Available online at www.sciencedirect.com
ScienceDirect
Infant Behavior & Development 30 (2007) 146–152
Infant Behavior & Development

Spontaneous smile and spontaneous laugh: An intensive longitudinal case study

Kiyobumi Kawakami [a,*], Kiyoko Takai-Kawakami [b], Masaki Tomonaga [c], Juri Suzuki [c], Fumiyo Kusaka [d], Takashi Okai [d]

[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] *Primate Research Institute, Kyoto University, Kanrin, Inuyama, Aichi 484-8506, Japan*
[d] *Showa University, School of Medicine, 1-5-8, Hatanodai, Shinagawa-ku, Tokyo 142-8666, Japan*

Received 15 May 2006; received in revised form 8 August 2006; accepted 9 August 2006

Abstract

One male infant was observed from the day of his birth to the end of the 6th month. Total observation days were 171 days, and total observation time was 329 h 25 min and 35 s. Five hundred and sixty-five spontaneous smiles and 15 spontaneous laughs (smiles accompanied by vocal sounds) were observed. Developmental psychologists have thought that spontaneous smiles integrate at about 3 months, but spontaneous smiles were recorded even in the 6th month. The percentage of bilateral smiles increased from the 2nd month. This is the first intensive longitudinal study on spontaneous smiles and spontaneous laughs.

Keywords: A newborn infant; Spontaneous smiles; Spontaneous laughs; An intensive longitudinal case study

In a study of observations of newborns, 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)". And Wolff (1987) wrote that "Endogenous or spontaneous smiles in sleep . . . have sometimes been referred to as precursors of social smiling (p. 39)". Spontaneous smiles might be one of the roots of our positive emotions.

Certainly several researchers have observed spontaneous smiles (Emde, McCartney, & Harmon, 1971; Freedman, 1965, 1974; Gewirtz, 1965), but there has been little systematic research. We know two exceptions: Shimada (1969) observed 84 infants from 1 to 7 weeks cross-sectionally (at one point in time). He found that spontaneous smiles tend to be more frequent at first, and, with time, their frequency decreases while their duration increases. Messinger et al. (2002) studied Duchenne smiles (involving cheek raising) and non-Duchenne smiles (absence of cheek raising) in 25 neonates (mean age = 55 h). One-half of the neonates showed bilateral Duchenne smiles.

Kawakami et al. (2006) presented the fundamental data of spontaneous smiles and spontaneous laughs (smiles accompanied by vocal sounds). They observed 10 newborn infants cross-sectionally and 6 infants longitudinally. Uni-

* Corresponding author. Tel.: +81 3 3407 5811; fax: +81 3 3407 1986.
E-mail address: kawakami@u-sacred-heart.ac.jp (K. Kawakami).

0163-6383/$ – see front matter © 2006 Elsevier Inc. All rights reserved.
doi:10.1016/j.infbeh.2006.08.004

lateral spontaneous smiles were more common than bilateral smiles in neonates, but by 2 months, 80% of spontaneous smiles were bilateral. The mean duration of spontaneous laughs was longer than that of spontaneous smiles, and all spontaneous laughs were bilateral.

Both Messinger et al. (2002) and Kawakami et al. (2006) claim the necessity of longitudinal studies on spontaneous smiles to shed light on the genesis of affective expressions. This paper is the first intensive longitudinal research on spontaneous smiles and laughs. This preliminary study will explore more elaborate longitudinal research design for studying these behaviors.

Kawakami et al. (2006) concluded that "spontaneous smile" and "spontaneous laugh" might be different behaviors from the beginning. Recently, Waller and Dunber (2005) examined smiling-like display and laughing-like display in chimpanzees. To consider more detail on differences between spontaneous smiles and laughs in humans, we want to add longitudinal data.

The purposes of this study were (1) to present intensive longitudinal data of spontaneous smiles and spontaneous laughs, and (2) to further investigate the differences/similarities of spontaneous smiles and spontaneous laughs.

1. Method

1.1. Participant

One Japanese boy was observed from the day of his birth to the end of the 6th month. He had no recognized medical problems, and had experienced normal delivery. His birth weight was 2610 g. The Apgar score at the delivery was 9, and 5 min later it was 10. The gestational age was 38 weeks 6 days.

1.2. Procedure

It is difficult for researchers to record spontaneous smiles and laughs systematically because they occur unpredictably in association with irregular sleep. As adopted by Kawakami et al. (2006) and Takai (2005), we asked the mother to record spontaneous smiles and laughs by herself. The recording conditions were (1) record baby's face from near position, (2) at sleeping time, (3) on a bed if possible, (4) in silent circumstances, (5) using a tripod if possible.

Total observation days were 171 days within 181 days (6 months), and total observation time was 329 h 25 min and 35 s, 7.6% of that period of his life time. The recording strategy of the mother was "(1) all sleeping time in their home, (2) in silent circumstances, (3) when she was awake".

According to Japanese regulations, we are not required to obtain approval for this work from a Research Ethics Committee.

1.3. Definition of "spontaneous smile"

Oster (1978) 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), 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 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 (Wolff, 1961); (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.

First, we checked all tapes recorded by the mother. Second, 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 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 $r = .79$ ($p < .01$).

2. Results

2.1. Spontaneous smiles

From the 9th day (no spontaneous smile was recorded until the 9th day) to 181-day-old, 565 spontaneous smiles were observed. The durations of spontaneous smiles were determined by averaging the durations recorded by the two coders. The mean duration was 2.57 s (S.D. = 1.28).

The second column of Table 1 shows the means of durations of spontaneous smiles per week. We can observe spontaneous smiles as late as 6 months of age. The fourth column shows the frequencies of spontaneous smile. By the methods adopted by this study, the comparisons of frequencies are not valuable.

At ages 4–6 months, the baby sometimes slept prone. Sixty-three spontaneous smiles were observed in this position. It is very difficult to determine the lateralities of smiles in these cases. And two spontaneous smiles were observed when he was held by the mother. Five hundred spontaneous smiles were analyzed and the lateralities noted.

Three hundred and fifty-eight were bilateral (see Fig. 1A), and 142 were unilateral. The percentage of bilateral smiles among all smiles increases from the 2nd month as shown in Fig. 2. The number of unilateral spontaneous smiles on the right side of his face (see Fig. 1B) were the same as the number on the left side (see Fig. 1C; 71, respectively). 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: 112, bottom side: 7; χ^2 (1) = 92.6, $p < .01$].

Table 1
Development of spontaneous smile

Weeks	*M* duration (s)	S.D.	Frequencies
2	2.64	1.09	21
3	2.96	1.78	19
4	2.72	.9	18
5	2.09	.77	11
6	2.48	1.4	16
7	1.79	.44	8
8	1.83	.32	4
9	2.43	1.39	14
10	2.38	.61	10
11	2.05	.89	44
12	2.66	1.18	47
13	2.43	.96	19
14	2.41	1.7	16
15	2.48	1.14	36
16	2.59	1.13	18
17	2.78	1.4	27
18	3.01	1.43	18
19	2.72	1.64	36
20	2.27	1.03	56
21	2.93	1.59	28
22	2.75	1.07	18
23	3.03	1.66	18
24	2.37	1.05	31
25	3.1	2.1	8
26	3.01	1.44	24

Fig. 1. (A–C) Bilaretal and unilateral spontaneous smiles.

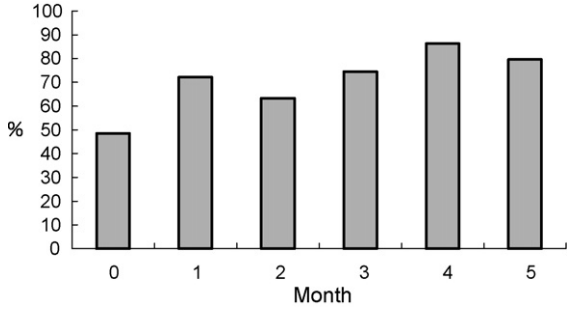

Fig. 2. Percentages of bilateral spontaneous smiles by month.

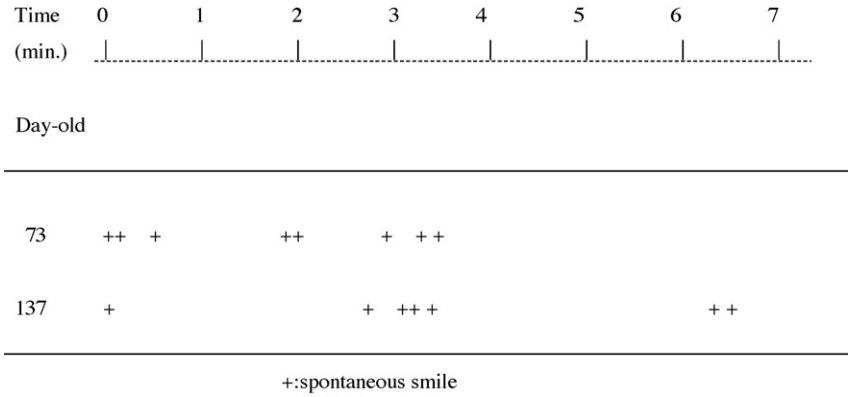

Fig. 3. Smiles bursts.

2.2. Spontaneous laugh

Fifteen spontaneous laughs, from 11- to 181-day-old, were observed. The mean duration of spontaneous laughs was 4.37 s (S.D. = 1.89). The mean duration of spontaneous laughs was longer than that of spontaneous smiles [$F(1, 578) = 28.34$, $p < .001$]. There was no developmental change in the duration of spontaneous laugh.

The laterality of one spontaneous laugh could not be determined because he was sleeping on his stomach. Thirteen out of 14 spontaneous laughs were bilateral. One unilateral spontaneous laugh (left side of the face) was observed at 133-day-old.

2.3. Smile bursts

Takai (2005) defined the bursts of spontaneous smiles as a "period of more than 7 spontaneous smiles in 7 min". In the longitudinal study on one male infant's first 6-months, Takai (2005) found seven smile bursts.

Fig. 3 shows the smile bursts of this study. Two smile bursts, at 73 and 137-day-old, were found.

3. Discussion

First, we should recognize that we observe spontaneous smiles even in the 6th month (mothers reported to us that they observed them after the 12th month). Kagan and Fox (2006) noted: "... the 1st year consists of two important transitions. One occurs at 2–3 months, and the second at 7–12 months of age. The first transition is accompanied by disappearance of newborn reflexes, endogenous smiling, ... (p. 169)". The results of this study prove that the description on spontaneous smiles in the influential handbook should be changed. At 2 months, infants show socially elicited smiles (Rochat, 2001). Spontaneous smiles and social smiles coexist during infant periods. Spontaneous smiles

do not transform into social smiles. These might be the most important results of this longitudinal study. Our positive emotions may have several roots.

From Fig. 2, the rise of bilateral smiling began at the 2nd month. Kawakami et al. (2006) discussed that developmental changes in the brain might cause this phenomenon. By the development of cerebral control, unilateral spontaneous smiles may be changed to bilateral spontaneous smiles. For this child, dramatic changes appeared at the 2nd month. By analyses of the brain at the time of spontaneous smiles, especially at the time of "smile bursts", we will learn some phases of developmental changes.

The asymmetrical tonic neck reflex (ATNR) is observed during the first 2 or 3 months of life, and it is usually integrated by 6 or 7 months (Snow, 1989). Can we relate the results of Fig. 1 to ATNR? Both Hauser (1993)'s rhesus monkeys and Holowka and Petitto (2002)s' human infants showed right hemisphere dominance for the production of facial expression. There was no dominance of lateralities in this study. This is a case study, so we need to study more cases to generalize the results.

Waller and Dunber (2005) observed silent bared teeth display (smiling-like) and relaxed open mouth display (laughing-like) in chimpanzees, and they discussed the differences of the two displays. Their morphological definitions of "smiling-like" and "laughing-like" displays are a little different from ours. The results of this study show that the durations of spontaneous laughs were longer than those of spontaneous smiles, and almost all of spontaneous laughs were bilateral as shown by Kawakami et al. (2006). Only one spontaneous laugh was unilateral in this case. This unilateral spontaneous laugh was observed at 133-day-old. Kawakami et al. (2006) claimed that "Spontaneous smile" and "Spontaneous laugh" might be different behaviors from the beginning. We confirmed this claim by the results of this study. To study the origins of spontaneous smiles and spontaneous laughs, it might be necessary to observe premature babies and to watch fetuses using a three-dimensional ultrasound scope.

To compare the frequencies of spontaneous smiles by weeks/months, fixed schedules of observation may be better using many participants.

Acknowledgements

We would like to thank Mary Blish, Fumito Kawakami, Tetsuhiro Minami, & Jacqueline Mast for their kind support. And we wish to express our appreciation to the infant & his parents for their help.

References

Ekman, P., & Friesen, W. (1978). http://www.-2.cs.cmu.edu/afs/cs/project/face/www/facs.htm.

Emde, R. N., McCartney, D., & Harmon, R. J. (1971). Neonatal smiling in REM states. 4: Premature study. *Child Development*, *42*, 1657–1661.

Freedman, D. (1965). Hereditary control of early social behavior. In B. M. Foss (Ed.), *Determinants of infant behavior: Vol. 3*, (pp. 149–159). London: Methuen.

Freedman, D. (1974). *Human infancy: An evolutionaly perspective*. Hillsdale: LEA.

Gewirtz, J. L. (1965). The course of infant smiling in four child-rearing environments in Israel. In B. M. Foss (Ed.), *Determinats of infant behavior: Vol. 3*, (pp. 205–248). London: Methuen.

Hauser, M. D. (1993). Right hemisphere dominance for the production of facial expression in monkeys. *Science*, *261*, 475–477.

Holowka, S., & Petitto, L. A. (2002). Left hemisphere cerebral specialization for babies while babbling. *Science*, *297*, 1515.

Izard, C. E. (1983). *The maximaly discriminative facial movement coding system*. Instructional Resources Center, University of Delaware.

Kagan, J., & Fox, N. (2006). Biology, culture, and temperamental biases. In N. Eisenberg (Ed.), *Handbook of child development: Vol. 3*,(sixth ed., pp. 167–225). NY: Wiley.

Kawakami, K., Takai-Kawakami, K., Tomonaga, M., Suzuki, J., Kusaka, F., & Okai, T. (2006). Origins smile and laughter: A preliminary study. *Early Human Development*, *82*, 61–66.

Messinger, D., Dondi, M., Nelson-Goens, G. C., Beghi, A., Fogel, A., & Simion, F. (2002). How sleeping neonates smile. *Developmental Sciences*, *5*, 48–54.

Oster, H. (1978). Facial expression and affect development. In M. Lewis, & L. A. Rosenblum (Eds.), *The development of affect* (pp. 43–74). NY: Plenum Press.

Rochat, P. (2001). *The infant's world*. Cambridge: Harvard University Press.

Takai, K. (2005). Development of spontaneous smiles and spontaneous laughs: From observations of one infant from 6-days to 6-months old (in Japannese). *Journal of Japan Society of Perinatal and Neonatal Medicine*, *41*, 552–556.

Shimada, S. (1969). The development of smiling response in early infancy (in Japanese). *Seishinshinkeigaku-zashi (Journal of Psychoneurology)*, *71*, 741–756.

Snow, C. W. (1989). *Infant development*. Englewood Cliffs: Prentice Hall.

Waller, B. M., & Dunber, R. I. M. (2005). Differential behavioral effects of silent bared teeth display and relaxed open mouth display in chimpanzee (*Pan troglodytes*). *Ethology*, *111*, 129–142.

Wolff, P. (1959). Observations on newborn infants. *Psychosomatic Medicine*, *21*, 110–118.

Wolff, P. (1961). Observations on the early development of smiling. In B. M. Foss (Ed.), *Determinants of infant behavior: Vol. 2*, (pp. 113–138). London: Methuen.

Wolff, P. (1987). *The development of behavioral states and the expression of emotions in early infancy*. Chicago: The University of Chicago Press.