A Survey on Sensory Hypersensitivity Among University Students in Japan and China

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Abstract: This study aimed to investigate sensory hypersensitivity among university students. A 27-item questionnaire contained statements of modality-specific sensitivity (visual, auditory, gustatory, olfactory, and tactile). A total of 65 Japanese undergraduate students and 31 Chinese master’s students majoring in design were enrolled in the study. The results showed that (i) Design major students in the two countries reported a similar tendency of modality-specific sensitivity, and they all mostly involved visual hypersensitivity. (ii) Chinese students reported sensory hypersensitivity problems more frequently than Japanese students in all five domains. (iii) More Chinese students preferred coping with the sensory hypersensitivity by avoidance than Japanese students, whereas more Japanese students preferred coping with it by bearing. Our study suggests that the prevalence of and coping strategies for sensory hypersensitivity differs between the countries.

Keywords: Sensory hypersensitivity, Design students, Cultural differences

1. INTRODUCTION

Sensory hypersensitivity is a symptom of excessive sensory processing in which small changes in the stimulus intensity are perceived [1]. People can be hypersensitive to all sensory modalities, including vision, audition, taste, olfaction, and tactile sensation [2]. Sensory hypersensitivity can frequently occur in children and adults with migraine [3], pervasive development disorder [2], Tourette syndrome [4], as well as typically developing healthy adults [5]. For example, hyperacusis (hypersensitivity in auditory perception) prevalence among typically developing healthy adults is approximately 5%–20% [6].

Living with sensory hypersensitivity is a challenging task. People with sensory hypersensitivity can suffer in case of bright light, the sound of a dripping tap, the flavor of raw food, or perfume [7], which are common in daily life. Moreover, researchers illustrated the case regarding visual sensory processing wherein part of healthy individuals are irritated by the bright light of freezers in a supermarket or fluorescent lights in appliance stores [8]. This phenomenon can interfere with the individuals’ functioning and concentration when working and may result in clinical depression [9]. However, this issue has not been recognized by most researchers. Their discomfort and irritation are often misinterpreted as a sign of pickiness or laziness [10]. According to studies, hypersensitivity-friendly workplaces can be created if hypersensitive and non-hypersensitive workers can mutually understand and make low-cost accommodations, such as replacing fluorescent lights with LED lights [11, 12]. A hypersensitivity-friendly learning environment can be achieved in the same manner. The installation of sensory hypersensitivity space designs in airports and stadiums has recently begun.

A good example is a calm-down space at Narita International Airport, which utilizes sound-absorbing materials for hyperacusis passengers [6]. However, this kind of consideration has not yet been fully taken into account in universities and schools. Contrastingly, previous studies have demonstrated a positive relationship between the higher temporal resolution of processing vibrotactile stimuli and the degree of sensory hypersensitivity [13]. It has been reported that some hypersensitive individuals can detect small displacements in vibrotactile stimuli at both low (33 and 25 Hz) and high frequencies (200 Hz) [14, 15]. We consider that this kind of superior abilities in people with sensory hypersensitivity can be advantageous in art and design.

Therefore, we aimed to investigate the sensory conditions of design students to improve their experiences in the learning environment. With the advent of coronavirus disease in 2019, there has been a rise in the opportunities for online lectures in universities, and numerous students more easily feel tired or irritable concerning visual and auditory stimuli. This study aims to examine whether Japanese and Chinese design students exhibit sensory-hypersensitivity related problems and their coping strategies, for an exploratory purpose. We conducted surveys with students in Japan and China to see the prevalence of sensory hypersensitivity in universities in both countries. We also examined their coping strategies because previous studies have shown...
differences in stress-coping strategies [16] and responses to stressors between them [17,18].

2. METHOD

2.1 Participants

In this study, data were collected through an online questionnaire. A total of 65 Japanese undergraduate students in the design program at the University of Tsukuba (UT) were included (55 women, 10 men, $M=18.9, SD=1.3$). A total of 31 Chinese master’s students in the industrial design program at Tianjin University (TJU) were included (12 women, 19 men, $M=24, SD=1.4$). The average age of participants from Tsukuba University was younger than those from Tianjin University ($t=17.32, df=94, \alpha=.001$). The gender ratio was also significantly different between the two countries ($\chi^2=20.98, df=1, \alpha=.001$). This study was approved by the ethical committee (approval number: G29-11) of the Faculty of Art and Design, University of Tsukuba. All participants in both countries provided informed consent before administering the online questionnaires.

2.2 Questionnaire

There were 104 questions in total, divided into 6 parts. The first five parts consist of questions related to one of the following sensory modalities: visual, auditory, gustatory, olfactory, or tactile. The last part contained demographic questions. In the first five parts, questions regarding sensory hyper-sensitivity experience are listed in Table 1. Item content was developed after an extensive literature review of questionnaires such as the adult sensory profile [19], a 25-item measure of sensory hypersensitivity in patients with chronic fatigue [20]. These scales have been considered reliable and verified in previous studies [21-23]. Moreover, questions related to symptoms frequency, sensory hypersensitivity information search preferences and coping strategies were also included in the first five parts. To assess coping strategies, we asked questions such as, “How do you deal with your visual hypersensitivity?” for each sensory modality (i.e., visual, auditory, gustatory, olfactory, and tactile). The participants were asked to choose one answer from “to bear,” “to consult doctors or experts,” and “to avoid.”

The Japanese and Chinese questionnaires contained the same list of questions and were parallelly implemented. Additionally, the questionnaire was originally written in Japanese, and the Chinese questionnaire was back-translated to prevent misunderstanding and guarantee an accurate depiction of each statement. The questions regarding symptoms were set as multiple-choice questions, and the remaining questions were single-choice ones.

3. RESULTS

3.1 General comparison

The students reported sensory-hypersensitivity problems in both countries. There appears to be a similar number of students in both countries with similar preferences in sensory modalities based on the results of the questionnaires. Visual sensation is considered an aspect that mainly triggers hypersensitivity problems. This was followed by auditory and olfactory (3rd). Tactile sensation is the aspect that induces the least hypersensitivity of all. Overall, students in China experienced more hypersensitivity problems than Japanese students in all sensory modalities.

Since the data collected from the questionnaires were categorical variables, the chi-square test of independence was conducted using SPSS Windows software version 28. The country of origin and each sensory modality were chosen as variables, and we compared the frequencies at which students in Japan and China selected the same sensory modalities. If there was no relationship between country and sensory modality selection, the actual proportion was expected to be approximately equal. Otherwise, the proportion of students in the same sensory modality should be close to the proportion in the sample. From Table 2, the $\alpha$-value of all the five sensory modalities is less than our chosen significance level (0.05). Therefore, in conclusion, statistical evidence suggests an association between country and sensory modality selection. Chinese students reported sensory hypersensitivity problems more frequently than Japanese.

Effect size of chi-square test is understood as following. Visual(\(\alpha=-.44\)); Auditory(\(\alpha=-.37\)); Gustatory(\(\alpha=-.30\)); Olfactory(\(\alpha=-.25\)); Tactile(\(\alpha=-.26\)). Two countries showed strong negative relationship on visual hypersensitivity, moderate negative relationship on auditory and gustatory hypersensitivity, and weak negative relationship on olfactory and tactile hypersensitivity.

3.2 Proportion of the 27-item sensory hypersensitivity

Table 1 shows the proportions of each item in the two countries. “Feel uncomfortable when polka dot pattern appears” is the most unpleasant experience for Chinese design students. The chi-square test for this statement was implemented. $\chi^2(1)=29.2, \alpha=-.55, p<.01$. Under the auditory sensory aspect, more Chinese students claimed that “It is difficult to concentrate in a noisy environment.”
The chi-square test for this statement was implemented. $\chi^2(1) = 19.2$, $\phi = -.45$, $p < .01$. Under the gustatory sensory aspect, an overwhelming number of Chinese design students indicate that they are “Extremely unacceptable towards some food of specific taste” $\chi^2(1) = 32.1$, $\phi = -.58$, $p < .01$. However, few Japanese students experience gustatory hypersensitivity. Regarding olfactory sensory, “Feel uncomfortable when smelling peculiar odor in confined spaces such as subways” $\chi^2(1) = 9.0$, $\phi = -.31$, $p = .01$ are mentioned mostly among
Chinese design students. Finally, “extremely concerned about the texture of cloth or underwear” bothers many Chinese design students \( \chi^2(1)=23.4, \phi = -.49, p < .01 \).

### 3.3 Coping strategies for sensory hypersensitivity

Students who considered themselves to have sensory hypersensitivity were asked how they would deal with the issue. The results are shown in Figure 1. It displays the number of students using three different coping strategies under modality-specific sensitivity.

Avoiding the stimuli that trigger discomfort is ranked first in both countries, followed by bearing the issue and seeking a consultant with specialized expertise to help, which is the least favorite solution among students. A 2x3 Chi-square test was applied (\( \chi^2(2)=24.7, \phi = .30, p < .01 \), and it provided evidence that the proportion of each coping strategy differed significantly between Japanese and Chinese design students.

### 3.4 Gender Differences

As mentioned in the Participants section, it was known that participants’ gender was significantly different between the two countries. Previous studies on migraine claimed that migraine was more prevalent in women than in men, and migraine increased the incidence of sensory hypersensitivity among university students in Japan and China. Our results suggest that university students in these two countries have reported similar sensory hypersensitivity tendencies. Visual hypersensitivity is ranked first, as it triggers the most irritation. However, according to the chi-square test results, Chinese students reported more

4. DISCUSSION AND CONCLUSION

Efforts to ascertain why students in China reported more hypersensitivity problems than Japanese ones are needed as the next step. It is worth examining whether the result is due to Chinese students’ higher proclivity toward being sensitive—the hypersensitivity is expected to be assessed directly in future studies. According to the previous studies regarding self-disclosure, it is known that there was more self-disclosure about distress over one’s future occupation among Chinese students. Contrastingly, more self-disclosure was seen over interpersonal stress among Japanese students [16]. Therefore, we consider that: (i) self-disclosure about physical discomfort may also vary between Chinese and Japanese students. (ii) Chinese students live on the campus and stay in public spaces longer, indicating that they may be more exposed to external stimuli than Japanese students. We tend to employ university students with the same educational background; thus, we chose students from the design department at the University of Tsukuba and Tianjing University. However, the gender proportion of the design department at the University of Tsukuba was unbalanced. This issue needs to be considered in a future study. Furthermore, we are interested in environmental and product design, which could be utilized for people with sensory hypersensitivity in Japan and China.

This study conducted a questionnaire to obtain general information about university students’ perception and knowledge of sensory hypersensitivity. We designed a 27-item questionnaire to identify the characteristics of sensory hypersensitivity among university students in Japan and China. Our results suggest that university students in these two countries have reported similar sensory hypersensitivity tendencies. Visual hypersensitivity is ranked first, as it triggers the most irritation. However, according to the chi-square test results, Chinese students reported more

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**Figure 1**: Coping strategies of sensory hypersensitivity between UT students (Japan) and TJU students (China)
sensory hypersensitivity problems than Japanese students. Primarily, it occurs when facing the following occasions: “feel uncomfortable when polka dot pattern appears,” “It is difficult to concentrate in a noisy environment,” “extremely unacceptable towards some food of specific taste,” “feel uncomfortable when smelling others’ body odor,” and “extremely concerned about the texture of cloth or underwear.” Our data reflect similar problems as hypersensitive workers meet in the workspace [10], so similar accommodation in learning environments may assist them in studying more comfortably.

Moreover, most students in both countries choose to avoid stimuli that may trigger hypersensitivity in the future, with more Japanese students preferring to bear the issue than Chinese students. The interaction of individualism and collectivism might explain it. Individualism respects individual goals, and prioritizes the principle of competition. Collectivism, on the other hand, is a type in which individual goals, values, and attitudes are strongly influenced by the members of the inner group, and the principle of cooperation is prioritized [25]. As discussed in a previous cross-cultural study between Chinese and Japanese, it revealed that Japanese university students reflected more characteristics of collectivism. Many of them tend to act according to the group’s judgment and the customs of their peers [17]. Moreover, a previous study regarding over-adaptation also indicated that fear of negative evaluation by peers affected over-adaptation mainly in Japan. Contrastingly, fear of negative evaluation by teachers has a more significant effect on over-adaptation in China [18]. Most university students spend much more time with peers than teachers, and we consider it might trigger the formation of “bearing the issue” behavior among Japanese students. According to the descriptive questions in our investigation, we also understand that most students had minimal knowledge about sensory hypersensitivity. They noticed uncomfortable feelings or irritation, but few of them made connections with sensory hypersensitivity. Our data showed that this could be one factor influencing coping strategies.

ACKNOWLEDGEMENTS
This study was supported by the Topic-Setting Program to Advance Cutting-Edge Humanities and Social Sciences Research Area Cultivation (AFD29210), Grant-in-Aid for Scientific Research(A) (18H03663), and Grant-in-Aid for Scientific Research(B) (21H03758) awarded to Shinichi Koyama.

REFERENCES
1. Acevedo, B., Aron, E., Pospos, S., and Jessen, D.; The functional highly sensitive brain: a review of the brain circuits underlying sensory processing sensitivity and seemingly related disorders, Philosophical Transactions of the Royal Society B: Biological Sciences, 373(1744), 2018.
2. Futoo, E., Miyawaki, D., Goto, A., Okada, Y., Asada, N., Iwakura, Y., Yanagihara, E., and Inoue, K.; Sensory hypersensitivity in children with high-functioning pervasive developmental disorder, Osaka City Medical Journal, 60, pp.63-71, 2014.
3. Hanna, J. J., Chong, C. D., Dunkrieger, G. M., Ross, K. B., and Schwedt, T. J.; Sensory hypersensitivities in those with persistent post-traumatic headache versus migraine, Cephalalgia Reports, 3, 2020.
4. Isaacs, D., Key, A. P., Cascio, C. J., Conley, A. C., Walker, H. C., Wallace, M. T., and Claassen, D. O.; Sensory hypersensitivity severity and association with obsessive-compulsive symptoms in adults with tic disorder, Neuropsychiatric Disease and Treatment, 16, pp.2591-2601, 2020.
5. Kumagaya, S., Ayaya, T., Takenage, T., Onuma, H., and Nakamura, K.; Prevalence and risk factors for hyperacusis in general college students, Audiology Japan, 56(3), pp.234-242, 2013. (in Japanese)
6. Sakuma, T.; Hyperacusis and sound environment in daily life, The Journal of the Acoustical Society of Japan, 77(5), pp.296-301, 2021. (in Japanese)
7. Dunn, W., and Brown, C.; Factor analysis on the sensory profile from a national sample of children without disabilities, The American Journal of Occupational Therapy, 51(7), pp.490-495, 1997.
8. Otake, M., Zhang, M., Kao, C. W., Matsuura, K., and Koyama, S.; Design proposals for people with sensory hypersensitivity based on survey and interview, Art and Design Session Proceedings: Tsukuba Global Science Week, pp.43-46, 2018.
9. Iwanaga, R., Taku, H., Ito, H., Hirashima, T., and Tsuji, M.; Workshop4: Sensory profile, Japanese Journal of Child and Adolescent Psychiatry, 57(1), pp.66-70, 2016.
10. Wachholtz, A., Bhowmick, A., Herbert, L. B., and Marcus, D.; More is not always better: An epidemiological assessment of migraine frequency and the impact on relationships, Journal of Pain Management & Medicine, 3(2), 126, 2017.
11. de Vries, B.; Autism and the right to a hypersensitivity-friendly workspace, Public Health Ethics, 14(3), pp.281-287, 2021.
12. Scott, M., Falkmer, M., Girdler, S., and Falkmer, T.; Viewpoints on factors for successful employment for adults with autism spectrum disorder, Plos One, 10(10), 2015.

13. Ide, M., Yaguchi, A., Sano, M., Fukatsu, R., and Wada, M.; Higher tactile temporal resolution as a basis of hypersensitivity in individuals with autism spectrum disorder, Journal of Autism and Developmental Disorders, 49(1), pp.44-53, 2019.

14. Blakemore, S. J., Tavassoli, T., Calo, S., Thomas, R. M., Catmur, C., Frith, U., and Haggard, P.; Tactile sensitivity in Asperger syndrome, Brain and Cognition, 61(1), pp.5-13, 2006.

15. Puts, N. A. J., Wodka, E. L., Tommerdahl, M., Mostofsky, S. H., and Edden, R. A. E.; Impaired tactile processing in children with autism spectrum disorder, Journal of Neurophysiology, 111(9), pp.1803-1811, 2014.

16. Gu, P. L.; A cross-cultural study of self-disclosure about distress and interpersonal stress between Chinese and Japanese university students, Journal of Japanese Clinical Psychology, 29(3), pp.293-304, 2011. (in Japanese)

17. Wang, K., and Nakamura, M.; A cross-cultural study about interpersonal values between Chinese and Japanese university students: On the structure of Individualism, Collectivism, and Contextualism, Bulletin of the Faculty of Education Ehime University, 52(1), pp.79-88, 2005. (in Japanese)

18. Wang, X.; A comparison of the relationship between fear of negative evaluation by other patterns and over-adaption in Japan and China, Annual Report Graduate School of Education Tohoku University, 65(2), pp.61-71, 2017. (in Japanese)

19. Brown, C., Tollefson, N., Dunn, W., Cromwell, R., and Filion, D.; The adult sensory profile: Measuring patterns of sensory processing, American Journal of Occupational Therapy, 55(1), pp.75-82, 2001.

20. Dixon, E. A., Benham, G., Sturgeon, J. A., Mackey, S., Johnson, K. A., and Younger, J.; Development of the Sensory Hypersensitivity Scale (SHS): A self-report tool for assessing sensitivity to sensory stimuli, Journal of Behavioral Medicine, 39(3), pp.537-550, 2016.

21. Ryu, M., and Ikeda, K.; ASD traits and sensory profiles of normally developed adults and their relation to mismatch negativity in response to local and global auditory deviants, Japanese Journal of Physiological Psychology and Psychophysiology, 35(3), pp.193-205, 2017. (in Japanese)

22. Boogert, F.V.D., Klein, K., Spaan, P., Sizoo, B., Bouman, Y.H.A., Hoogendijk, W.J.G., and Sabine J, R.; Sensory processing difficulties in psychiatric disorders: A meta-analysis, Journal of Psychiatric Research, 151, pp.173-180, 2022.

23. Aykan, S., Vatansever, G., Erdogan, B. D., and Kalaycioglu, C.; Development of sensory sensitivity scales (SeSS): Reliability and validity analyses, Research in Developmental Disabilities, 100, 103612, 2020.

24. Kreiser, N. L., and White, S. W.; ASD in females: Are we overstating the gender difference in diagnosis?, Clinical Child and Family Psychology Review, 17(1), pp.67-84, 2014.

25. Triandis, H. C.; Allocentric vs. idiocentric social behavior: A major cultural difference between Hispanics and the mainstream, University of Illinois, 1983.

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