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Origins of smile and laughter: A preliminary study

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Abstract To present fundamental data, spontaneous smiles and spontaneous laughs (smiles accompanied by vocal sounds) were cross-sectionally observed in 10 newborn infants and longitudinally observed in six infants. Unilateral spontaneous smiles were more common than bilateral smiles in neonates, but by 2 months almost all spontaneous smiles were bilateral. All spontaneous laughs were bilateral. "Spontaneous smile" and "Spontaneous laugh" might be different behaviors from the beginning.

Human newborn infants show spontaneous smiling, "a slow, gentle, sideward and upward pull of mouth, without rhythmical movements or contraction of other facial muscles," after the first 24 h during irregular sleep, drowsiness, and alert inactivity [1]. This smile occurs without known external or systematically demonstrable internal causes [2].

Although several researchers have observed spontaneous smiles [3—6], except for the work of Shimada [7] and Messinger et al. [8] there has been little systematic research. Shimada studied the phenomenon in 84 newborns from 1 to 7 weeks of age and observed three types of spontaneous smile: incomplete smile, half smile (unilateral, see Fig. 1), and complete/full smile. He found that spontaneous smiles tend to be more frequent at first, and, with time, their frequency decreases while their duration

Figure 1 Unilateral spontaneous smile.

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increases. Messinger et al. studied Duchenne smiles and non-Duchenne smiles in 25 neonates. One-half of the neonates showed bilateral Duchenne smiles. Further, Messinger et al. emphasized the need for longitudinal research to investigate whether the way in which young infants smile impacts later socioemotional development.

To shed light on the genesis of these affective expressions, we present fundamental data on spontaneous smiling and laughter in human infants. This is a preliminary study that explores an elaborate research design for studying these behaviors.

1. Method

1.1. Participants

Two groups of infants, A and B, were observed in the study. The infants in Group A, all newborns, were each observed for 1 h. The infants in Group B, who ranged from 4 to 87 days in age, were observed over a period of weeks. The Group A was observed under controlled conditions to record frequencies of spontaneous smiles. The Group B was longitudinally observed under natural conditions to record spontaneous smiles and laughs.

1.1.1. Group A

The final participants were 10 newborn infants (6 females and 4 males; M=4.80 days, S.D.=1.69) born at Showa University Hospital in Tokyo.[1] They had no recognized medical problems, and had experienced normal delivery. The mean birth weight was 2914.80 g (S.D.=424.70). The mean Apgar score at the delivery was 8.70 (S.D.=0.68) and 9.60 (S.D.=0.52) 5 min later. The mean gestational age was 38.84 weeks (37.1—40.3, S.D.=1.16). The gestational age is important because it is expected to influence the appearance of spontaneous smiles [3]. The observational design was explained to parents, and informed consent was obtained.

1.1.2. Group B

It is difficult for researchers to record spontaneous smiling and laughter systematically because it occurs somewhat unpredictably in association with irregular sleep. Therefore we asked mothers to record these behaviors when they observed them. The participants were 6 infants (2 males and 4 females). They had no recognized medical problems, and had experienced normal delivery. The mean birth weight was 2911.83 g (S.D.=272.34). Table 1 shows their records.

Table 1 Group B participants

Gender	Days old	Frequency	Duration of recording
female	69—87 (1)	5	0:49:46
male	26—85 (2)	6	3:8:0
male	4—39 (3)	17	2:25:36
female	26—72 (4)	11	6:57:2
female	31—69 (5)	36	1:19:7
female	17—34 (6)	7	2:45:22

"Days old" means from 69-day-old to 87-day-old, for example. Frequency means frequencies of spontaneous smile. Duration of recording means 0 h 49 min 46 s, for example. (1) 69,76,86,87. (2) 26,81,85. (3) 4,9,10,18,19,20,23,30,38,39. (4) 26,35,42,56,72. (5) 31,33,35,37,38,39,41,43,47,48,49,56,68,69. (6) 17,22,34.

1.2. Procedure

1.2.1. Group A

In Japan, newborn infants usually stay a week after delivery in a hospital. At Showa University Hospital, where this research was conducted, infants stay in one large nursery room, and all mothers visit the nursery for an hour every 2 h to give milk and change diapers at the same time. All procedures were performed from 10 a.m. to 3 p.m., a quiet period between visits from mothers, so all data was obtained under the same conditions and can be compared. For the observation an infant was brought to a small room isolated from the sounds of other infants and caregivers. The infants were asleep almost all the time during the observations. They were in a baby bed, and did not have pacifiers. The observer recorded the infant's face by Digital Video Camera Recorder (SONY DCR-PC110) in the face. The observation time was 1 h per infant (M=55.19 min, S.D.=20.78).

1.2.2. Group B

The mothers were asked to record spontaneous smiles by themselves. The instructions were (1) record baby's face in the face position, (2) at sleeping time, (3) on bed if possible, and (4) in silent circumstances.

1.3. Definition of "spontaneous smile"

Oster [9] used three criteria to code an infant's smile: (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) [10]); 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 [8]. 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) [11]).

We used 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 [2]; (4) continuing more than 1 s; (5) smiles continued within 1/6 s are combined; (6) smiles with vocal sounds are defined as spontaneous laughs. The second criterion was used because we cannot discriminate between spontaneous and elicited smiles during an alert inactivity state.

The onset and offset of smiles and laughs 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 or laugh, we moved the video back

[1] One newborn infant did not show spontaneous smiling during the observation. She was eliminated from the study.

sequentially to the onset frame (immediately prior to which there were no facial movements). And 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 and laughs using the Digital Video Camera Recorder (SONY DCR-PC110). Only spontaneous smiles and laughs identified by both coders were included in the subsequent analysis. The percentage of intercoder agreement was 91.67%. Correlation of the event durations recorded by the two coders was $r=0.92$ ($p<0.01$).

2. Results

2.1. Spontaneous smiles in Group A

Twenty-four spontaneous smiles were observed (the frequency range per newborn was 1 to 6). The durations of spontaneous smiles were determined by averaging the durations recorded by the two coders. The mean duration was 1.97 s (S.D. = 0.68). An analysis of duration found no gender difference (female: 1.94 s, male: 1.99 s), no Apgar score effect (Apgar 9: 2.00 s, Apgar 8: 1.93 s), no gestational age effect (37—38 weeks: 2.00 s, 39—40 weeks: 1.93 s), and no age effect (2 to 4 days old: 1.95 s, 5 to 8 days old: 1.98 s).

Unilateral spontaneous smiles were more frequently observed than bilateral spontaneous smiles (unilateral: 20, bilateral: 4), $\chi^2(1)=10.6$, $p<0.01$. An example of a unilateral smile from an infant in Group B is shown in Fig. 1. When lying on one side, unilateral spontaneous smiles were more frequently observed on the side of the face away from the surface of the bed (top side: 18, bottom side: 2), $\chi^2(1)=12.8$, $p<0.01$, as in Fig. 1, where the infant is lying on his right side and smiling on his left side. Unilateral spontaneous smiles were more frequently observed on the left side of the face than the right side (left: 13, right: 7), although this difference was not statistically significant.

2.2. Spontaneous smiles in Group B

The mean duration of observations was 174.15 min (S.D. = 130.06) per infant. There were 82 spontaneous smiles observed, 21 in newborns less than 1 month old, 41 in infants 1 month old, and 20 in those 2 months old.

Of the 24 spontaneous smiles observed in mothers' arms, 5 were on the right side of the face, 4 were on the left side, and 15 were bilateral.

Of the 58 spontaneous smiles observed in infants lying on beds, the laterality of 5 could not be determined. Fig. 2, depicting a 42-day-old infant, shows how a smile can change from unilateral to bilateral. The laterality of this smile could not be determined. Among 53 spontaneous smiles, bilateral smiles were more frequent than unilateral smiles (bilateral: 36, unilateral: 17), $\chi^2(1)=6.8$, $p<0.01$. Unilateral spontaneous smiles were more frequent on the side away from the bed surface (side away from bed: 16, side near bed: 1), $\chi^2(1)=13.2$, $p<0.01$. There was no statistically significant difference in frequency of unilateral smiles on different sides of the face (left: 10, right: 7).

Figure 2 Spontaneous smile changes from unilateral to bilateral.

3. Spontaneous smiles in Groups A and B

Combining the data from Groups A and B, Fig. 3A shows the percentage of bilateral smiles in different aged infants

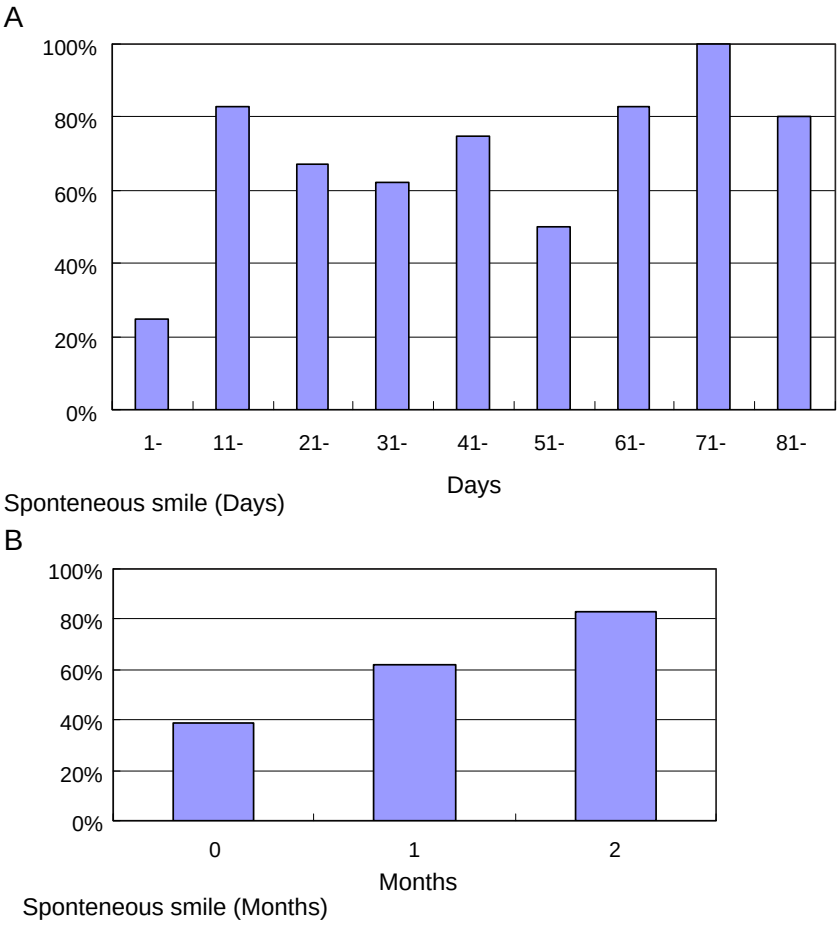

Figure 3 (A) Percentages of bilateral spontaneous smile by 10 days. (B) Percentages of bilateral spontaneous smile by month.

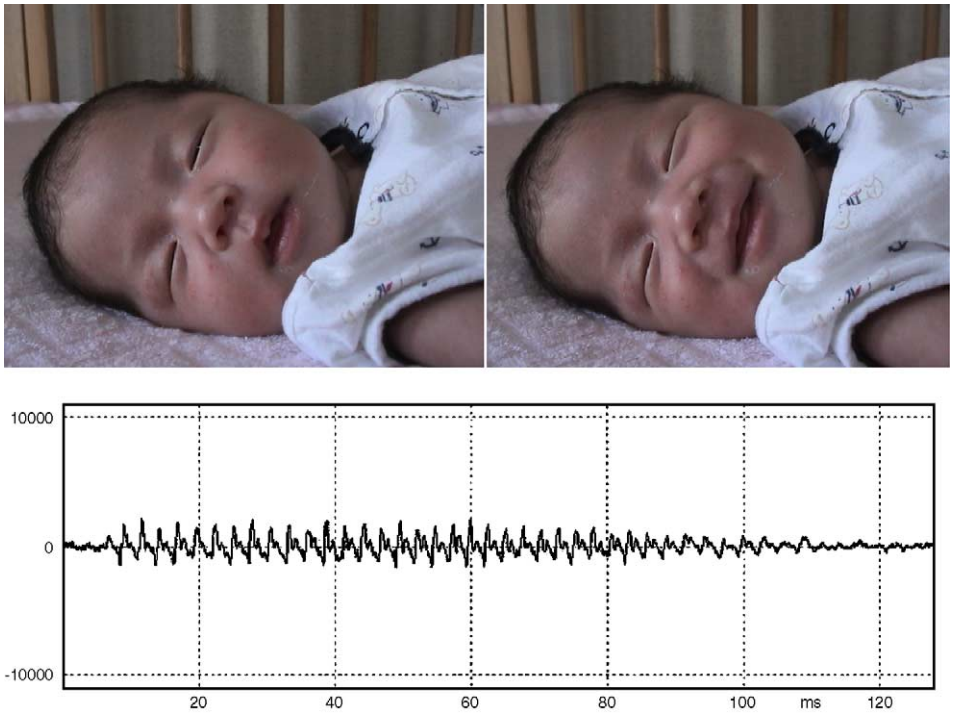

Figure 4 Spontaneous laugh. Abscissa indicates millisecond, and ordinate amplitude.

(grouped in 10-day periods). Fig. 3-2 shows the same data grouped by month. These figures show that the proportion of bilateral smiles increases gradually and consistently with age.

Unilateral spontaneous smiles occurred more frequently on the side of the face away from the bed surface (side away from bed: 34, side near bed: 3), $\chi^2(1)=26.0$, $p<0.01$.

The frequency of unilateral smiles did not significantly differ on the right and left sides of the face when the infant was being held by the mother (right: 5, left: 4). However, there were significant differences when the infant was lying on a bed (right: 14, left: 23), $\chi^2(1)=6.0$, $p<0.05$.

3.1. Spontaneous laugh in Group B

As noted in the METHOD section, spontaneous laughs are different from spontaneous smiles only because they involve vocal laughing sounds. Nine spontaneous laughs were observed. Three out of the four infants who were observed from 0 months of age showed spontaneous laughter—one 17-day-old female, one 24-day-old male, and another 26-day-old male. Fig. 4 shows facial changes and sound waves of the 26-day-old while spontaneously laughing. One female showed 4 spontaneous laughs when 1 to 2 months of age. The mean duration of facial changes during spontaneous laughter was 3.08 s. The mean duration of spontaneous laughs was longer than that of spontaneous smiles (2.17 s), $F(1,113)=7.75$, $p<0.01$. All spontaneous laughs were bilateral.

4. Discussion

Holowka and Petitto [12], using infants from 5 to 12 months, showed that babies open the right side of their mouth while babbling, and open the left side while smiling. They claimed that left hemisphere cerebral specialization while babbling suggests language functions in humans are lateralized from a very early point in development. And they thought that babies' emotional expression may be controlled by the right hemisphere even at the early age of 5 months. Our results on spontaneous smiling in Group A support the early stage of their hypothesis, but as we saw in the data of Group B, the dominance of unilateral spontaneous smiling disappears later. We speculate that this may be one of the U-shaped phenomena in developmental psychology described by Siegler [13].

We found dominance of unilateral spontaneous smiles on the side of the face away from the surface of the bed and on the left side of the face. Can we relate unilateral smiles to the asymmetrical tonic neck reflex (ATNR: [14]) in newborn infants? ATNR is observed during the first 2 or 3 months of life, and it is usually gone by 6 or 7 months [14]. When the participants showed the bilateral spontaneous smiles, they were more likely to be laying on their right side than their left (right: 25, left: 7), $\chi^2(1)=10.2$, $p<0.01$. When showing unilateral spontaneous smiles, they were more likely to be laying on their right side than their left side (right: 26, left 11), $\chi^2(1)=6.0$, $p<0.05$. The dominance of unilateral spontaneous smiles on left side of the face may be related to the ATNR.

Fig. 3A shows there is a large increase in smiles after 10 days and, possibly, another increase after 51 days. This hints at the possibility that a more conscious, less sleep-linked smile is developing or 'coming on-line'.

The rise of bilateral smiling suggests the development of a more mature behavioral pattern and perhaps the development of more mature cerebral control over these behaviors. The longer duration of laughter and increased number of bilateral smiles over a period of days suggest that these are more stable behavioral structures than unilateral smiles.

Sroufe and Waters [15] thought "laughter" appears at about 4 months. How can we explain this discrepancy? Might this be further evidence of the U-shaped phenomenon? The durations of spontaneous laughs were longer than those of spontaneous smiles, but the frequency of laughs was much lower. "Spontaneous smile" and "Spontaneous laugh" might be different behaviors from the beginning.

To record spontaneous smiles and laughs in more detail, it will be necessary to observe them by more intensive longitudinal research designs.

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