An Investigation on the User Experience of Compressive Tactile Stimulation Clothing

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Introduction

Interpersonal touch and affective touch play a crucial role in social interactions and have a positive influence on mental health. Research showed that touch deprivation increases stress, disrupts psychological resilience as well as coping with stressful situations, which can increase the risk of developing anxiety disorders and depression (Benarji et al, 2021). Skin-to-skin contact and other forms of tactile stimulation improve stress coping in animals and humans (Dunbar, 2010). In healthy adults, receiving massages has been associated with lower blood pressure, heart rate, cortisol levels, and decreased anxiety (Moyer et al, 2004). Likewise, receiving frequent hugs relates to lower blood pressure and heart rate (Grewen et al, 2003) and one study showed that hugging a human-shaped cushion can reduce cortisol levels (Sumioka et al, 2013). In this context, clothing naturally presents a great potential for tactile sensory stimulation to promote health and wellbeing as it is often defined as the second skin, an object closest to our skin that surrounds our bodies for a whole lifetime. This study investigates user's experience of sensory clothing, specifically how compressive tactile stimulation on different upper body locations is experienced. We designed four compression vests with inflatable sections located on different parts of the torso and evaluated the user experience on 10 female participants in dynamic conditions using a think-aloud protocol and post-use survey.

Method

Four compression vests with different inflatable sections were designed and prototyped. Compressive sections of the vests were located on 1) Shoulder and Front Torso (P1), 2) Shoulder and Back Torso (P2), 3) Front and Back Torso (P3), 4) Shoulder, Front and Back Torso (P4) based on previous studies - The garment pressure at shoulder was the greatest because the fat is thinner. Then the pressures on breast and back were higher. The breast of female body has a sharp curvature and the fabric strain leading to greatest pressure recorded. The less fat and bigger curvature change are the reasons for lager pressure at back. - (Liu et al, 2013; Jeon et al, 2020; Jun & Jang, 2020). The prototypes were drafted in women's size 10. The inflatable compressive sections of each vest were constructed as an air tight bladder by laminating the textiles with a thermoplastic polyurethane film using heat press.

* This is result of the Kongju National University Research Year project.

P1: Front & Shoulder	P2: Shoulder & Back	P3: Front & Back	P4: Front, Back, Shoulder
			

Figure1: Vest prototypes with inflatable zones highlighted.

10 female participants, aged 19-50, were recruited to explore the user experiences of varying locations of tactile compressive stimulation in dynamic conditions. We employed a with-in subject experimental protocol where each subject wore and evaluated each vest in a randomized order in four different location conditions. Participants wore the compression vest in the unactuated state and vest was inflated until the compression reached the desired level for each participant. Participants were then photographed while standing still from front, back and side views to evaluate the fit of each vest in the actuated state. Next, participants were asked to flex, extend and rotate their torso and shoulders in standing position, walk and finally sit and repeat the flexion, extension and rotation of the torso and shoulders. We employed think aloud technique and participants verbally shared their thoughts, feelings as they go through the test protocol. At the end of each vest condition, participants filled in a 5-point Likert type survey evaluating the 'location of compression', 'amount of compression', 'mobility', 'tactile comfort' and 'visual style' (1 most pleasant, 5 least pleasant). A one-way ANOVA with Tukey HD test was performed to test significance among compression location conditions and the qualitative data from the think aloud session was analyzed.

Results and Discussion:

Based on the survey results, compression location on the front and back torso (P3) was evaluated most positively and Tukey's HSD Test for multiple comparisons showed a statistically significant difference based between compression location of P3, P2, P4, and P1. Pleasantness of the amount compression perceived by participants resulted in the order of P3>P1>P4>P2. This result indicates preference for compression on the torso rather that the shoulder. Participant comments about P3 included "comfortable rather than restrictive", "feels like hug", "gives sense of stability", "feel cozy". There was no statistically significant difference for variables of pressure amount, mobility, tactile comfort and visual style among 4 prototype categories. Qualitative data from the think aloud protocol indicated certain preferences. P3 and P1 were rated more positively while P4 was evaluated the most negatively for mobility. In the standing position, participants felt most comfortable in the P3, which did not restrict the neckline and armhole areas and did not cause discomfort when moving the torso. In the sitting position, participants reported P4 positively as the air was pushed forward. In the tactile comfort category, positive evaluations were equally high for P2 and P3 while P4 was ranked negatively. For P4, participants commented "My back feels swollen, my neck and chest feel stuffy" or "It feels like the air is coming in behind me and pulling my neck". For

the visual style variable, positive evaluation was given in the order of P2>P3>P1>P4. In general, this predicts a tendency to prefer air injection to the side and back rather than the front of the body. Results indicate that compression on shoulders were not perceived as pleasing. Also including inflatable bladders on shoulders affected the fit of the vests around the neckline and armhole in the actuated state creating snug fit digging into the skin as well as limiting shoulder mobility. Another interesting finding was regarding the difference in pleasantness of the compression based on the body posture.

P1: Front & Shoulder	P2: Shoulder & Back	P3: Front & Back	P4: Front, Back, Shoulder
			
			

Figure2: Results of vest prototypes with inflating test

Conclusion

This study sheds light into how compression locations on the upper body are perceived by users and provides valuable design criteria for development of compressive sensory clothing. Future research will test the perception of the amount of compression using the most preferred prototype option. The findings will also be used to develop an aesthetically pleasing sensory clothing for the upper body.

References

Banerjee, D., Vasquez, V., Pecchio, M., Hegde, M. L., Ks Jagannatha, R., & Rao, T. S. (2021). RETRACTED: Biopsychosocial intersections of social/affective touch and psychiatry: Implications of 'touch hunger'during COVID-19. *International Journal of Social Psychiatry*, 0020764021997485.

Dunbar, R. I. (2010). The social role of touch in humans and primates: Behavioral function and neurobiological mechanisms. *Neuroscience & Biobehavioral Reviews*, *34*(2), 260-268.

Jeon, E. J., Jung, H. Y., Kim, H. E., and You, H. C. (2020). Analysis of Body Surface Area by Fitness Motion Using 3D scan data of Korean Elderly Female. *Fashion & Textile Research Journal 22*(5). 650-659

Grewen, K. M., Anderson, B. J., Girdler, S. S., & Light, K. C. (2003). Warm partner contact is related to lower cardiovascular reactivity. *Behavioral medicine*, *29*(3), 123-130.

Liu, H., Chen, D., Wei, Q., and Pan, R. (2013). An investigation into the bust girth range of pressure comfort garment based on elastic sports vest. *The Journal of the Textile Institute 104*(2) 223-230.

Jun, M. H., Jang, J. A. (2020). Development of Cool-touch Functional Dancesport Top for Middle-aged Women. *Fashion & Textile Research Journal 22*(5). 628-638.

Moyer, C. A., Rounds, J., & Hannum, J. W. (2004). A meta-analysis of massage therapy research. *Psychological bulletin*, *130*(1), 3.