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Roots of smile: A preterm neonates' study

Kiyobumi Kawakami[a,*], Kiyoko Takai-Kawakami[b], Fumito Kawakami[c], Masaki Tomonaga[d], Makoto Suzuki[e], Yukiko Shimizu[e]

[a] University of the Sacred Heart, 4-3-1, Hiroo, Shibuya-ku, Tokyo 150-8938, Japan
[b] Japan Women's University, 2-8-1, Mejirodai, Bunkyo-ku, Tokyo 112-8681, Japan
[c] Tokyo Institute of Technology, 2-12-1, Ookayama, Megura-ku 152-8550, Japan
[d] Primate Research Institute, Kyoto University, Kanrin, Inuyama, Aichi 484-8506, Japan
[e] Kameda Medical Center, 929, Higashi-cho, Kamogawa, Chiba, Japan

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ABSTRACT

Twenty-two preterm neonates were observed 1 h per neonate in the NICU. Ninety-five spontaneous smiles were recorded. Younger and smaller neonates showed more and longer spontaneous smiles than older and larger. The youngest neonate was 200 days from conception on the observational day. She was 511 g. This infant showed spontaneous smiles. The roots of spontaneous smiles are discussed.

Smiling has probably received the greatest attention by investigators of early behavioral and emotional development (Wolff, 1987, p.105). For example, Ambrose (1961, 1963) conducted intensive studies on infant smiling. As the first stage of smiling, Wolff (1959) noted: "Spontaneous smiling (defined as a slow, gentle, sideward and upward pull of the mouth, without rhythmical mouthing movements or contraction of other facial muscles) was observed. . .during irregular sleep, drowsiness, and alert inactivity, but never during regular sleep, alert activity, or between bursts of crying (p. 115)".

Kawakami et al. (2006, 2007) have studied spontaneous smiles and spontaneous laughs (smiles accompanied by vocal sounds) intensively. They found that (1) unilateral spontaneous smiles were more common than bilateral smiles in neonates, but by the 2nd month bilateral smiles were more common, (2) spontaneous smiles were observed as late as the 6th month, (3) spontaneous laughs were observed from the first month, (4) the durations of spontaneous laughs were longer than those of spontaneous smiles and (5) almost all spontaneous laughs were bilateral.

To investigate the roots of smile, Kurjak (2004) used 4D sonography to observe fetal behavioral movements. However, even now it is difficult to code 4D smiling by the strict criteria referred to later. Wolff (1987) and Emde, McCartney, and Harmon (1971) observed spontaneous smiles in preterm neonates. But we can use more detailed data by digital videos. Recently, Dondi et al. (2004), in an exploratory study, observed Duchenne smiles in preterm neonate infants. The Duchenne smiles observed in preterm neonates are like the one-month olds' smiles.

The purposes of this study were (1) to present the digital data of spontaneous smiles in preterm neonates, and (2) to consider the roots of smile by the data.

* Corresponding author.
E-mail address: kawakami@u-sacred-heart.ac.jp (K. Kawakami).

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1. Method

1.1. Participants

Twenty-two (10 females and 12 males) preterm neonate infants born and cared for in the neonatal intensive care unit (NICU) of Kameda Medical Center in Chiba, Japan, were observed in this study. They were born (1) under 280 gestational days, and (2) under 2500 g birth weight, but (3) they were healthy enough. The mean gestational day was 210.73 (S.D. = 28.18). The mean birth weight was 1149.32 g (S.D. = 485.34). The mean Apgar score at the delivery was 5.68 (S.D. = 3.03) and 7.59 (S.D. = 2.28) 5 min later. The mean observational day calculated by gestational day was 251.18 (S.D. = 28.48). The mean body weight on the observational day was 1807.05 g (S.D. = 805.51). The observational design was explained to parents, and informed consent was obtained. This research was conducted with the fully informed permission of the ethical committee of Japan Women's University.

1.2. Procedure

To keep the daily medical care of NICU, the observers did nothing to the neonates except to ask staff to remove pacifiers. Some neonates were in the incubator and the others were in a baby bed / held by someone. The other conditions were the same, so all the data can be compared. The observer recorded the neonate's face by Digital Video Camera Recorder (SONY DCR-PC110) en face. The observation time was 1 h per neonate (M = 3581.68 s, S.D. = 559.11).

1.3. Definition of "Spontaneous smile"

To code infant's smile, Oster (1978) used three criteria: (1) the action had to appear subjectively smile-like when viewed at normal speed; (2) there had to be more than a trace of AU12 [Action Unit in the Facial Action Coding System (FACS), Ekman & Friesen, 1978]; and (3) the AU12 component of the smile had to be visible for at least 1 s. AU12 (lip corner raising) is recognized as the basis of all smiles by other researchers (Messinger et al., 2002). Also, "lip corner raising" is an important criterion in other facial coding systems [e.g., Code 52 in The Maximally Discriminative Facial Movement Coding System (MAX), Izard, 1983].

We adapted strict criteria for identifying spontaneous smiles as follows: (1) lip corner raising (AU12 in FACS and Code 52 in MAX); (2) during irregular sleep, drowsiness; (3) without known external or systematically demonstrable internal causes (Wolff, 1963); (4) continuing more than 1 s; (5) smiles continued within 1/6 s were combined.

The onset and offset of smiles were determined as follows. Our digital video camera recorder had a button to move a video sequentially by 1/30 s. When we found a smile, we moved the video back sequentially to the onset frame (immediately prior to which there were no facial movements). From the onset, we moved the video forward sequentially to the offset (immediately following which there were no facial movements).

1.4. Coding

Two coders independently identified spontaneous smiles using the Digital Camera Recorder (SONY DCR-PC110). Only spontaneous smiles identified by both coders were included in the subsequent analysis. The percentage of intercoder agreement was 90.9%. Correlation of the event durations recorded by the two coders was $r = 0.87$ ($p < 0.01$).

2. Results

2.1. The basic data

Ninety-five spontaneous smiles were observed. All neonates showed spontaneous smiles in the observations (Frequencies; M = 4.32, S.D. = 4.19, the least 1 and the most 18). Fig. 1 shows one sample of bilateral spontaneous smile (The infant was held by his mother during the observation). The durations of spontaneous smiles were determined by averaging the durations recorded by the two coders. The mean duration was 3.28 s (S.D. = 1.56). The youngest neonate, 200 days old on the observational day (calculated by gestational day) weighing 511 g, showed spontaneous smiles. She was born on the 180 gestational day, birth weight was 501 g, and the Apgar score at the delivery was 1.

2.2. Analyses of frequencies

In the following analyses cutting points were determined by means with the exception of gender. On the frequencies of spontaneous smiles, there was no effect from: gender ($F(1,20) = 0.08$), gestational day (more than 210 days vs. less; $F(1,20) = 0.10$), birth weight (more than 1149 g vs. less; $F(1,20) = 0.81$), nor Apgar score at delivery (more than 5 vs. less; $F(1,20) = 0.22$). But the observational day effect was significant (more than 251 days vs. less; $F(1,20) = 7.86$, $p < 0.05$). Younger neonates showed more spontaneous smiles than older. The body weight on the observational day effect was significant

Fig. 1. Bilateral spontaneous smile.

as well (more than 1807 g vs. less; $F(1,20) = 7.86$, $p < 0.05$). Smaller neonates showed more spontaneous smiles than larger neonates.

2.3. Analyses of duration

On the durations of spontaneous smiles, there was no effect from: gender ($F(1,93) = 0.00$), gestational day (more than 210 days vs. less; $F(1,93) = 0.03$), birth weight (more than 1149 g vs. less; $F(1,93) = 2.49$), nor Apgar score at delivery (more than 5 vs. less; $F(1,93) = 0.86$). But the observational day effect was marginally significant (more than 251 days vs. less; $F(1,93) = 3.09$, $p < 0.10$). Younger neonates showed longer spontaneous smiles than older. The body weight on the observational day effect was marginally significant too (more than 1807 g vs. less; $F(1,93) = 3.09$, $p < 0.10$). Smaller neonates showed longer spontaneous smiles than larger neonates.

Fig. 2. (A). Right side spontaneous smile. (B). Left side spontaneous smile.

2.4. Laterality of spontaneous smiles

Sixty-one spontaneous smiles could be judged by laterality. Thirty-seven were bilateral; 19 were on the left side of the faces; 5 were on the right side. There was no significant difference between bilateral and unilateral smiles. There were more left smiles than right smiles (χ^2 (1) = 8.16, $p < 0.01$). Fig. 2A shows a spontaneous smile on the right side, and Fig. 2B shows a smile on the left side.

3. Discussion

The youngest neonate, 200 days old at observation and weighing 511 g, showed spontaneous smiles. There is a possibility that younger neonates than she exhibit spontaneous smiles. The roots of spontaneous smiles may be earlier.

The most interesting results of this study are the important effects of the observational day and the body weight on the observational day on both frequencies and durations of spontaneous smiles. Younger (smaller) neonates showed more and longer spontaneous smiles than older (larger). In our previous study (Kawakami et al., 2006), 10 full-term neonates (6 females and 4 males) were observed by procedure similar to the one used in this study. The mean age in days was 4.80 (S.D. = 1.69). The frequencies of smiling in full-term neonates ($M = 2.40$, S.D. = 1.65) occurred less than in preterm younger ($M = 6.70$, S.D. = 5.12) and more than in preterm older neonates ($M = 2.33$, S.D. = 1.61). The duration of smiling in full-term neonates ($M = 1.97$, S.D. = 0.68) was shorter than in both preterm younger ($M = 3.46$, S.D. = 1.63) and preterm older neonates ($M = 2.85$, S.D. = 1.30). The dash line in Fig. 3 shows that the durations of spontaneous smiles become shorter with days. Are there the precursors to spontaneous smiles in utero? The dot line in Fig. 3 shows data of previous case study of ours (Kawakami et al., 2007). The durations of spontaneous smiles have no clear tendencies with age in days. Because the dot line was developed from the previous case study, it will be necessary to get more data to consider the developmental changes in durations of spontaneous smiles.

Bilateral spontaneous smiles occurred more frequently than unilateral smiles, but there was no significant difference between them in the current study. Kawakami et al. (2006, 2007) found that unilateral spontaneous smiles were more common than bilateral smiles in full-term neonates, but by the 2nd month bilateral smiles were more common. Is this one of the U-shaped phenomena in developmental psychology described by Siegler (2004)?

Left side smiles occurred more frequently than right side smiles. Holowka and Petitto (2002) showed that infants from 5 to 12 months open the right side of their mouth while babbling and open the left side while smiling. They speculated that babies' emotional expression may be controlled by the right hemisphere even at such an early age. Our results support their hypothesis in the preterm neonates.

We cannot find the true roots of smiling, so we plan to continue the survey in an effect to uncover them.

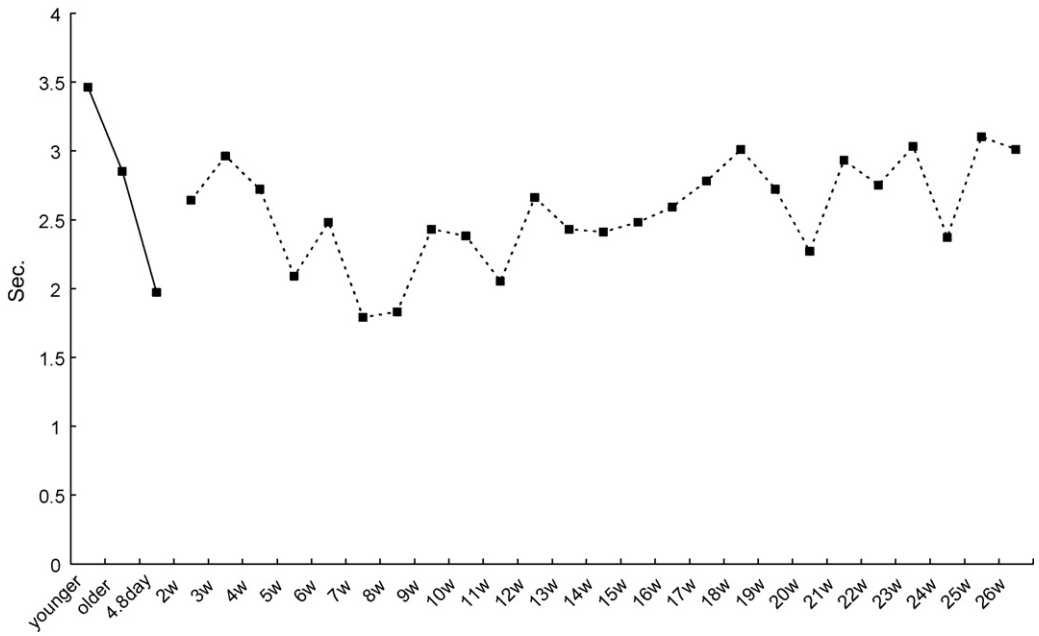

Fig. 3. The developmental changes of the durations of spontaneous smiles.

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