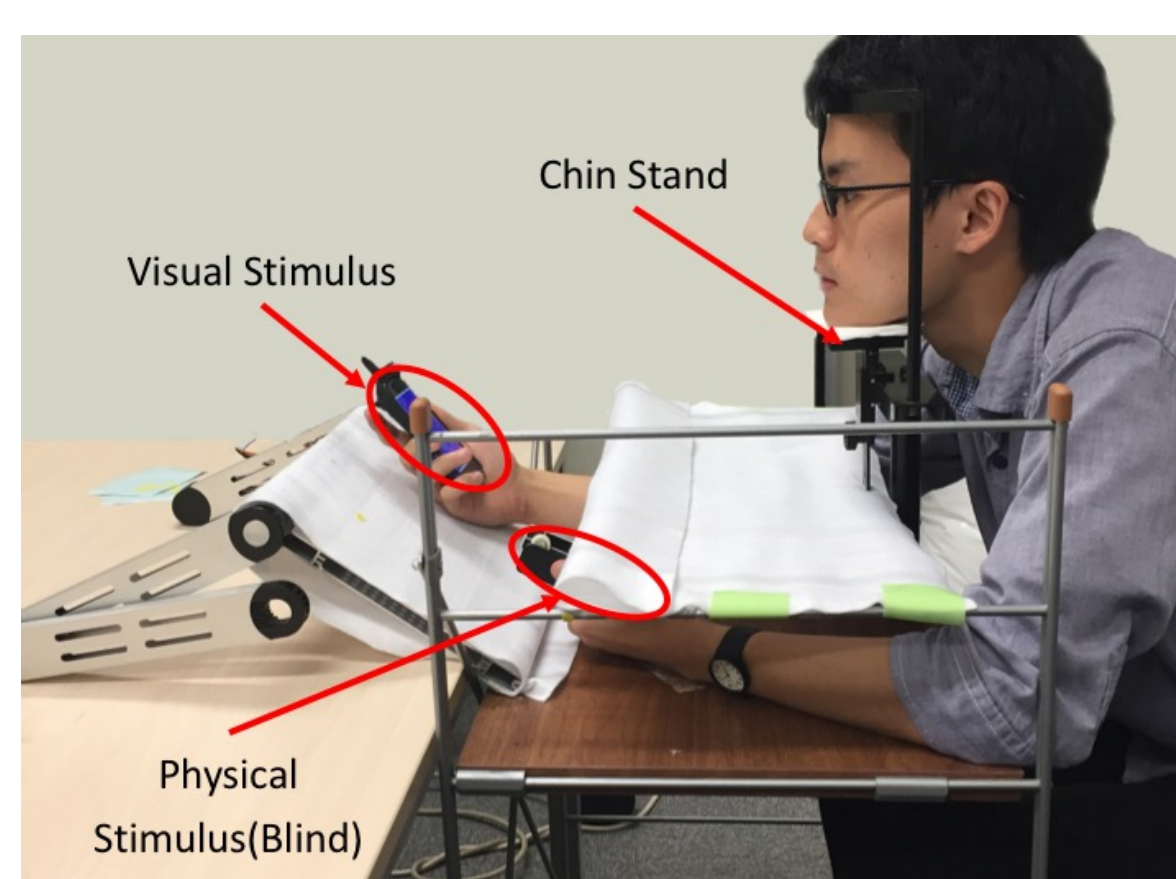


Fig.3 Experimental setup

Spring constant in (N/mm)			
PS as Standard Stimulus(SS)		VS as Comparison Stimulus(CS)	
			0.300
1.010	1.196	2.030	0.416
			0.577
			0.800
			1.109
			1.538
			2.133
			2.958

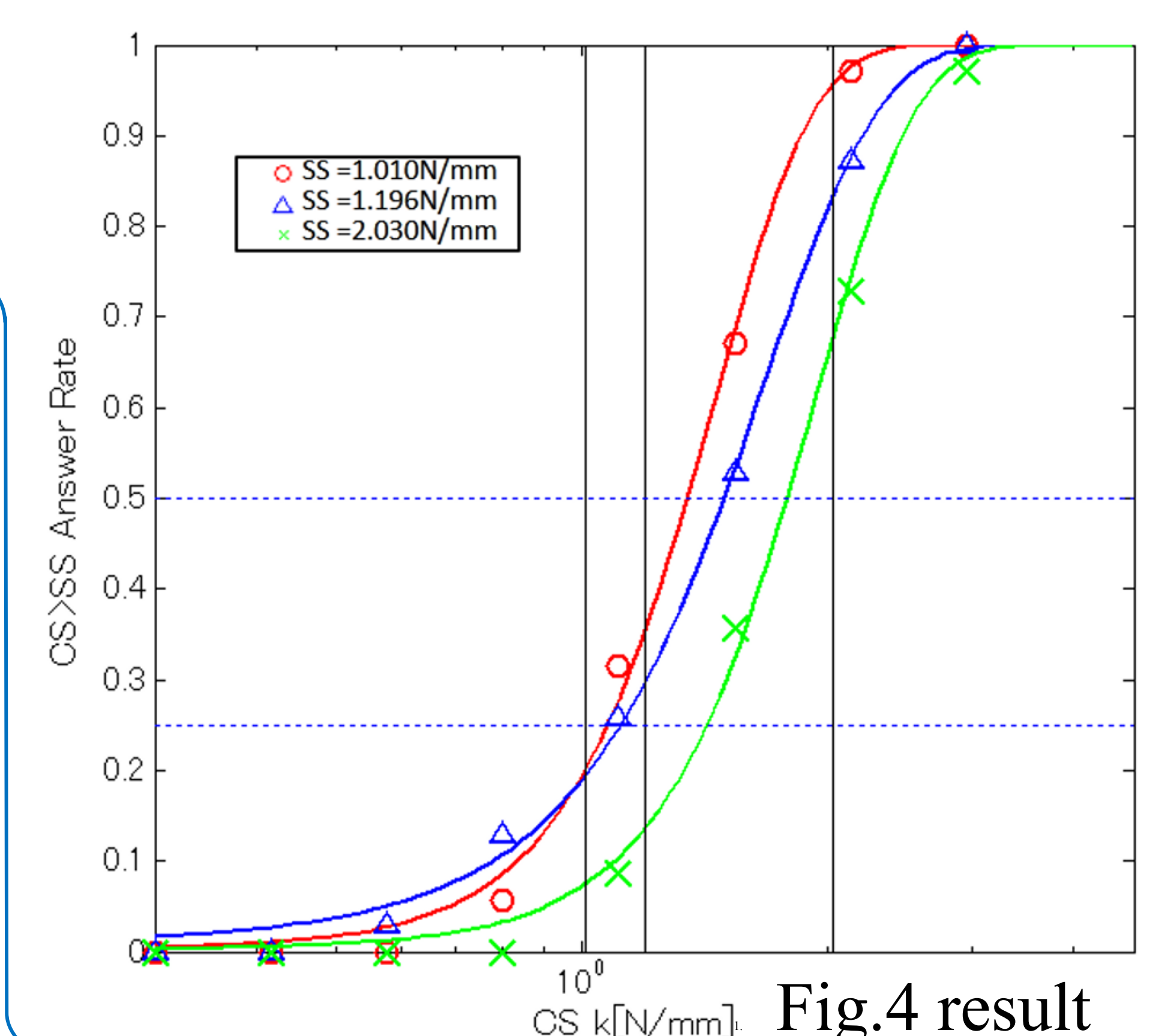
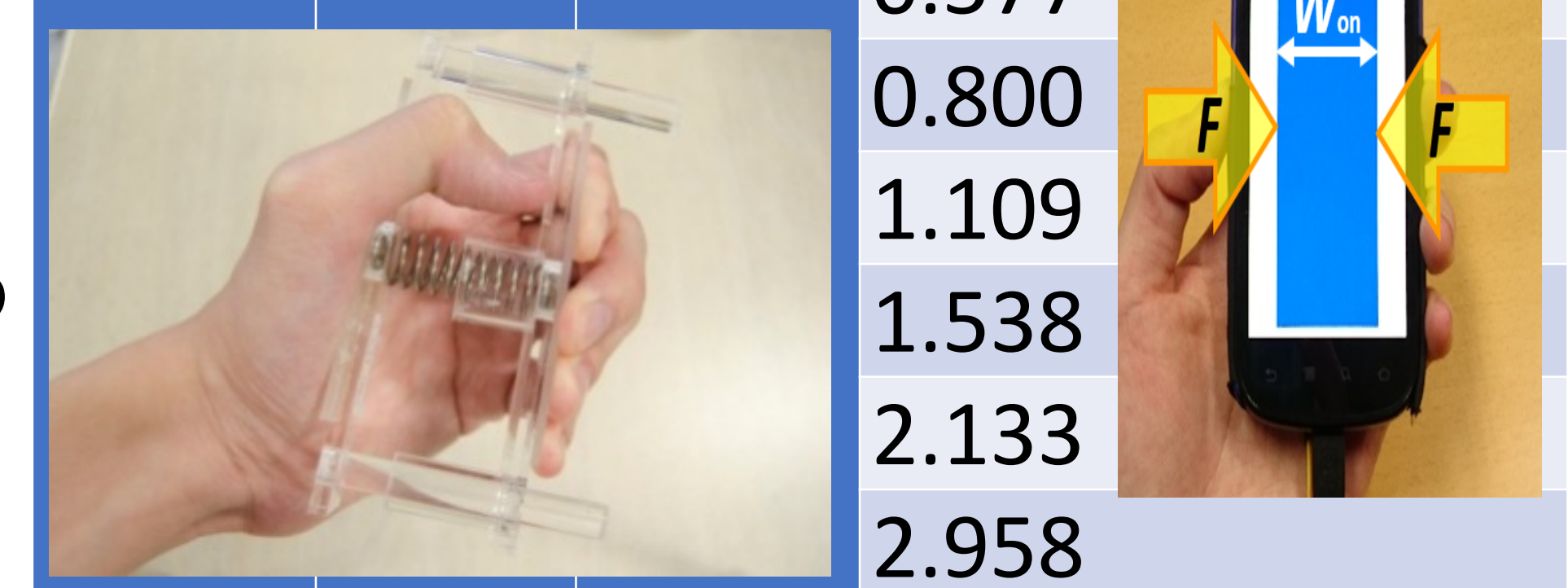


Fig.4 result

Conclusions & Future Work

- ✦ Clarify the relationship between physical and visual stimulus
- ✦ Further investigation is required to confirm that the participants never have a certain strategy to answer the questions (intentionally reproduce the effect).

References

- [1] A. Lecuyer, "Simulating Haptic Feedback Using Vision: A Survey of Research and Applications of Pseudo-Haptic Feedback", PRESENCE, Vol.18, No.1, pp.39-53, 2009.