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Description	

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Into the Womb – Born Again: A VR Experience of Being Warmly Swaddled Using "Otonamaki" from Japanese Method

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Figure 1: Fetal VR experience with a cloth.

Figure 2: VR video image of a fetus in the womb.

Figure 3: Okurumi, swaddled baby (Halfpoint, Julia Dorofeeva/Shutterstock.com).

Abstract
Some relaxation methods create a sensation of returning to the fetal stage, but often involve large pieces of equipment such as a floating tank. This study develops a portable virtual reality (VR) system that brings users back into the fetal state of relaxation. It explores the effects of being swaddled in a stretchable cloth that simulates the feeling of being in the mother's womb. The user's entire body is wrapped in cloth using a Japanese technique called Otonamaki. While being swaddled, participants experience an artistic video and sound representation of the womb. The heart rates and questionnaire answers of swaddled people and those from the control group were compared. Questionnaire results show that being swaddled can reduce subjective tension. Heart rate results show no signs of mental stress caused by swaddling. The future plan is to incorporate this VR setup into medical devices and therapy to relieve tension.

1. Introduction
There are several relaxation systems that provide their users with a feeling of being returned to the fetal stage. This study develops and relaxation a fetal experience virtual reality (VR) system named "Into the Womb."
The system makes people feel as if they are in the mother's womb by using a head-mounted display (HMD) and swaddling them, using a cloth to wrap their whole body. Applies the child-rearing method Okurumi to adults (Kimura, Fujii, Hasegawa & Miyata, 2019) (Figure 1,2), that is a method of calming down a baby by wrapping its whole body in cloth (Figure 3).

2. System
This VR experience system makes it possible for users to feel as if they had returned to the fetal stage. After putting on the HMD and holding the controller in both hands, users are wrapped in a cloth. Two camera viewpoints are shown in the 360-degree VR video. Users can view the state of the fetus from one angle and also take the position of the fetal viewpoint at another angle. In the latter case, they can move both hands of the fetus using the controllers. The experience time lasts approximately one minute. Figure 4 shows how to wrap a user in the cloth and shows how to get him/her out of the cloth. The Oculus Quest HMD "Guardian function" is turned off for the HMD to be used inside the cloth.

2.1 360-degree VR video contents
The experience starts after the user select language on the title screen. The user first watches the fetus from a third-person perspective (Figure 2). Subsequently, the fetus comes closer, as if it was linked to the user, and the screen fades out. Afterward, the user assumes the fetal viewpoint and sees the image of the inside of the womb. The images

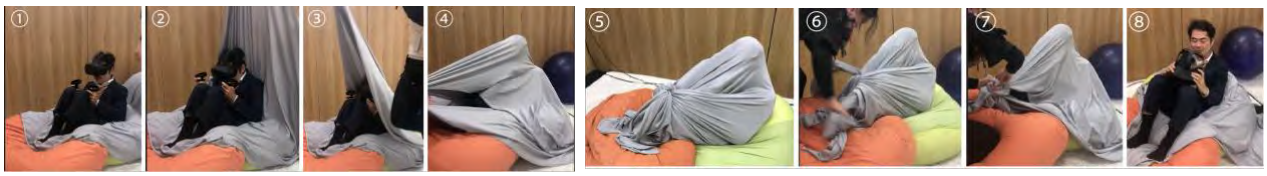

Figure 4: The procedure of wrapping and releasing the participant in cloth before the fetal VR experience.

include legs and hands, which the user can move using the controllers. The background environment shows red water with some bubbles, which resembles conditions in the womb. In the end, the screen fades out again and users look at the fetus objectively. The light pours from above the VR world, the screen fades out to white, and the experience finishes.

3. Experiment

We analyzed participants were 63 healthy people (49 men and 14 women) between 20 and 60 years of age. And whom 31 (21 men and 10 women) experienced the fetal VR with swaddling and 32 (28 men and 4 women) experienced it without swaddling. The experiment involved questionnaires to evaluate their mental states before and after the VR experience.

3.1. Experimental design

Participants responded to a questionnaire as shown in Table 1 before and after the VR experience. They could answer each question using a seven-point Likert scale ranging from "Not at all true" to "Very true." The questions were created referring to a short-form self-report measure to assess relaxation effects (Sakakibara, Teramoto, & Tani, 2014).

Table 1: Questionnaire used before and after the VR experience

(1) I can calm down breathing.	(7) I am relieved.
(2) My heart beats faster than usual.	(8) I am very comfortable.
(3) I feel sleepy.	(9) I feel at ease.
(4) My vitality is full.	(10) I feel nostalgic.
(5) I feel very relaxed.	(11) I am nervous.
(6) I feel very calm.	(12) I am worried about the future.

The experimental procedure was first explained to all participants and it was confirmed that none of them had a heart disease, abnormality in blood pressure, and claustrophobia, they were not pregnant, and they did not feel ill. They were told that they could terminate the experience at any time if they felt ill or if they felt the cloth was too tight. They filled out the informed consent forms and questionnaires.

The participants sat on a large cloth grasping the knees and attached the HMD onto the head. They were asked to hold the controllers in front of the chest. 31 persons of them were wrapped in the cloth using the Otonamaki method. After an instruction by the staff, the VR video and sound started. The participants could move back and forth and sideways freely in a sitting posture. After the experience ended, they took off the cloth and HMD and answer the questionnaire. The average time of the total experiment was approximately 10 min.

3.2. Result

The difference before and after the VR experience with and without swaddling was analyzed by a two-sided Welch's t-test and a significance level of $p<.05$ was determined. The results is shown in Table 2. Items (1) to (12) in Table 2 correspond to those in Table 1.The number is the average change in answers between before and after the experience. Significant differences were observed in "(9) I feel at ease" ($p=0.0131$), "(11) I am nervous" ($p=0.0450$), and "(12) I am worried about the future" ($p=0.0272$). Figure 5 shows the bar graphs of the change of the questionnaire results.

Table 2: Results of questionnaires comparing VR experiences with and without the cloth.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
with cloth	-1.39	1.13	0.323	-0.710	0.548	0.0645	-0.0968	0.581	0.516	1.16	-0.581	-1.16
without cloth	-1.84	1.88	-0.656	0.000	-0.281	-0.281	-1.03	0.0313	-0.719	0.250	0.406	-0.313
p-value	0.381	0.188	0.0937	0.0735	0.0624	0.408	0.0701	0.227	**0.0132**	0.102	**0.045**	**0.0272**

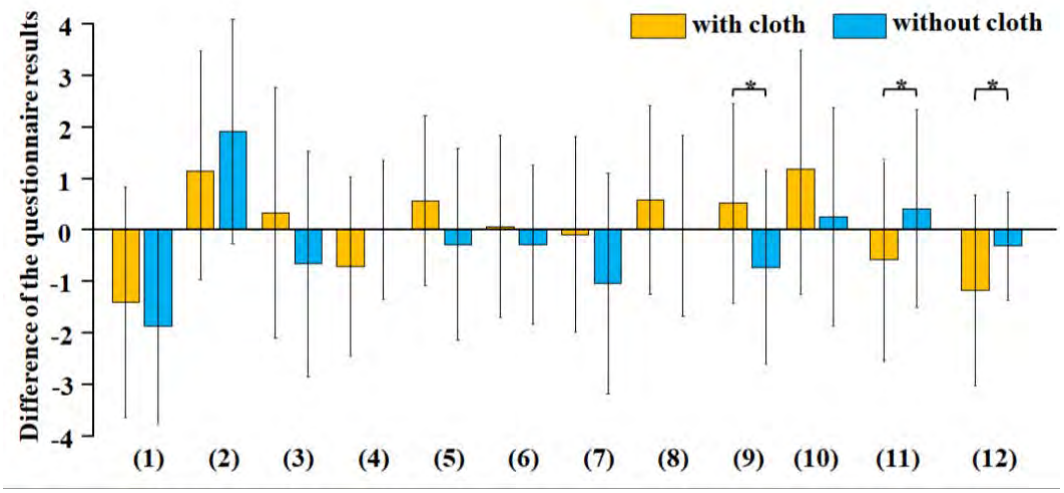

Figure 5: Bar graphs of the change of the questionnaire results between before and after the experiment(*p<.05).

3.3. Discussion: Changes in emotions read from questionnaires

Questionnaire results show that there were significant differences of $p < .05$ in "(9) I feel at ease," "(11) I am nervous," and "(12) I am worried about the future." Particularly in "(9) I feel at ease" and "(11) I am nervous," the results showed that the VR experience with the cloth could create relaxing effects, whereas the degree of relaxation became lower after the VR experience without the cloth. These results indicate that being swaddled when experiencing fetal VR can invoke positive emotions and reduce tension.

4. Conclusions

This paper compared the effects of fetal VR experiences with and without the cloth. No negative effects of being swaddled in cloth were found. Using the cloth during fetal VR experiences could reduce anxiety about the future and bring ease. It is suggested that our fetal VR experience has a relaxing effect on people's emotions. It is believed that this fetal VR experience can contribute not only to the development of relaxation devices and therapy but also to the improvement of the social environment for raising children.

5. References

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