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https://doi.org/10.15017/4774160

出版情報：九州大学総合臨床心理研究. 12, pp.35-40, 2021-03-15. Center for Clinical Psychology and Human Development, Kyushu University
バージョン：
権利関係：

*Bulletin of Center for Clinical Psychology and Human Development, Kyushu University*
*Vol. 12, pp. 35－40.*

# Understanding forced smiles in individuals with autism spectrum disorder

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Abstract

This study aimed to examine the understanding of forced smiles in individuals with autism spectrum disorder (ASD). The forced smile is defined as the laughter intentionally reaction with the superficial smile not to depend on natural feelings to be funny expressed. We recruited 26 (10 with ASD and 16 with neurotypical development [ND]) participants who were asked to define forced smiles, rate Kikuchi's Scale of Social Skills, and distinguish the forced smiles from 28 images of natural laughter and 28 images of forced smiles on a PC. As each participant viewed these images, their gaze movement was measured via an integrated eye tracker (Tobii Pro X3-120). The results indicated that the definition of the forced smile was the same between the two groups. The ND group correctly distinguished more of the forced smile images compared with the ASD group. We found a positive correlation between social skill scores and correct forced smile distinction scores in the ND group. The ND group also recorded a significantly longer visual fixation at the left eye compared with the ASD group. Meanwhile, we found differences in the eye movement, length of visual fixation, and fixation count between low- and high-score cases in the ASD group. We discussed the understanding of forced smiles with respect to the concepts of propositional/intuitive mentalizing and weak central coherence.

Keywords: forced smile, ASD, mentalizing

**Introduction**

Laughter lubricates relationships (Wood, A. & Niedenthal, P., 2018). Wood et al. (2018) proposed three distinct social tasks accomplished by human laughter: to reward the behavior of others and reinforce the ongoing interaction; to ease social tension and signal affiliation and the absence of threat; and to enforce social norms, negotiate status, and correct undesirable behavior in others by conveying dominance or superiority. Giles and Oxford (1970) categorized seven types of laughter: tickling laughter, humorous laughter, anxiety laughter, social laughter, ignorance laughter, derision laughter, and apologetic laughter. The latter four types are characterized as "forced smiles" and are a ubiquitous social signal in human interactions.

The "forced smile" phenomenon refers to the social skills that are routinely used by many to maintain smooth social relations (Oshimi, T., 1999). The characteristic form of expression of the Japanese culture is a restrained negative expressiveness and an explicit expression of positive feelings. Individuals exhibit undeveloped social meta-communication skills if they are unable to understand the intentions of other people and the context of their vague expressions, thereby leading to maladaptive social interactions. Structural and functional understanding, such as the appropriate meta-recognition to behave and monitor social skills, operate impressions, the atmosphere, and the state of mind of oneself and others.

Displaying a particularly conspicuous maladaptive behavior in such situations is a symptom of the autism spectrum disorder (ASD). ASD is among the most common neurodevelopmental disorders. The traditional symptom domains (that is, social, communication, and atypical behaviors) can be reduced to the domains of social and communication symptoms, and categorized into restricted and repetitive behaviors, interests, or activities (A.P.A., 2013). This study aimed to understand the atypical development in persons with ASD and the typical development (TD) of social meta-communication.

Although the forced smile phenomenon is important for maintaining human relations, a review of the literature on social skills development of people with ASD reveals that not much is known about it academically. A weak central coherence (Happé F.& Frith U. ,2006) that is suggested to characterize ASD may impact whether a forced smile is understood through intuitive mentalizing or through verbal proposition mentalizing. Therefore, this study aimed to shed light on the recognition of forced smiles in people with ASD.

It is necessary to determine the process for distinguishing expressions not only in terms of language protocol but also from an automatic processing perspective (Kamio, Y., 2004). Doing so would elucidate how a person with ASD understands an expression only as well as it is recognizable when a person from ASD judges an expression definitely. This study evaluated a language protocol in verbal proposition mentalizing and eye movement, which is a part of automatic processing in intuitive mentalizing. The eyes have been described as the windows to the soul. Eyes provide important clues for deciphering mental states, such as feelings or thoughts, which often appear unconsciously in people's minds. However, people with ASD experience difficulties in judging a person's mental state from observing their eyes (Baron-Cohen, S., Wheelwright, S., & Jolliffe, T., 1997). Wagner, Hirsch, Vogel-Farley, Redcay, and Nelson (2013) used eye-tracking to examine the neural, behavioral, and autonomic correlates of emotional face processing in adolescents with ASD. Abnormalities in the processing of information from the eyes (Leekam, S.R., Hunnisett, E. M. C., & Moore, C., 1998; Baron-Cohen, S., Wheelwright, S., Hill, J., Raste, Y.P., & Plumb, I., 2001; Spezio, M.L., Adolphs, R., Hurley, R.S, & Piven, J., 2007) are characterized by specific scan paths on emotional faces: individuals with ASD spend less time on faces in general (Pelphrey, K.A., Sasson, N.J., Reznick, J.S., Paul, G., Goldman, B.D., & Piven, J., 2002), and in particular, focus less on the eyes (Klin, A., Jones, W., Schultz, R., Volkmar, F., & Cohen, D., 2002).

The present study aimed to examine how persons with ASD define

forced smiles, how the accuracy of the forced smile distinction relates to social skills, and how persons with ASD distinguish forced smiles in verbal proposition and intuitive mentalization.

The general hypothesis was that persons with ASD would show a lower accuracy for distinguishing forced smiles and use a different strategy from neurotypical groups.

Forced smile is defined as intentional laughter and superficial smile as a reaction to funny expressions, and which does not depend on one's natural feelings.

## Method

### 1. Participants

The sample consisted of 10 persons with ASD (mean chronological age of 21.3 ± 4.8 years) and 16 individuals with neurotypical development (mean chronological age of 22.4 ± 1.7 years). All autistic disorder diagnoses were confirmed by a medical institution. Participants with ASD were recruited from the Autism Society. Intellectual disability (as defined by an IQ score of less than 70) was an exclusion criterion. All participants had normal or corrected vision. They were informed of the study objectives and gave their consent.

### 2. Measures

① Definition of forced smiles: Each participant was asked to answer, "What is a forced smile?"

② Kikuchi's Scale of Social Skills (Kiss-18) (Kikuchi, 1988): This scale consists of 18 items. Example items include, "Is a conversation the one that does not break off too much even if I talk with another person?" and "When a partner is angry, can you soothe him well?" A five-point Likert scale was used for responses, from "I care very much" to "I don't care at all."

③ Distinction of a forced smile: The participants were shown 28 images of "natural laughter" and "forced smile" on a PC (56 images in total). "Natural laughter" and "forced smile" images were presented in a para-random manner. They were shown at two-second intervals. The participants were asked, "Was it a natural laughter or forced smile? Why do you think so?"

④ Eye movement: As each participant viewed the 56 images, and their gaze behavior was measured using an integrated eye tracker (Tobii Pro X3-120). The eye-tracking device was built into the PC screen and did not require fixing of the position of the participants' heads. The areas of interest (AOIs) for each expression image were set as the entire face, both eyes, the right and left eyes, nose, and mouth. Participants' length of visual fixation and fixation count for each AOI were noted.

The tasks were individually administered in a quiet room during one session lasting about an hour.

### 3. Ethical consideration

The study was approved by the ethical review board of the author's affiliation. All participants gave written informed consent and assented to participate in the study following a full explanation of the objectives, procedures, potential benefits, and risks. All participants were informed that the research results would be made publicly available through a scientific journal. The participants were informed of the right to refuse to participate in the study or to withdraw consent to participate at any time without reprisal. When a participant was incapable of giving informed consent, their parents' informed consent was sought.

## Results

### 1. Definition of a forced smile

Protocols of the ASD and the TD groups were classified into four laughter types: to smile forcibly, to express depending on the atmosphere of the place even though it may not be interesting, to be anxious about not letting relations with the other person worsen, and to present a good impression of oneself.

### 2. Distinction of forced smile

**Correct answers**

The study conducted a *t*-test of the correct scores, which indicated that the TD group scored significantly higher than the ASD group ($t$ (24) = 2.7, $p < .05$).

**Distinction reason (verbal proposition mentalizing)**

The judgment reasons were classified based on whether the part that was paid attention to was singular or plural regarding the pieces that were answered correctly when it was a distinction reason for a forced smile (Table 1). In the TD group, reference to the poor balance of the plural parts, such as eyes, mouth, and cheeks was 14, whereas the

Table 1. Distinction among reasons for forced smiles

| | TD | | ASD | |
|---|---|---|---|---|
| Attention part | n=16 | Reference example | n=10 | Reference example |
| Only one part | 2 | Only the mouth<br>・The mouth opens without power entering<br>・The corners of the mouth do not go up very much | 4 | Only the mouth<br>・Lips are drawn<br>Only the eyes<br>・Although the eyes do not laugh, the photographer "laughingly" says so and the eyes do seem to laugh.<br>・A downward glance |
| Multiple parts | 14 | ・Only the mouth laughs, the eyes do not laugh<br>・Only the corners of the mouth go up, the eyes remain the same<br>・The rise in the corners of the mouth is unnatural and stretches the cheeks<br>・The corners of the mouth are awkward and the top half of the face does not change<br>・The zygomatic position does not change and the eyes move, but do not seem to change.<br>・The left side generally rises and shrinks<br>・Power enters the muscle, but there is no movement | 6 | ・The mouth laughs, but the eyes do not laugh<br>・Power is apt to enter the corners of the mouth and the corner of the eyes<br>・Power seems to enter around the corners of the mouth, the corner of the eyes, or the whole face |

reference for solely the eyes or the mouth was only 2 out of 16. In the ASD group, the reference for only one part was 4 out of 10. When a forced smile was identified in the TD group, there were many people who judged it on seeing the whole face with each part.

**3. Correlation of Kiss-18 and forced smile distinction scores**

Pearson product-moment correlation coefficient analysis between the Kiss-18 scores and correct forced smile distinction scores showed a positive correlation between the two variables in the TD group ($r = .41$, $p < .05$) but not in the ASD group ($r = .62$, *n.s.*) (Fig 1).

**4. Eye movement (intuitive mentalizing)**

① The *t*-test for the length of visual fixation and fixation count for each AOI indicated that the TD group had a significantly higher length of visual fixation in the left eye than the ASD group ($t$ (24) = 2.62, $p < .05$) (Fig 2).

② Some of the subjects with ASD and TD showed differences in eye movements, even though they had comparable score points of Kiss-18 and distinction of the forced smile. A difference in eye movement between an ASD case (57 points on Kiss-18, 40 points on distinction scores) and a TD case (64 points on Kiss-18, 40 points on distinction scores) indicating the same degree was observed. In terms of length of visual fixation, a TD case was longer than ASD for the AOIs of the right eye, left eye, nose, and mouth. In terms of fixation count, the ASD case was higher than the TD for the AOIs of the left eye, nose, and mouth (Table 2).

③ There were differences between the subjects with ASD who had high versus low scores for both Kiss-18 and distinction of the forced smile in eye movements. A difference in eye movement between a low score case (not more than 50 points on Kiss-18, not more than 35 points on distinction scores) and a high score case (not less than 50 points on Kiss-18, not less than 35 points on distinction scores) in the ASD group was noted. In terms of length of visual fixation, in a high score case, the AOI of the eye was longer than the AOI of the nose and mouth. In terms of fixation count, it was higher for a high score case than a low score case in each AOI (Table 3).

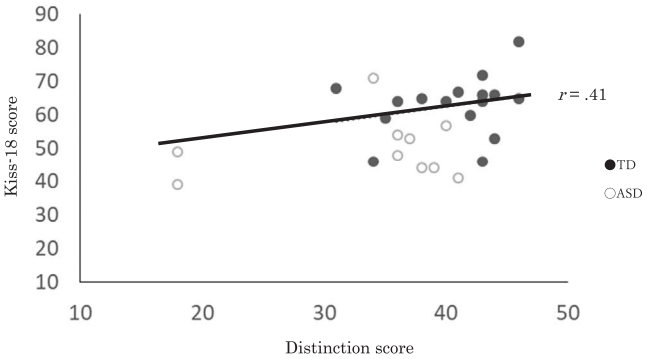


Fig 1. Pearson correlations between Kiss-18 scores and correct distinction of forced smiles scores

**Discussion**

This study examined the definition of forced smile, the accuracy of distinction of forced smile related to social skills, and intuitive mentalization in eye movement.

A summary of the conclusions is as follows. Forced smile was commonly defined by ASD and TD groups as follows: to smile forcibly, to express depending on the atmosphere of the place, to be anxious about not letting a relationship with the other person worsen, and to present a good impression of oneself. The ASD group scored lower than the TD group on distinction of forced smile. A positive correlation between the Kiss-18 and forced smile distinction scores was observed in the TD group but not in the AD group. The TD group had a significantly higher length of visual fixation in the left eye

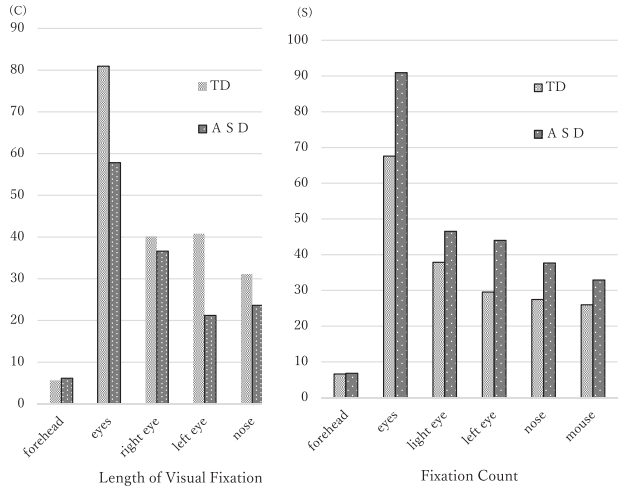


Fig 2. Length of visual fixation and fixation count for each AOI

Table 2. Length of visual fixation and fixation count for each AOI in high Kiss-18 and distinction scores

| AOI | Length of Visual Fixation | | Fixation Count | |
|---|---|---|---|---|
| | TD | ASD | TD | ASD |
| forehead | 6.01 | 6.17 | 15.27 | 1.36 |
| eyes | 80.95 | 57.83 | 58.39 | 78.1 |
| right eye | 40.14 | 36.61 | 32.53 | 32.17 |
| left eye | 40.81 | 21.23 | 25.86 | 45.93 |
| nose | 31.14 | 23.63 | 17.18 | 24.8 |
| mouse | 29.78 | 20.17 | 9.5 | 23.05 |

Table 3. Length of visual fixation and fixation count for each AOI in high and low score cases in ASD group

| AOI | Length of Visual Fixation | | Fixation Count | |
|---|---|---|---|---|
| | high | low | high | low |
| forehead | 7.9 | 1.46 | 2.0 | 5.0 |
| eyes | 53.2 | 36.5 | 79.3 | 82.9 |
| right eye | 32.3 | 29.6 | 36.0 | 35.2 |
| left eye | 20.89 | 6.95 | 43.3 | 47.1 |
| nose | 16.8 | 28.4 | 25.3 | 33.2 |
| mouse | 13.8 | 23.5 | 24.7 | 35.3 |

compared with the ASD group. Some of the subjects with ASD and TD showed differences in eye movements, even though they had comparable score points of Kiss-18 and distinction of the forced smile. The differences in eye movement were shown between a low- and high-score (Kiss-18 and distinction of the forced smile) case in the ASD group.

Both ASD and TD groups provided the same definition of a forced smile, coinciding with the definition of a previous study (Oshimi, T., 1999). Therefore, even if a difference was observed in the distinction of forced smiles, it did not occur in terms of the definition but in the accuracy of the distinction.

The TD group tended to distinguish forced smiles correctly, indicating that they have more effective skills for maintaining smooth social relations. Many studies have reported on the difficulty experienced by persons with ASD regarding understanding the expressions of others. Similarly, they were shown to have difficulty understanding a forced smile. A positive correlation was shown between social skills scores and the correct distinction of forced smiles scores in the TD group. However, no correlation was found in the ASD group. The ability to distinguish forced smiles may vary depending on an individual's social skills. Therefore, the skills related to the distinction of forced smiles need to be examined.

This study considered the reasons for forced smile distinction as part of the propositional mentalizing of the forced smile. The TD group judged the balance between each part of the face, the overall expression and general impression, and the sense of incongruity. Regarding the difference between laughter and forced smiles, Duchenne (1990) indicated that a smile is produced by the joint action of two facial muscles. The zygomaticus major muscle lifts the corners of the mouth, and the orbicularis oculi raises the cheeks, causing the subsequent laugh lines at the outside corners of the eyes (Duchenne, 1990). Ekman and Friesen (1982) reported that the common elements in the facial expressions of all such positive experiences are the actions of two muscles. They explained the zygomatic major pulling the lip corner upward toward the cheekbone and the orbicularis oculi raising the cheek and gathering the skin inward from around the eye socket. In addition, Ekman, Hager, and Friesen (1981) revealed that deliberately made facial expressions, such as false smiles, would require more cortical involvement, and thereby be more likely to show asymmetry because of cerebral specialization, compared with uncontrolled, spontaneous, and felt emotional expressions.

In the TD group, the reasons for distinction between forced and natural smile were based on the whole face, which may explain the accuracy of their distinction. Meanwhile, in the ASD group, the reason involved only one part of the face which accounted for approximately half, and as for propositional mentalizing that was how a forced smile was distinguished. The concept of "weak central coherence" (Happe, F., & Frith, U., 2006) implies that persons with ASD have a perceptual bias for local not global stimulus features. This upper limit may have led to a lower accuracy of distinction.

Eye movement as an intuitive mentalizing was analyzed for the length of visual fixation and fixation count for each AOI. The TD group reported a significantly higher length of visual fixation in the left eye, compared with the ASD group. Even if the distinction of the forced smile is the same, the strategy for distinction may differ.

A difference in eye movement, length of visual fixation, and fixation count between an ASD case and a TD case who recorded the same Kiss-18 and distinction scores was found (Table 2). However, the study could not delve into the meaning of this difference in terms of ASD. The results suggest the use of an atypical strategy in the ASD group.

Further, differences in eye movement, length of visual fixation, and fixation count between the low- and high-score cases in the ASD group were observed (Table 3). Therefore, a variety of aspects exist in the ASD group. Kamio (2004) indicated that the difficulty in recognizing facial expressions in ASD changes with the development of persons with ASD; they may not develop a strategy during typical development, and instead a unique atypical strategy is developed. In the theory of mind task, persons with ASD use verbal propositional mentalizing and not intuitive mentalizing (Beppu, S., & Nomura, K., 2005). A similar phenomenon may have occurred in the present task. It may be recognized that intuitive attention is turned to the whole face in persons with TD; however, people with ASD exhibit reduced attention and sense of incongruity. Moreover, this study suffered the limitation of a small sample size. Therefore, further examination is required to determine these differences.

The so-called Duchenne smile, in which the muscles around the eye are activated, in addition to the muscle that pulls the lip corners up (Ekman, P., Davidson, R.J., Friesen, W.V., 1990) is not universal but rather limited to certain cultures (Pascal T., Manon, L., Pierre, G., & Ursula, H., 2012). Studies on smile perception have been restricted to Western countries, which is suggestive of a display rule that would need to be acquired during socialization in different cultures. Thus, future work is needed to elucidate the sociable function and perception of laughter/smiles in Eastern countries, which may have specific cultures related to laughter (Li, S., & Shibuya, S., 2011). Further research is required to examine forced smile in the Japanese culture.

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**Acknowledgement**

I am grateful to many for their assistance and support throughout this investigation. I wish to thank all the participants who generously helped me complete this study. Special thanks go to Shiori Imamura, who cooperated in this study. This work was supported by JSPS KAKENHI (grant number 17K18707).