Exposure to kawaii-ness activates facial expressions related to the salience network: A pilot study

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Abstract:

In recent years, kawaii-ness has been attracting attention in relation to facial expressions and cognitive function. In this study, we measured changes in facial expressions related to the triple network due to exposure to kawaii-ness in 19 healthy adults. As a result, there were changes in facial expressions related to the saliency network (SN). On the other hand, there were no changes in facial expressions related to the default mode network and central executive network. This is the first pilot study showing that exposure to kawaii-ness may enrich facial expressions related to the SN.

Keywords: gray matter volume, kawaii-ness, saliency network, triple network

1. Introduction

In recent neuroscience, the effect of kawaii-ness has been attracting attention. Kawaii, a Japanese adjective meaning cute, good, pretty, adorable, and lovely, is used in everyday situations to express a favorable evaluation of an object or person and refers to the emotion that is generated in the viewer (Nittono, 2016). Nittono and Ihara (2017) found that showing subjects pictures of cute objects, such as human babies or animals, activated the zygomatic major muscle, which is associated with smiling, more than neutral pictures. In the field of neuroscience, it has been revealed that brain regions including the anterior cingulate cortex (ACC) (Abraham et al., 2014) and insula (Abraham et al., 2014; Mascaro et al., 2014) respond to baby faces.

However, there are only limited studies that have clarified the relationship between objects other than infants and the brain. Therefore, it has not been clarified from a neuroscience perspective why character goods with kawaii-ness continue to fascinate people. A clue to address this issue may be found in the two different factors that underlie parents' motivation to care for their infants: protection and nurturing (Hofer et al., 2018). Protection refers to the motivation to protect infants from harm, while nurturing refers to the tendency to respond to infants in a supportive, gentle, and physically caring manner (Hofer et al., 2018). While protection is related to parenting practices, nurturing is related to sensitivity to infant cuteness (Hofer et al., 2018). Consistent with Hofer et al.'s assertion, a study of 23 healthy nulliparous women found that higher self-reported rates of care were associated with increased neural responses to infant faces in several brain regions involved in reward and salience processing, including the ventral tegmental area (VTA), putamen, amygdala, ACC, and insula (Bos et al., 2018). Although it is unclear whether people feel protective over character goods, which are inanimate unlike human infants, it is not difficult to imagine that they would feel a sense of care. According to Nittono (2016), cuteness and kawaii-ness are different, with the former referring to the attributes of an object, while the latter refers to the emotions that arise in the viewer who sees the object. Furthermore, kawaii-ness not only induces the viewer's protection to help the young survive, as in the baby schema (Lorenz, 1971), but also increases the desire to continue looking at the object and to coexist with it (Nittono, 2016).

The activation of the ACC and insula in infants revealed by Bos et al.'s study may be related to their role in social-emotional processing, empathy for others, and salience processing (Uddin et al., 2017). The salience network (SN), which consists of the insula and cingulate gyrus, responds to attention-grabbing, i.e., salient, stimuli and guides behavior in response to those stimuli (Seeley et al. 2007). The SN also acts as a hub to shift attention resources to external stimuli, particularly as a mediator between the default mode network (DMN) and the central executive network (CEN) (Manuello et al. 2018; Varjacic et al. 2018; Li et al. 2022). Therefore, if an individual has a sense of upbringing toward a particular character toy, exposure to the character toy may stimulate the SN, but not the DMN or CEN, resulting in changes in the facial expressions associated with the SN.

This study compares three networks. The CEN, which consists of the dorsolateral prefrontal cortex and posterior parietal cortex, is important for the active storage and manipulation of information in working memory, attention, problem solving, decision-making, and self-awareness (Smith & Jonides, 1998; Wager & Smith, 2003). The SN, which includes the anterior insula and ACC (Seeley et al., 2007), responds to subjective salience, whether cognitive, homeostatic, or emotional (Goulden et al., 2014). The SN also acts as a switch between the CEN and DMN, inhibiting the latter and activating the former when salient stimuli or cognitive challenges are presented, a process essential for attention and flexible cognitive control (Cai et al., 2016; Chen et al., 2015). On the other hand, the DMN includes the posterior cingulate cortex and parts of the frontal lobe, the medial prefrontal cortex, and the posterior temporal lobe region around the temporoparietal junction, including the inferior parietal lobe (Buckner et al., 2008; Uddin, 2015). The DMN is preferentially activated when individuals are not focused on the external environment and are engaged in various domains of cognitive and social processing (Buckner et al., 2008). Based on the above discussion, this study hypothesizes and tests that exposure to character goods with kawaii-ness alters facial expressions related to the SN, but not the DMN or CEN.

2. Materials and Methods

2.1. Participants

A total of 19 people (14 men and 5 women) participated from April to May 2025. The average age was 50.3 ± 8.8 years. Previous small-scale fMRI studies using the baby schema manipulation showed that a sample size of at least 16 was sufficient to detect moderate to large effects (Bos et al., 2018; Glocker et al., 2009), so we aimed to recruit more than 16 participants, given that this is a pilot study. The subjects were randomly selected from employees in the development department of a private company, and they measured their facial expressions using the application described in the next section every morning and afternoon from April 21 to 25 (pre-test). From April 28 onwards, they were asked to wear or place around themselves five items in Figure 1 that were assigned according to the participants' preferences from the four characters of Sanrio Entertainment Co., Ltd. shown in Figure 2, and their facial expressions were measured in the same way as in the pre-test from May 12 to 16 (post-test). According to self-report, none of the participants had any neurological, psychiatric, or other medical history that could affect the central nervous system. All methods were carried out in accordance with relevant guidelines and regulations, all participants provided written informed consent before participation, and anonymity was maintained. This study was approved by the Ethics Committee of the Tokyo Institute of Science (Approval Number 2023137).

Figure 1. Items used in the study. The four on the left are for personal use, and the one on the right is for workplace use.

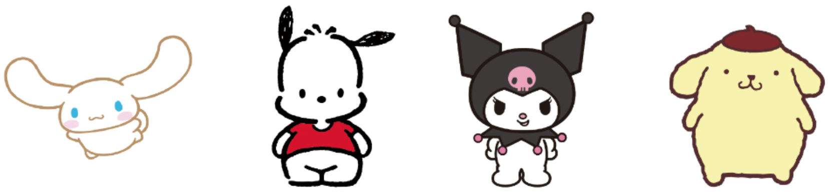

Figure 2. Characters used in the study

2.2. Facial Expression Information

To measure facial expressions, we used an application developed by Panasonic (Namba et al., 2025). In this application, participants sit in front of a camera and imitate the facial expressions in the photos displayed on a PC screen. As shown in Figure 3, there are four types of facial expressions: happiness, anger, sadness, and surprise. The photos were randomly displayed for each subject, and facial expression data was obtained when the subject imitated each facial expression for 5 seconds. The facial expression data was then converted into indices reflecting the DMN, CEN, and SN based on their characteristics. In a previous study, the correlation coefficients with the DMN, CEN, and SN calculated from images acquired by MRI were 0.58, 0.63, and 0.74, respectively (Namba et al., 2025).

Figure 3. Facial expressions used in the measurements.

2.3. Data analysis

From the facial expression information collected during the five days of the pre-test and the five days of the post-test, figures reflecting the GMV of the CEN, SN, and DMN were calculated and corrected for age. In other words, a regression analysis was performed with age as the independent variable and GMV as the dependent variable, and the expected value obtained was subtracted from the actual value to calculate the correction value used in the study. The correction value was used to calculate the mean values of the pre-test and post-test, and the two were compared using a paired t-test. The criterion for significance was set at 5% on both sides, and correction was performed for multiple comparisons using the Bonferroni test. All statistical analyses were performed using IBM SPSS Statistics version 28 (IBM Corp., Armonk, NY, USA).

3. Result

Table 1 shows the results of paired t-tests. DMN ($t = 2.41$, $p = 0.027$), CEN ($t = 2.38$, $p = 0.029$), and SN ($t = 2.77$, $p = 0.013$) were significant at $p < 0.05$. Of these, the significance of the SN was maintained in multiple comparisons using the Bonferroni test, $p < 0.017$ (=0.05/3 tests), but not for the DMN and CEN.

Table 1. Paired t-test results

	Pre			Post				
	Mean	SD	SE	Mean	SD	SE	t	p
DMN	0.43	1.72	0.39	1.22	1.26	0.29	2.41	0.027
CEN	0.76	2.43	0.56	1.65	2.07	0.48	2.38	0.029
SN	-2.79	2.21	0.51	-1.84	2.52	0.58	2.77	0.013

4. Discussion

The results of this study showed that exposure to kawaii-ness character goods altered facial expressions related to the SN. This suggests that incorporating kawaii-ness into daily life may activate facial expressions and affect the SN and related brain regions. This is significant in light of the large role that the SN plays. Previous studies have shown that bvFTD, schizophrenia, bipolar disorder, major depression, attention-deficit/hyperactivity disorder, anxiety conditions, autism spectrum disorder, and substance abuse disorders are all associated with volume loss or connectivity changes in the SN (Goodkind et al., 2015; Sha et al., 2019). In social life, the SN is primarily involved in reward, decision-making, errors, pain, conflict, and inhibition, encoding the rewarding or punishing aspects of social life (Behrens et al., 2008; Klucharev et al., 2009). It also drives people to change their behaviors and internal states in line with social norms when norm violations induce negative emotions (Luo et al., 2018; Wu et al., 2016).Others are thought to regulate human decision-making across a variety of personal and social contexts (Grabenhorst and Rolls, 2011; Gu et al., 2019).Therefore, the SN serves as a general motivational system to encode the reward/punishment properties of social choices and outcomes, with reference not only to self-interest but also to normative social principles (Luo et al., 2018; Xiang et al., 2013).

On the other hand, inability to control facial expressions may have a negative impact on an individual's socio-emotional environment and has been linked to depression, schizophrenia (Berenbaum and Rotter, 1992), affective flattening (Trémeau et al., 2005), and reduced levels of trait empathy in healthy adults (Williams et al., 2013). Alterations in socio-emotional attitudes, including impaired spontaneous emotional expression, empathy, emotion reading, and insensitive emotional expression, have also been found in patients with behavioral variant frontotemporal dementia (bvFTD), right temporal frontotemporal dementia (rtvFTD), semantic variant primary progressive aphasia (svPPA), and Alzheimer's disease (AD) (Fernandez-Duque et al., 2010; Kumfor and Piguet, 2012). Facial blunting, i.e., reduced facial expression of emotions, is a transdiagnostic component of serious mental illness (Cooper et al., 2013; Gaebel and Wölwer, 2004) and is associated with poorer social and occupational functioning (Cohen et al., 2020; Riehle et al., 2018) and increased suicide risk (Grigoriou and Upthegrove, 2020).

Therefore, in recent years, research has been conducted using AI techniques to identify facial features characteristic of people with severe mental illness (Cowan et al., 2022), identify depression from facial expressions and images (Gavrilescu and Vizireanu, 2019; Kong et al., 2022), and predict neural networks from facial expressions

(Vogt, 2024). This study fits into this research trend and is the first to show that exposure to kawaii-ness can change facial expressions related to SN. By incorporating kawaii-ness and enriching facial expressions, the workplace may become more lively and people may be able to work more comfortably. In addition, the link between facial expressions and brain structure suggests that enriching facial expressions will lead to a healthier brain, improved work performance, and reduced risk of dementia. Of course, it is premature to assert these possibilities from this pilot study, and it is expected that these possibilities will be verified in various ways in the future. In that case, it is expected that the roles of other brain networks such as DMN and CEN, which were not significant in multiple comparisons, will be reevaluated by taking larger sample sizes, leading to new discoveries.

4. Limitations

This study has several limitations. First, the results of this study indicate that SN-related facial expressions may be improved by exposure to kawaii-ness, but do not indicate an improvement in SN. Second, this study did not include a control group, so we cannot exclude the possibility that factors other than the intervention may have influenced the results. Third, because this study was conducted on Japanese subjects, caution is required regarding whether the results can be applied to other countries. Fourth, the small sample size limits the generalizability of the results. Fifth, age was used as a control variable in this study. However, background information not included in this study, such as socioeconomic status such as income and differences in the communities to which participants belong, may have influenced the results.

5. Conclusion

In recent years, interest in kawaii-ness has been growing. In this pilot study, a longitudinal study of 19 Japanese adults showed that exposure to kawaii-ness may enrich facial expressions related to SN. If a causal relationship can be confirmed in future studies, this study may be useful for preventing dementia by introducing kawaii-ness.

Declarations

Ethics approval and consent to participate

This study was approved by the Ethics Committee of the Tokyo Institute of Science (Approval Number 2023137), and all methods were carried out according to the relevant guidelines, regulations, and principles of the Declaration of Helsinki. All participants provided written informed consent before participating, and their anonymity was maintained.

Consent for publication

Not applicable.

Data availability

The datasets used and/or analyzed in the current study are available from the corresponding author upon reasonable request.

Author Contributions

K.K. did data analysis, wrote the main manuscript text, and prepared the figures and tables. Y.N., M.O., A.K., and Y.Y. were responsible for conceptualization, data curation, funding acquisition, and project administration. All authors reviewed and edited the manuscript.

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Competing interests

The authors declare no competing interests. A.K. who worked for Sanrio Entertainment, Co., Ltd. were involved in developing the research concept and reviewing the manuscript as co-authors but were not involved in data analysis.

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