

What is distinct about infants' "colic" cries?

Ian St James-Roberts

Abstract

Aims—To investigate (1) whether colic cries are acoustically distinct from pre-feed "hunger" cries; (2) the role of the acoustic properties of these cries versus their other properties in accounting for parents' concerns about colic.

Design—From a community sample, infants were selected who met Wessel colic criteria for amounts of crying and whose mothers identified colic bouts. Using acoustic analyses, the most intense segments of nine colic bouts were compared with matched segments from pre-feed cries presumed to reflect hunger.

Results—The colic cries did not have a higher pitch or proportion of dysphonation than the pre-feed cries. They did contain more frequent shorter utterances, but these resembled normal cries investigated in other studies. There is no evidence that colic cries have distinct acoustic features that are reproducible across samples and studies, which identify a discrete clinical condition, and which are identified accurately by parents.

Conclusions—The most reliable finding is that colic cries convey diffuse acoustic and audible information that a baby is highly aroused or distressed. Non-acoustic features, including the prolonged, hard to soothe, and unexplained nature of the cries may be specific to colic cries and more important for parents. These properties might reflect temperament-like dispositions.

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In Western cultures, a substantial minority of parents become distressed about their baby's persistent crying during the first three postnatal months. Community surveys in Denmark,¹ England,² Finland,⁴ Sweden,⁵ and the USA⁶ have found that ~ 12-20% of mothers are upset by the crying, or seek the help of a clinician because of it. A better understanding of this phenomenon, often referred to as "infant colic", is of importance both for parents and for the community health services that provide families with care.

Because it is parents who seek help for their babies' crying, parental subjective characteristics might contribute to this clinical picture. There is evidence that this is the case.²⁻⁷⁻⁹ In addition, it seems likely that the specific features of some infants' crying contribute to their parents' concerns. To understand the underlying causes, we need to know what exactly is reliably distinct about the crying

behaviour of infants selected for colic. One known feature is the amount of crying. Many infants selected because of parental reports of colic or prolonged crying do cry for substantial lengths of time when measured objectively.³⁻¹⁰

A second feature attributed to colic crying in the clinical literature is a distinct audible quality, or cry type. For example, Wessel and colleagues¹¹ widely used "rule of threes" defines colic as: "paroxysms of irritability, fussing or crying lasting for a total of more than three hours per day and occurring on more than three days in any one week". In addition to providing criteria for colic cases based on amount of crying, the word "paroxysmal" in their definition seems to imply an abrupt onset, striking intensity, or other distinct audible features. This view is widely shared. For example, in a review of 50 articles on colic, Barr¹² found that 42% included "paroxysmal crying" as a feature of colic. As Carey¹³ has pointed out, the word "colic" derives from the Greek word for the intestine. At least since Illingworth's seminal reviews,¹⁴⁻¹⁵ colic has commonly been thought of as a distinct crying syndrome, probably caused by gastrointestinal pain.

Although Wessel *et al* based their definition partly on observation, most research has been based solely on parental report. However, three research groups have recently provided independent evidence that colic cries are audibly or acoustically distinct.¹⁰⁻¹⁶⁻¹⁷ Because of their importance in understanding the nature and causes of infant colic, these findings need careful scrutiny.

In the first of these studies, Lester and colleagues¹⁶ used the Wessel criteria together with maternal reports of painful cry sound, abrupt cry onset, body hypertonia, and inconsolability to select 16 infants with colic. Using computer based acoustic analysis, they found that the crying of infants with colic elicited by electrode removal was of a higher fundamental frequency (pitch) and contained more dysphonation (heard as a "harsh" sound) than the crying of 16 infants without colic. However, the colic group consisted mainly of prematurely born babies. Some babies had histories implicating neurological impairment, which might have affected their cries. In a subsequent study using naturally occurring cries of full term infants, Lester and colleagues¹⁸ found no differences in fundamental frequency or dysphonation between the cries of infants with colic and other infants' cries, although in this case the mean resonant frequencies were higher.

More recently, Zeskind and Barr¹⁷ also found no overall differences in the acoustic properties of the cries of 11 infants with Wessel's colic and the naturally occurring cries (before or after

Thomas Coram
Research Unit,
Institute of Education,
University of London,
27/28 Woburn Square,
London WC1H, UK
I St James-Roberts

Correspondence to:
Dr St James-Roberts.
email: tejt312@ioe.ac.uk

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feeds) of 22 infants without colic. When the single "most vehement" cry utterance was selected, the utterances of infants with colic did not decline in dominant frequency and dysphonation after a feed, whereas these features of the most vehement utterance of infants without colic did decline. However, these single utterances were approximately one second in duration, so it is debateable whether such brief acoustic attributes are perceived by parents and are the source of their concerns about the crying of babies with colic.

The third research group examined audible, rather than acoustic, features of cries.¹⁰ In this case, radiomicrophones were used to make 24 hour recordings of the vocalisations of infants who met Wessel criteria for amount of fussing and crying. At the same time, the infants' mothers recorded periods of fussing, crying, and colic in diaries, using preset definitions. The audiorecordings, transcribed by reliably trained, blinded researchers, provided independent evidence about the audible features of the colic bouts and other fussing/crying.

The finding, in both the diaries and audiorecordings, was that intermittent fretful behaviour (fussing) was the predominant type of crying in all the infant groups. The most reliable distinguishing feature of the babies who met the Wessel criteria was that they had prolonged periods of relatively intense crying—that is, with a higher normal crying to fussing ratio than is found in moderate criers. Intense crying, however, was rare in the audiorecordings and did not differ between the groups. Nor was there any evidence that perceived colic bouts—identified by a third of the mothers of babies who met with the Wessel criteria as "painful sounding" in the diaries and colic checklists—were audibly distinct, compared with the crying periods that other mothers considered to be normal fussing/crying. The colic bouts lasted longer, but did not have a sudden onset or contain more intense crying than the periods that other mothers did not perceive to be colic bouts. Of note was the fact that the infants who met with the Wessel criteria were objectively hard to soothe, both for researchers using a standard soothing procedure and for mothers. The researchers concluded that the unsoothable and unexplained nature of the colic crying might be more central distinguishing features than an abnormal sound.¹⁰

Each of these three research groups has found evidence that the crying of infants selected for colic using the Wessel definition for crying amount differs somewhat from the crying of other infants in its audible or acoustic quality. Less clear is whether the colic infants' crying is "distinct" in the sense implied in the clinical literature and by the Wessel definition, or whether it is these attributes that lead parents to seek expert help. The focal question is whether colic crying denotes a distinct clinical syndrome involving gastrointestinal pain, or some other pathological condition, which can be identified reliably by the sound of babies' cries.

The aim of our study was to throw light on to this question, using acoustic analysis of the colic cries assessed by trained listeners in the study described above. An obvious limitation of that study is that the data were based on the listening skills of one team of researchers. By using a validated, standardised method of acoustic analysis, the acoustic parameters of the colic crying can be compared both with non-colic crying within this study and to the cries of infants in other studies.

In a departure from the method used in previous acoustic studies, the approach adopted was to compare the colic cries with audibly intense sections of pre-feed cries from infants judged not to have colic. This reflects the consistent evidence in each of the earlier studies that colic crying is somewhat more intense than average infants' cries. Hence, a repetition of this finding would not significantly advance our understanding. A more stringent test was to compare the colic cries with the most intense sections of cries that ceased in response to feeding—that is, to cries presumed to be a result of hunger. If the acoustic features did not differ, this would imply that parents are unlikely to be able to distinguish reliably between colic and hunger based on the acoustic properties of babies' cries.

Methods

SUBJECTS

The aim was to obtain a representative sample based on infants' amounts of crying, unbiased by clinical referral. Over 11 months, 597 mothers were approached in the postnatal wards of a large maternity hospital and invited to participate in a study of infant crying. Except that twins and babies admitted to special care were excluded, the mothers were approached unselectively. Of 558 mothers who agreed to take part, 530 were interviewed successfully over the telephone to obtain measures of their babies' crying at 4–5 weeks of age, using the "crying patterns questionnaire" (CPQ). The CPQ is a screening instrument that asks about the number of minutes of infant fussing and crying that have usually occurred in the morning (6 am to noon); afternoon (noon to 6 pm); evening (6 pm to midnight); and night (midnight 6 am) during the last week. "Usually" is defined as on most days in the week. Agreement between CPQ and maternal diary measures of crying is substantial.^{19 20}

Next, the CPQ measures were used to choose three groups of infants for follow up assessments:

- Persistent criers ($n = 67$) who met slightly modified Wessel criteria by fussing/crying for three or more hours/day most days in the last week. The term "persistent criers" is preferred because selection was based solely on the amount of infant fussing and crying
- Evening criers ($n = 38$) who fussed/cried for an hour or more in the evenings, 30 minutes or less in each other period of the day, and less than three hours in total

- Moderate criers (n = 55) who fussed/cried for 30 minutes or less in all four periods of the day.

Demographic particulars for the three samples, together with demographic and CPQ crying figures for those not followed up, have been reported.²¹ There were no demographic differences between the three selected groups. Compared with the UK population as a whole, mothers included in all three groups were slightly older, of a higher social class, and less likely to be of Asian or Afro-Caribbean origins, and the infants were more likely to be firstborns.

CRYING MEASURES

At 5–6 weeks of infant age, the peak age for crying,²² each mother was asked to complete a three day diary of her baby's behaviour, based on those used in previous crying studies.^{8 10 20 23}

The researchers explained and began the diaries with the mothers during a home visit, leaving a telephone number for queries. The diaries were completed prospectively, such that infant behaviours (feeding, sleeping, awake and content, crying) were shaded in more or less as they occurred on charts with a resolution of five minutes of time. The mothers were asked to shade in three types of crying—fussing, crying, and colic—separately, using the following definitions:

- fussing—baby is unsettled and irritable and may be vocalising but not continuously crying
- crying—periods of prolonged distressed vocalisation
- colic—bouts of intense, unsoothable crying and other behaviour, perhaps caused by stomach or bowel pain.

The diaries were kept for three successive days wherever possible: 82% of the 160 mothers kept them for at least one day, 72% for two days, and 56% for three days. Eighteen per cent of the mothers, evenly divided between the groups, failed to provide diary data.

Whenever a colic bout was recorded in a diary, the mother checked the behaviours she had perceived to be evidence of colic on a list, modelled on the “infant colic checklist” of Lester *et al.*¹⁰ This listed audible crying features and visible behaviours thought to be symptoms of colic. In all, 23 behaviours could be identified. Analyses confirmed that “distinct sounding” and “painful sounding”, together with visible symptoms such as clenched fists and raised knees, were the perceived features of the colic bouts.¹⁰

In addition to the maternal reports, a 24 hour audiorecording of each infant's vocalisations was made during one of the diary days, using calibrated Audio Ltd FM radiomicrophones and Uher model 4400 voice activated tape recorders, as in previous research.^{3 10 20} An electronic clock recorded the time of day and duration of each vocalisation precisely. By matching the audiorecording with the concurrent diary, it was possible to identify colic bouts and non-colic, fussing and crying periods. The hospital ethics committee approved the study.

ANALYSIS OF CRY SEGMENTS

Both the audiorecordings, obtained for all 160 infants, and diaries for 132 infants confirmed the planned group differences in amounts of crying.¹⁰ Among 132 infants with matching diaries and audiorecordings, 20 of 54 persistent criers, eight of 33 evening criers, and three of 45 moderate criers were judged by their mothers to have at least one colic bout.¹⁰ On average, one in six of these 31 infants' distress periods was recorded as a colic bout. Corresponding diary and audio records of colic bouts were available in 14 cases. In the remainder, the colic bouts identified in the diaries occurred on days that were not recorded.

As Green and colleagues²⁴ have noted, acoustic analysis involves the sampling of cry bouts, and this has been neglected in the research literature. Because of the processing involved, digital computer acoustic analyses typically examine 1–30 second segments of cry vocalisation (30 seconds using our system), while fussing and crying periods typically last in the region of 5–20 minutes, and colic bouts for 20–50 minutes.¹⁰ Which segment of the bout to select, its length, and the number of segments analysed might affect the findings.²⁴

The sampling method used here was based on the earlier finding that trained listeners detected no evidence that the colic bouts had a rapid or intense onset, or were particularly intense overall, compared to the fussing/crying periods of other persistent criers.¹⁰ In many cases, the mothers' diaries showed that colic periods were immediately preceded by fussing/crying periods that ran directly into the periods identified as colic. This suggested that the most acoustically distinct aspects of colic bouts might lie not in their early segments or in the bout overall, but in the segments that contained the most intense distressed vocalisation. In keeping with this reasoning, Zeskind and Barr's¹⁷ analyses found that only “the most vehement cry utterance” of the cries of infants with colic differed acoustically from non-colic cries.

From the 14 infants with audiorecorded colic bouts, it was possible to select 10 separate 30 second audiorecorded segments that involved the most intense crying in that bout, and were suitable for acoustic analysis. In the remainder, parental voices or other background noises precluded acoustic analysis. The mean length of the audiorecorded colic bouts from which the segments were taken, 28.78 minutes, is similar to the 21 minute mean length of the colic bouts as a whole.¹⁰

The pre-feed, hunger cry segments were selected in as similar a way as possible, and approximately matched to the colic segments on audible cry intensity. Fourteen infants were identified who met the following criteria:

- (1) they were not reported by their mothers to have colic bouts
- (2) they had an audiorecorded period of crying immediately before a feed recorded in a diary
- (3) this audiorecorded period contained a segment judged by the trained listeners to be audibly intense

Table 1 Differences in the acoustic properties of colic and pre-feed cry segments

	Colic cries	Pre-feed cries	F (1 df)	p value
Length of cry utterance (seconds)	0.77 (0.16)	1.26 (0.52)	7.15	0.015
Number of utterances > 0.5 seconds	18.60 (8.38)	19.00 (6.90)	0.01	0.90
Number of short utterances (< 0.5 seconds)	17.00 (7.59)	9.08 (7.15)	6.32	0.02
Totalled numbered of utterances	35.6 (10.61)	28.08 (5.98)	4.39	0.049
Fundamental frequency (Hz)	491 (48)	458 (56)	2.14	0.16
Mean phonation (%)	77.50 (16.26)	57.73 (13.93)	8.99	0.007
Mean dysphonation (%)	19.80 (18.00)	40.04 (14.07)	8.39	0.007
Mean hyperphonation (%)	0	0.40 (0.77)	2.45	0.13

Values are mean (SD) unless otherwise stated.

Table 2 Comparison of our findings and those of Lester et al¹⁶

	Our study		Lester et al	
	Colic cries	Pre-feed cries	Colic cries	Non-colic cries
Mean fundamental frequency (Hz)	491	458	492	414
Mean dysphonation (%)	20	40	17	8

- (4) their crying stopped on feeding, as confirmed by diary and audible evidence
- (5) no fussing or crying occurred within 10 minutes after the end of the feed.

Criteria 2 and 4 resemble those used to identify pre-feed hunger cries in cry type research and other research.^{25 26} The most audibly intense 30 second segments of these pre-feed cries were selected for comparison with the colic segments. The mean length of the pre-feed crying bouts from which the segments were selected, 12.15 minutes, is similar to that of the crying bouts in general (10 minutes).¹⁰

Acoustic analysis of the segments was carried out blinded, using an automated computer program²⁷ used successfully in previous acoustic studies.^{16 18} This program allows cry segments up to 30 seconds in duration to be analysed. The crying is low pass filtered at 5 kHz, digitised at 10 kHz, and the fast Fourier transform is computed for each 25 ms block of each cry utterance. Blocks that are inharmonic, containing a high degree of turbulence or dysphonation, are analysed separately from harmonic blocks that are mostly phonation. Measures of the duration of cry utterances, interutterance interval, and the ratio of phonation to dysphonation are considered mainly to reflect respiratory influences. Laryngeal influences are reflected by the average and range of the fundamental frequency, with hyperphonation indicated where the fundamental frequency exceeds 1000 Hz. Influences of the vocal tract are indicated by the average and range formants or resonance frequencies (F1 and F2). The reliability of the system has been established as within 2% for identification of a single 25 ms block and 1% for calculation of acoustic frequency measures.¹⁶

Results

Usable acoustic data were obtained for 21 of the 24 cry segments analysed (nine of 10 colic and 12 of 14 pre-feed segments). Inspection of visual records for the three rejected segments identified a lack of clear inspiratory gaps between vocal expiration and inspiration, so that the program was unable to isolate separate utterances. Wolff²⁸ pointed out that both

expiratory and inspiratory parts of normal cries may contain sound. In our case, the intense nature of the selected segments, leading to more or less continuous vocalisation, was probably the reason for this finding. Because this problem did not occur particularly for one type of segment, it was unlikely to bias the results.

Table 1 contains the findings for the main acoustic variables reported in previous crying and colic studies and shows the variables on which significant differences between colic and pre-feed cries were found in our study. The most noteworthy difference is in the duration of the cry utterances, which were significantly shorter in the colic segments. This resulted in a significantly increased total number of short utterances. Colic cries tended to be higher in fundamental frequency, but no significant difference in this or in hyperphonation was found. The significant difference in dysphonation was in the opposite direction: the pre-feed cries had a higher percentage of dysphonation. No significant differences were found in other cry parameters, including measures of variability of the fundamental and formant frequencies.

Table 2 compares our acoustic findings with those obtained by Lester et al,¹⁶ who used the same method of acoustic analysis used here. Lester et al did not report the lengths of cry utterances and their cries were elicited by electrode removal. Although statistical comparison is not possible, the fundamental frequency and dysphonation in the cries of the infants with colic in the study of Lester et al are strikingly similar to those of the colic cries in this study. The difference is in the comparison cries. The elicited cries of the average infants in the study of Lester et al are far lower in dysphonation and fundamental frequency than the pre-feed, hunger cries of infants in our study.

Discussion

When parents complain of infant colic, it seems likely that aspects of their babies' crying behaviour are partly responsible for their disquiet. This study assessed whether distinct acoustic properties of colic cries might be a central source of parents' concerns. Infants whose amount of crying met the criteria of Wessel and colleagues¹¹ for colic and whose mothers recorded colic bouts in diaries were selected. The most intense 30 second segments from the selected colic bouts were compared with audibly intense segments of pre-feed cries of infants judged not to have colic. The question addressed by this comparison is whether colic cries contain distinct acoustic information that allows them to be distinguished from cries which, because they cease upon feeding, are usually referred to as hunger cries.

Two acoustic parameters, fundamental frequency (audible pitch) and dysphonation (audible harshness), have been the main focus in previous studies of infant pain, colic, crying, and cry perception.^{16 17 24 29} Our finding was that the colic cries did not have a higher pitch, or proportion of dysphonation, than the pre-feed cries. Indeed, the dysphonation in the

pre-feed cries was greater. The pre-feed, as well as colic cries in our study were similar in pitch and dysphonation to the cries of colic infants in the study of Lester *et al*,¹⁶ which used the same methods of acoustic analysis. This suggests that these two studies agree about the acoustic properties of colic cries. The different results reflect the types of cries that the colic cries were compared with: in the analysis of Lester *et al* they were compared with elicited cries of infants who usually cried moderate amounts, but in our study they were compared with matched pre-feed cries. That is, colic cries have a higher pitch and more dysphonation than elicited cries of infants who cry moderate amounts, but not compared with audibly intense pre-feed, hunger cries.

Although not higher in pitch or dysphonation, the colic cries examined here did contain more frequent, short utterances than the pre-feed cries. However, this difference is difficult to interpret. For one thing, the colic utterances do not appear shorter in duration than those in other studies of normal infants' hunger and "basic" cries.²⁶⁻²⁸ Porter and colleagues²⁹ did find that the most invasive (and presumably painful), stages of circumcision surgery elicited the shortest cry utterances, which were perceived to be the most urgent. However, Gustafson and Green³⁰ reported that cry segments containing long utterances were perceived as more aversive than cries with shorter utterances. Zeskind and colleagues³¹ found that cry utterances became progressively shorter as feeding was delayed. This suggests that, if the infants without colic in our study had been left to cry for longer before feeding, their cry utterances would have become closer in length to the colic cry utterances.

These findings highlight the complexities involved in infant crying and its interpretation, as well as drawing attention to the methodological limitations of our study and previous colic studies. An obvious weakness here is the small number of colic bouts (nine) and the limited durations (30 seconds) of the segments that were analysed acoustically. In mitigation, it should be recognised that these nine 30 second samples were the outcome of 160 sets of 24 hour audiorecordings, emphasising the practical difficulties involved in obtaining valid, naturalistic measures of colic crying. Moreover, compared with previous studies,¹⁶⁻¹⁷ the numbers of cries analysed are similar, and the cry samples are of equal or greater length. A further limitation is that the cry samples were taken from one segment, containing the most audibly intense 30 seconds of crying, within the colic bouts. Although this approach was based on previous research and a clear rationale, it remains possible that different results would be obtained if different segments were examined.

As Green *et al* have proposed recently,²⁴ more sophisticated acoustic analyses, including analyses of sequential structure, will be needed in future studies. Until this work is completed, it remains possible that more robust evidence that infants selected for colic have acoustically distinct cries will be found. In the meantime, although there is agreement that colic cries are

relatively intense compared with crying in general, we lack evidence that they have distinct acoustic features, which are reproducible across samples and studies, which identify a discrete clinical condition, and which are reliably identified by parents.

The impetus for much of the research into infant colic stems from the view of Wasz-Hockert and colleagues²⁵ that infants have discrete cry types, which convey specific information about their causes, together with Illingworth's¹⁴⁻¹⁵ conclusion that the behaviour of infants with colic is a result of digestive pain. Evidence has since accumulated that judging whether an infant is in pain is difficult, even for trained professionals in laboratory conditions, while it is particularly difficult in naturalistic circumstances where the stimulus is unseen.³² A debate has developed around the broader issue of the sort of mental and physical states that young babies can experience and convey in their behaviour.³³ Both lines of research emphasise how difficult it is to infer the causes reliably from crying behaviour. The view adopted by several contemporary cry researchers is that crying in young infants is a graded signal, which conveys the degree of an infant's distressed arousal, but which might not convey anything distinct about the cause.²⁴⁻²⁶⁻³⁴

In the light of these theoretical arguments, the finding that emerges most robustly from the studies so far is that colic cries convey diffuse acoustic and audible information that a baby is highly aroused or distressed. This does not distinguish a colic cry from a hunger cry reliably, or allow parents to distinguish the cause of the crying using acoustic information. A proviso is that this conclusion depends on how colic is defined and infants are selected. It is likely that infants with medical complications would be more extraordinary in their cries, and research in clinical populations has documented the existence of such cases.³⁵ The implication of our findings is that such cases are rare in the community and are not typical of colic as it is currently defined.

If the acoustic properties of crying convey only a high state of arousal, why do parents become concerned, seek help for the crying, or judge that an infant has colic? It is possible that parents combine acoustic with visible and other clues, such as clenched fists, raised knees, and flatulence. Indeed there is evidence that these features do contribute to parents' perceptions of colic.¹⁰⁻¹⁶ However, the same issue about the specificity of these crying features is raised. It may well be that these behaviours are characteristic of intense crying in general, rather than specific evidence of colic. This remains to be tested.

According to graded signal theory, parents work out the causes of a crying bout by referring to contextual information and testing out alternative explanations on a trial and error basis.²⁴⁻³⁴ Three non-acoustic features of colic crying bouts found in recent studies—their prolonged, hard to soothe, and unexplained nature⁸⁻¹⁰⁻³⁶—seem particularly pertinent to this process. These properties have been found reliably and confirmed by objective methods.¹⁰

Moreover, although data for older infants are sparse, they appear to be more or less specific to the crying of 1–3 month old infants.

These properties recall Donovan and Leavitt's laboratory studies,³⁷ in which induced repeated failure to be able to control an infant's crying was found to lead to feelings of ineffectiveness and helplessness in adult listeners. In social psychology, repeated exposure to uncontrollable aversive stimulation has been found to elicit helpless, anxious, and depressed behaviour in both animal and human adult recipients—a phenomenon known as "learned helplessness".³⁸ It seems likely that repeated exposure to prolonged, relatively intense, hard to soothe, and unexplained crying bouts in newborn infants would induce such feelings of learned helplessness in parents. The parents would be expected to become depressed and to seek expert help, which are both colic sequelae.^{8 39}

This interpretation of the evidence encompasses only the features that distinguish colic crying behaviour and why these have such an impact on Western parents—it does not attempt to explain the causes of the behaviour. Its importance lies both in drawing attention to infants' inability to soothe themselves as a core feature of colic and in aligning colic with temperament research.⁴⁰ Variations in crying intensity, bout length, and soothability might be a result of individual differences in the reactivity to stimulation or inability to inhibit response, which are coming to be recognised as core dimensions of infant temperament.⁴¹ This view is consistent with recent evidence that individual differences in fussing and crying are stable during early infancy,^{40 42 43} with the finding that crying can be predicted from fetal measures,⁴⁴ and with the claim that colic behaviour has a neuroregulatory basis.¹⁶ By considering colic behaviour as the result of constitutionally based individual differences in reactivity and inhibition of response, we may make progress in uncovering its causes.

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Commentary

This interesting paper by St James-Roberts revived memories of a slim volume that I was given in 1968, soon after becoming a consultant, which was published by the (then) Spastics Society (reference 25 in St James-Roberts' paper). Unusually this monograph, *The infant cry*¹ with a foreword by Ronald Illingworth, had a 45 rpm gramophone record tucked into a pocket at the back and I remember playing this to a somewhat bemused hospital journal club, which was a cross specialty rather than a wholly paediatric audience. A search of my postretirement bookshelves yielded the volume and, to my gratification, the record was still in the pocket. A suitable record player was located in the attic and the record played again, this time to a 1998 paediatric trainee audience. They were more receptive and agreed that many, but not all, of the recorded cries could be recognised and allocated to their correct subgroups by causation.

A search of the literature on infant cries (after 1968) yielded no less than 75 papers, many from Scandinavian and East European sources. Many of these are reviewed in the paper under consideration, which does not attempt to differentiate between cries produced by the stimulus of colic and other painful stimuli. The so called "colic cries" are compared with "hunger cries" and found not to differ significantly. The Wasz-Höckert monograph used painful stimuli other than colic, including BCG or DPT vaccination, or pinching the biceps of the baby. The Wasz-Höckert group started from the premise that infant cries were "meaningful" and they recognised not only pain cries but also the "birth cry", "hunger cries", and pleasure "signals" as being distinct and recognisable. The cries of abnormal and brain damaged babies as well as normal babies were also studied by this group. As in the St James-Roberts' paper a number of parameters were recorded spectrographically and submitted to computerised analysis.

As indicated by St James-Roberts, the infant cry cannot be interpreted in the absence of the parental response. An interesting sidelight on this interaction appears in the *New Scientist*²

where a contribution from the International Society for Human Ethology in Vancouver is reported, which suggests that parents who believe that their first child had severe colic are less likely to have further children. The authors postulate that this may be an adaptation to "weed out less patient parents from the gene pool."

The literature on infant crying touches many areas of paediatrics, including parental vulnerability and response. Surely there must also be some relation to child abuse; perhaps the category of "learned helplessness" mentioned by St James-Roberts is relevant in this connection. There also seems to be some evidence that there is a link between early infant cry quality and sudden infant death syndrome.

Response to excessive infant crying seems to be very much a Western culture phenomenon. Perhaps it is some indication that we still have something to learn from child rearing practices in other cultures.

Cry recognition must be a specific protection for newborns of many other animal species. Animal work suggests that mothers can recognise the cry of their newborns in a flock or group situation. Human parents can recognise the cry of their own baby in about 80% (mothers) and 40% (fathers) of cases.³ Bottle fed infants are reported to cry more than breast fed infants, which may relate to subclinical cows' milk intolerance or aerophagy in the bottle fed group. There must be more to be written on cry characteristics other than in the exclusively "colic-pain" situation. Meanwhile this paper is an important contribution to a fascinating subject that is beginning to become more accessible to scientific analysis.

J R HARPER

Consultant Paediatrician ("Semi-retired")
Northampton, UK

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