INFANT CRY : DOES CRYING HAVE A TENSION RELEASING FUNCTION ?

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Infant cry was examined from the point of view of tension release. Unlike many studies of infant cry, it was suggested that the real-time unit of one bout of cry should be the basic unit of analysis. Analysis of the crying of 20 neonates elicited by nipple removal during the first week was conducted. It was shown that (1) cry response which had a short latency tended to be soothed easily when compared with that of a longer latency, (2) highly soothable infants tended to reach the rhythmic full-blown cry phase more frequently and sooner after birth, (3) short latency to full-blown cry and high soothability score were related to scarcity of total amount of crying. It was concluded that a short latency to rhythmic full-blown cry, high soothability in terms of the amount of cry after external intervention and the ease with which it was obtained were the features of a "good" cry.

Key words : infant cry, real-time, soothability, tension release.

INTRODUCTION

The cry of young infants has attracted the attention of both layman and specialist. Pediatricians often ask parents about, or try to listen to, the cry of an infant who has been referred for their attention. Numerous studies have been carried out to investigate the crys of young infants (see Lester, 1982 ; Ostwald, 1972). One reason for this is the underlying belief that the cry sounds of young infants can reveal for us conditions of the nervous system. Indeed, some researchers even describe cry as "a window" or "a mural" of the nervous system of young infants (Lester & Zeskind, 1981). As a consequence, a great number of studies on neonatal and/or infant cry have concentrated on cry sound and have used sound spectrography as the main tool of analysis (Ringel & Kluppel, 1964 ; Oi & Baba, 1973 ; Truby and Lind, 1965 ; Wasz-Hockert et al, 1968, 1971 ; Ostwald, 1968, 1972 ; Wolff, 1969 ; Lester & Zeskind, 1979).

Recently Golub (1980) has attempted to correlate acoustic features with some neurological or physiological conditions of neonates or young infants. Some of the results of this approach are correlations between some spectrographic features (e. g. high or low fundamental frequency, harmonic features, glides, shifts of fundamental frequency, melody type, bi-phonation, dysphonation, etc.) and some clinical signs ranging from cri du chat, bacterial meningitis to hyperbilirubenemia and Down's syndrome (see e. g. Lester & Zeskind, 1981).

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However, in most of these studies, the associations between cry features and clinical syndromes are based on the retrospective analysis of the cry of infants known to be abnormal, the identification of some spectrographic features in the cry does not necessarily lead to a valid diagnosis of the disease.

Another aspect of the cry of the young infant that has been the focus of attention concerns the signal value of cry sounds with respect to the communication between the young infant and his/her environment (Murray, 1979). Studies in this category include perceptual discriminability of various kinds of cry sounds by adults with different caretaking experience, and acoustic (and/or auditory) features of cry sounds of infants classified into groups such as temperamentally difficult vs. easy, well-nourished vs. malnourished, low birth weight vs. normal (Bates, Freeland, & Lounsbury, 1979 ; Frodi, Lamb, Leavitt, Donovan, Neff, & Sherry, 1978 ; Lester, 1976 ; 1979).

Crying in early infancy has also been discussed from the point of view of attachment behavior or of being the result of maternal contingency (Bell & Ainsworth, 1972 ; Gewirtz, 1977 ; Gekosky, 1983 ; Murray, 1979). In these discussions, the focus is on the change of frequency of cry episode in the first year and the maternal (or caregiver) behaviors as probable causes.

If the studies on infant cry as described above are arranged along a continuum indicating the length of the target unit employed in analysis, they seem to fall into two extremes : studies involving sound spectrographic analysis on the extremely short end (in most cases, a maximum of 2.4 seconds of cry signal is examined), and studies analyzing the change in frequency of cry episode on the extremely long end (ranging from several months to one year). It is to be noted that while in reality infant cry is usually expressed and experienced in an interval ranging from several seconds to several minutes, no study seems to focus on, or to adequately capture, this "real-time" unit of cry. The morphology of one bout of cry, from the grimacing and gasping before the utterance of the cry sound to the calming down of cry sound and general relaxation, has not been the focus of attention. Nor are individual differences in the quality of the unfolding of this process, or other concomitant responses such as body movements, respiration, facial expressions, receiving enough attention from researchers (for a few exceptions see Stark, Nathanson, 1974, on facial expression). In this paper, it will be argued that (1) the process of the unfolding of the "real-time" unit of infant cry is another important and significant aspect of the cry of an infant, (2) the cry should also be considered as a process with which an infant deals with the cause(s) of crying, and the quality of this expressive process reflects how successful the coping is, (3) the individual differences in some aspects of this process are stable individual characteristics which can have some effects on mother-infant interaction. As a first attempt, preliminary results of an on-going study will be presented.

STUDY 1 : QUALITY OF CRY AND SOOTHABILITY

If the view that : crying is a process with which an infant copes with whatever stress he/she feels, the quality of this expression reflecting how successful coping is ; is correct, it is reasonable to infer that a "satisfactory" cry lasts for less time than an "unsatisfactory" cry. According to Parmelee, crying is a maximal type of response, thus it can be viewed as indicative of the capacity of the nervous system to be activated and

to inhibit or modulate that activation (Parmelee, 1962). A "satisfactory" cry is activated optimally quickly and is easy to soothe.

In accordance with the underlying assumption of studies which emphasize the neurological foundation of cry production, it is reasonable to further assume that the capacity of the neonate to execute full-blown rhythmic cry depends on the integrity of the neonate's nervous system. A system that adapts itself quickly and is ready to perform it's maximal function is considered a better system.

Based on these viewpoints, the following hypotheses are formulated :

1. Latency to first cry or to rhythmic full-blown cry (RFBC) will be negatively correlated with soothability score. This hypothesis will be tested at several levels : (1) General level, throughout all trials, using correlation statistics. (2) Selected extreme groups level, comparing means of scores. (3) Individual trial level, using sign test.

2. Total amount of full-blown rhythmic cry will be negatively associated with positive features of "good" cry such as short latency to full cry and high soothability score. In other words, "good" crys are more effective.

3. Neonates who showed full-blown rhythmic cry in response to nipple removal sooner after birth will have more satisfactory cries and will sooth more easily.

Method

Subjects 20 healthy newborn babies without perinatal complications, 11 male and 9 female. The average birth weight is 3215 g (range : 2180 g to 4350 g). These babies were all born through the vagina.

Procedures RIS (response to interruption of sucking, cf. Bell, Weller and Waldrop, 1971) was observed on the first, third and fourth days (to be referred to as R 1, R 2, and R 3 respectively). Each observation consisted of 5 trials. Subjects were allowed to suck a rubber nipple for 20 seconds. After removal of the nipple, if no fussing or crying appeared within 60 seconds, the next trial began. However, if fussing or crying appeared within 60 seconds, observation continued until 90 seconds after the onset of fussing or crying, then a series of 5 kinds of stimuli, each of which lasted for 15 seconds, were applied till the subject was soothed. If these failed, the subject would be soothed before the next trial began. The five stimuli were : electronically produced chirping sounds ; human voice ; light strokes on subject's chest ; gentle restraint of subject's body and limbs ; and picking up and holding.

Data Analysis (1) A video recording of the above procedure was replayed and two coders coded the baby's response (second by second) by using a computer based event recorder. The responses were coded as follows :

S : Sucking or mouthing.
X : Searching.
V : Sporadic movement of limb(s) and/or head.
A : Gasping or audible acceleration of respiration.
G : Grimacing.
F : Fussing or negative vocalization.
C : Full-blown cry sound produced by fully opened mouth, [a:].
Z : Other behaviors such as hiccup(s), sneeze, smile.

(2) Soothability : Subject's tendency to self-soothe or to be soothed was scored according to whether self-soothing was observed or not during the stimulation and the position of the stimulus that became effective. The highest score was 10. A highly soothable group, consisting of 9 infants (2 male, 7 female), and a difficult-to-sooth group, consisting of 9 infants (8 male, 1 female) were chosen.

Results

(1) *Soothability and latency to RFBC (rhythmic full-blown cry)*

The correlation coefficients between the soothability scores and (a) the latency to cry is −0.49 ($p<.05$, one tail test), (b) the latency to RFBC is −0.32 ($p>.10$, N. S.). However, when the top and the bottom 5 subjects are selected respectively from both soothability groups, the correlation is −0.46 ($p>.10$, N. S.), with latency to RFBC, and −0.64 ($p<.05$) with latency to cry.

(2) *Group difference in soothability scores*

The differences between the high and the low soothability groups are shown in table 1.

TABLE 1

Soothability and mean latencies.

Soothability		High	Low	t	p<
	R 1	27.4 n=29	37.6 n=7	1.765	.1
Latency to cry	R 2	15.0 n=40	32.9 n=33	3.45	.001
	R 3	20.1 n=32	24.8 n=31	1.04	n.s.
	(Mean)	20.8 N=101	31.8 N=71	2.857	.001
	R 1	34.6 n=22	45.1 n=5	1.637	n.s.
Latency to RFBC	R 2	23.4 n=37	39.0 n=21	2.83	.001
	R 3	21.8 n=25	23.7 n=25	1.059	n.s.
	(Mean)	26.6 N=84	35.9 N=61	2.624	.001

While the differences diminish as the subjects get older, in R 2, in which a larger portion of infants tested showed full-blown cry, the difference proved to be consistently significant ($t=3.45$, $p<.001$; $t=2,831$, $p<.001$). When all the trials from R 1 to R 3 were combined, the two groups also proved to be significantly different in latencies to cry or to RFBC ($t=2.857$, $p<.001$; $t=2.624$, $p<.001$). These findings suggest that as groups,

neonates with higher soothability scores tended to execute "satisfactory" crys faster than those with low soothability scores.

In order to test Hypothesis 1 on a different level, 78 trials in which the subjects reached the criterion of showing at least 4 consective Cs in R 2 were chosen. For each trial, a soothability score (ranging from 0 to 10) and the latency to RFBC (ranging from 3 to 141 seconds) were obtained. The hypothesis was tested by comparing the two signs derived from the two values, using the means of each as dividing points. Thus, for a soothability score under 4, a "−" (and above 5, a "+") sign was assigned and for latency under 28, a "−" (and above 29, a"+") sign was assigned. If the two signs were different, the hypothesis was considered confirmed. The hypothesis was confirmed 47 times and remained unconfirmed 31 times. The difference indicated a trend (chi square is 3.28, $0.1 < p > .05$).

However, when subjects with soothability scores at both extreme ends of the scale were chosen and the same test carried out, the hypothesis was confirmed (chi square is 14, $p < .001$). Again, when we counted the number of subjects who showed more trials in which the hypothesis was confirmed, 14 out of 19 subjects were in favour of the hypothesis as against 5 who were not (chi square is 4.26, $p < .05$).

(3) *Early achievement of RFBC and soothability*

Between the two soothability groups (high and low), the difference in the number of RFBC trials observable on R 1, R 2, and R 3, separately and accumulatively, is shown in table 2.

TABLE 2

Difference in number of trials RFBC observed

Soothability	High			Low		
	R1	R2	R3	R1	R2	R3
# of trials	22	37	25	5	31	25
Accumulation		59	84		36	61
%	26.1	44.0	29.8	8.2	50.8	41
Accumulated % observed (n=84)	26.2	70.2	100	8.2	59	100
Accumulated % expected (n=135)	16.3	43.7	62.2	3.7	26.7	45.2

For the high soothability group 26.2% (and for the low soothability group 8.2%) of the total observed trials in which RFBC was observed were on R 1. By R 2 the high group showed 70.2% of the trials in which RFBC was observed in R1, R2 and R3 and in contrast, the low group showed 59.0%. The difference was greater when the expected accumulated percentages (five trials on each day) were compared. In addition, the total number of trials in which RFBC was observed over the three days, differed between the two groups.

(4) *Difference in amount of cry*

As another criterion of "satisfactory" or "good" cry, the number of bouts of crying after the infant reached RFBC was computed. Sixty-one point two per cent (61.2%) of

the trials from subjects with high soothability were found to have less than three bouts of crying during each trial, as compared with 30.4% of that of the subjects with low soothability. The difference was statistically significant (chi square 19.72, $p<.001$). This finding suggests that soothability or the capacity of the crying infant to inhibit crying, is related positively to the scarcity of crying after RFBC. In other words, the comparison seems to suggest that RFBC leading to higher soothability is more "effective" in decreasing any further urge to cry.

Comments

As shown above, hypotheses 1, 2, and 3 were partially supported. In general, it seems reasonable to conclude that there is a positive relationship between short latency to full-blown rhythmic cry (one criterion for "satisfactory" or "good" cry) and high soothability (one expression of inhibition capacity of the nervous system). Secondly, Newborns who showed early achievement of full-blown rhythmic crys proved to be more easily soothable.

Functioning as a warning signal or as a tension releaser agent, a cry with a short latency or rise time seems more adaptable than a long one. What is difficult to decide at this stage is how long is optimally short, in reality. Had we chosen 30 seconds as a criterion rather than 60 seconds to see if fussing or crying occured, the results would be quite different. Theoretically it would have been possible to figure out a more reasonable criterion had we had knowledge about other physiological constraints related to phonation, signal detection, etc. of the newborns. As for what is referred to in this paper as soothability many other aspects not treated in this paper will have to be considered. For example, how long does a baby have to be silent or not crying to be judged soothed ? What is the significance of a sudden change of state into drowsiness or sleep after a bout of "satisfactory" crying ? Perhaps, what the series of stimuli revealed was the infant's capacity to inhibit crying, a rather different concept from soothability !

Other criteria for "satisfactory" or "good" cry for neonates, such as smoothness in phonation, better synchrony with respiratory rhythm, other cry acts, and effectiveness in tension releasing (i. e. the rapidity with which muscle tension decreases), etc. are yet to be investigated in future analyses.

DISCUSSION AND SPECULATIONS

In this paper we have tried to point out the fact that the cry of the young infant, as well as that of the adult for that matter, has a tension releasing or cathartic function other than as a means of communication. Truby and Lind have pointed out that crying has two components : cry sound and cry act (Truby and Lind, 1965). However while researchers who emphasize the neurological diagnostic value of the acoustic features of infant cry sounds have speculated about the physico-acoustic mechanism of crying (cf. e. g. Lester & Zeskind, 1981 ; Golub, 1981), the emphasis in most of their studies is on cry sounds. Indeed, studies using spectrographic analysis have produced some interesting findings some of which might one day prove to be of diagnostic use. However, the availability of sonograph or similar electronic devices for the analysis of cry sounds is a mixed blessing ; for while it enables us to make precise and objective measurements of cry

sounds, it tends to limit the attention of researchers to that which is readily measureable.

It has been pointed out that the majority of studies concerning cry in infancy involve the clinical population (Lester & Zeskind, 1981). One of the main concerns of such studies is to investigate the association between clinical syndromes and acoustic features of the cry. Although, most of the studies to date have been conducted retrospectively and in cases where subjects were known to be abnormal (the analysis being superfluous) many researchers hope to be able to use cry features as diagnostic cues in neurological examination.

One thing these studies have in common is in treating the cry of the young infants as another primitive reflex. Under this conceptualization, attention is directed toward the relationship between some specific and/or patterns of the acoustic features of the infant cry and some clinical or pathological signs. In primitive reflexes (e. g. Moro, grasping, etc.), the temporal aspect of the reflex that is considered important is the appearance and/or the disappearance of the reflex ; a difference ranging from several days to one or two weeks is usually considered within the normal range. Furthermore, the qualitative judgement applicable to the primitive reflex concerns its vigour. As far as primitive reflexes are concerned these considerations are sufficient, since the neurological pathways which are considered as the basis, are relatively simple. The cry of the neonate can be considered as a primitive reflex if the details of one bout of crying are disregarded.

However, when the crying of the young infant is observed carefully, it reveals not only the species-specific pattern of sequence of responses, but also consistent individual differences. It seems that the crying of the young infant is better considered as a complex reflex that takes a relatively longer time to unfold (ranging from several seconds to several minutes), and this very process of unfolding shows consistent individual differences which are related to the integrity of the nervous system of the crier.

Whether to emphasize the tension releasing function of infant cry, is not unrelated to whether the young organism is recognized as having a capability beyond the level of a simple reflex. In addition, there are reasons to believe that newborns are equipped with capabilities that indicate the active and self-regulatory nature of the young organism (e. g. Haith, 1982).

In future study, it would seem profitable to integrate both components of what appears to be an integral whole, and to consider infant crying from the point of view of signal value and tension release. The static model which has resulted from spectrographic analysis will be enriched by including the more dynamic aspect of infant cry that this paper has tried to elucidate.

REFERENCES

Bates, J. E., Freeland, C. A., & Lounsbury, M. L. Measurement of infant difficulties. *Child Development*, 1979, 50, 794-803.

Bell, R. Q., Weller, G. M., & Waldrop, M. F. Newborn and preschooler : organization of behavior and relations between periods. *Monographs of the Society for Research in Child Development*, 1971, 36, Nos. 1, 2.

Bell, S. M., Ainsworth, M. D. S. Infant crying and maternal responsiveness. *Child Development*, 1979, 43, 4, 1171-1190.

Brennan, M., Kirkland, J. C. Discrimination of infants' cry-signals. *Perception and motor skills*, 1979, 48, 683-686.

Frodi, A. M., Lamb, M. E., Leavitt, L. A., Donovan, W. L., Neff, C., and Sherry, D. Fathers' and mothers' responses to infant smiles and cries of normal and premature infants. *Developmental Psychology*, 1978, 14, 5, 490-498.

Gewirtz, J. L., Boyd, E. F. Does maternal responding imply reduced infant crying ? : a critique of the 1972 Bell and Ainsworth report. *Child Development*, 1977, 48, 1200-1207.

Gekosky, M. J., Rovee-Coller, C. K., and Carulli-Rabinowitz, V. A longitudinal alalysis of inhibition of infant distress : the origins of social expectations ? *Infant Behavior & Development*, 1983, 6 (3), 339-351.

Golub, H. L. A physioacoustic model of the infant cry and its use for medical diagnosis and prognosis. *Journal of the Acoustic Society of America*, 1979, 65, S 1 ; 25-26.

Haith, M. Rules that babies look by. Hillsdale, N. J. : Erlbaum, 1980.

Lester, B. M., Zeskind, P. S. The organization and assessment of crying in the infant at risk. In A. M. Field, A. M. Sostek, S. Goldberg, H. H. Shuman (Eds.), Infants born at risk. New York : Spectrum, 1979, Pp. 121-144.

Lester, B. M. A synergistic process approach to the study of prenatal malnutrition. *International Journal of Behavioral Development*, 1979, 2, 377-393.

Lester, B. M. Spectrum analysis of the cry sounds of well-nourished and malnourished infants. *Child Development*, 1976, 47. 237-241.

Murray, A. D. Infant crying as an elicitor of parental behavior : an examination of two models. *Psychological Bulletin*, 1979, 86, 191-215.

Oi, T., Baba, Y. Cry sounds and diseases of the nervous system. *Shou ni igaku (Pediatrics)*, 1973, 6, 6, 61-77. (In Japanese)

Ostwald, P., Phibbs, R., & Fox, S. Diagnostic use of infant cry. *Biology of the Neonate*, 1968, 13, 68-82.

Ostwald, P. The sounds of infancy. *Developmental Medicine and Child Neurology*, 1972, 14, 350-361.

Parmelee, A. Infant crying and neurological diagnosis. *Journal of Pediatrics*, 1962, 61, 801-802.

Ringel, R. L., Kluppel, D. D. Neonatal crying : a normative study. *Folia Phoniatrica*, 1964, 16, 1-9.

Stark, R. E., Nathanson, S. N. Spontaneous cry in the newborn infant : sounds and facial gestures. In F. Bosma (Ed.), Fourth Symposium on Oral Sensations and Perceptions : Development in the Fetus and Infant. Washington, D. C. : US Government Printing Press, 1974.

Truby, H. M., Lind, J. Cry rounds of the newborn infant. *Acta Paediatrica Scandinavica* (Supplement), 1965, 163, 7-59.

Wasz-Hockert, O., Lind, J., Vuorenkoski, V., Partanen, T., Valanne, E. The infant cry : a spectrographic and auditory analysis. London : Spastic International Medical Publications and William Heinemann Medical Books (Clinics in Developmental Medicine No. 29). 1968.

Wolff, P. H. The natural history of crying and other vocalizations in early infancy. In B. M. Foss (Ed.), *Determinants of infant behavior* (IV). London : Methuen. 1969, Pp. 81-109.