

# ***A REASSESSMENT OF THE ROLE OF PITCH AND DURATION IN ADULTS' RESPONSES TO INFANT CRYING***

**Brian K. Dessureau  
Carolyn O. Kurowski  
Nicholas S. Thompson**  
*Clark University*

Researchers have identified pitch and duration as components of infants' cries that mediate adults' reactions. In this study, we used a novel method of cry manipulation to resolve a methodological confounding of pitch with other variables. The results demonstrate that differences in pitch mediate adults' perceptions.

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pitch infant crying

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The cry of a human infant has a marked effect on adult listeners. One of the most consistent findings in the literature is that the fundamental frequency (hereafter "*Fo*"), or pitch, of a baby's cry is an important determinant of adults' responses. In one of the original demonstrations of this connection, Zeskind and Lester (1978) examined the cries of 24 high-complications newborn infants and found that, among other variables, these cries were

characterized by an abnormally high pitch when compared with the cries of 24 low-complication infants. When these same cries were then played to adult listeners, the listeners rated the high complication cries as more urgent, aversive, grating, sick, distressing, piercing, discomforting, and arousing than the low-complication cries. More recently, Zeskind and Marshall (1988) demonstrated that *Fo* was the best predictor of how urgent,

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• **Brian K. Dessureau**, Francis L. Hiatt School of Psychology, Clark University, 950 Main Street, Worcester, MA, 01610-1477; e-mail: [bdessureau@clark.edu](mailto:bdessureau@clark.edu).

arousing, and distressing a cry was perceived to be. Adachi, Murai, Okada, and Nihei (1985) found that, among the features studied, only the  $F_0$  and the voiced phonation ratio predicted adult's negative responses. Porter, Miller, and Marshall (1986) found that cries elicited by more invasive circumcision procedures were higher in pitch and were rated by adults as more urgent than cries elicited by less invasive circumcision procedures. Finally, Frodi and Senchak (1990) found that the cries of abnormal infants with higher pitch (infants asphyxiated at birth or with *maladie du cri du chat*) were perceived by adult listeners to be more aversive and were also more effective in distracting adults from a concurrent behavioral task.

Many studies of adult physiological response to babies' cries have also suggested that variations in cry pitch affect adults' reactions. Zeskind (1987) demonstrated that while the cries of normal infants produce heart rate accelerations in adult listeners, the cries of infants with an abnormally high pitch produced both heart rate accelerations and decelerations, and that the change from baseline heart rate for these cries was greater than was seen for normally pitched cries. Boukydis and Burgess (1982), and Frodi, Lamb, and Wille (1981) also found such physiological responsiveness in relation to cries of different  $F_0$ .

Despite the quantity of evidence connecting high pitch cries to more negative responses by adults, a methodological confounding leaves room to question whether higher pitch is truly a determinant of adult responses. In all of these past studies, the variations in the pitch of the stimuli have been generated either by sampling the cries of various infants with different naturally occurring pitch levels or by using the cries of different infants in a variety of cry-inducing situations. This group has included infants undergoing invasive circumcision procedures (Porter, Miller, & Marshall, 1986), infants with early complications (Zeskind & Lester, 1978), and infants with a variety of perinatal birth defects (Frodi & Senchak, 1990). In an analysis of the cries from

some of these populations, Michelsson, Raes, and Rinne (1984) found that several characteristics besides  $F_0$  differ between the cries of such infants and normal controls. The inability in these studies to manipulate only cry pitch has left open the possibility that the adults' responses can be attributed not to the pitch characteristics of the cries but to other variables which covary with pitch across these samples.

Thus, the first goal of this research was to confirm the effect of pitch using a method of cry manipulation that avoids confounding pitch with other aspects of infants' cries. Recent advances in computer memory and speed have made it possible to alter the cry of a single infant to a variety of pitch levels. This technology allows us to circumvent many of these past stimulus problems because it assures that (1) the effect of individual differences cannot play a role in the adults' responses, and (2) that the  $F_0$  has been altered in the most direct fashion possible, allowing determinations of the role of pitch in adults' responses.

A second goal of this research was to clarify the role of cry duration in determining adult responses to babies' cries. Past research has suggested that variations in cry duration also play a role in mediating adults' responses. Zeskind and Lester (1978) initially noted that high-complications infants have a shorter first cry expiration, and that adults rated those cries more negatively. Gustafson and Green (1989) noted that the duration of the expiratory phase of a cry was correlated with adults' negative responses. And in a more recent study, Zeskind, Klein, and Marshall (1992) employed digital alteration of cry durations to show that cries with short pauses and both long and short expirations were rated as more abnormal than comparison normal cries. Although these findings have consistently demonstrated that cry duration does have an effect on adults' responses, the direction of this effect remains unclear, with both short and long durations producing more negative ratings.

The stimuli consisted of 25 different 15-s cry sounds. These were created by the manipu-

lation of the pitch and durational features of sections of a single cry bout of a 3-month old female infant. Using the program Sound Designer II running on an Apple Macintosh Quadra 700 computer, pitch and duration were independently manipulated by multiplying each variable by factors of 2.00, 1.50, 1.00, 0.67, and 0.50. The 25 stimulus cries were created by combining each of the five levels of pitch with each of the five levels of duration, resulting in a 5 x 5 design.

A group of 19 female undergraduates attending a private university agreed to participate in the study. The participants were between the ages of 18 and 21, and were predominantly of European decent. All of the participants indicated that their hearing was normal. Participants were tested individually and their reactions to the 25 cries were assessed using a Semantic Differential scale. After each cry sound, the participant rated that cry along eleven 7-point scales. The first six scales; urgent-not urgent, grating-not grating, arousing-not arousing, aversive-not aversive, and distressing-not distressing, were used by Zeskind and Lester (1978), and were intended to assess adults' reactions to the different cries.

These are referred to as response scales hereafter. The remaining five scales, animal-human, sick-healthy, old-young, male-female, and natural-artificial, represented more specific descriptors of the cries themselves, and were included to help interpret the five adult reactions scales. These are referred to as descriptive scales hereafter. The participants' physiological responses were also assessed by measuring both heart rate and skin conductance using the Unicom Heart Rate and EDG measurement programs. Because preliminary examination of the physiological data indicated that the equipment was not functioning properly, no further physiological analyses are reported here.

A 5 (pitch) x 5 (duration) repeated measures analysis of variance was conducted for each of the response and descriptive scales. A significant main effect of pitch was found on all of the adult response and descriptor variables (see Table 1).

A series of linear trend analyses were performed to examine the pattern of means for each of these variables. All but one of the adult variables showed the presence of a significant linear trend. This demonstrated that as pitch

TABLE 1  
Analysis of Variance (and Linear Trends) for Response Scales and  
Descriptive Scales with Pitch and Duration as Independent Variables

	Scale			
	Pitch		Duration	
	F	Linear	F	Linear
<b>Response Scales</b>				
Urgent-Not Urgent	53.63***	+	9.77***	+
Grating-Not Grating	20.90***	+	2.72*	
Arousing-Not Arousing	18.14***	+	1.50	
Piercing-Not Piercing	118.69***	+	4.20**	
Aversive-Not Aversive	20.99***	+	1.13	
Distressing-Not Distressing	28.62***	+	1.90	
<b>Cry Descriptors</b>				
Animal-Human	48.74***	+	0.60	
Sick-Healthy	12.09***		1.22	
Young-Old	37.67***	+	3.33*	-
Female-Male	86.85***	+	1.09	
Artificial-Natural	45.99***	+	2.28	

Note. All non-significant linear trends were omitted. + = a linear increase; - = a linear decrease.

\*  $p < .05$ . \*\*  $p < .01$ . \*\*\*  $p < .001$ .

increased, the participants' ratings of urgent,  $F(1, 420) = 189.83, p < .0001$ , grating,  $F(1, 420) = 65.33, p < .0001$ , arousing,  $F(1, 420) = 64.17, p < .0001$ , aversive,  $F(1, 420) = 69.20, p < .0001$ , piercing,  $F(1, 420) = 457.57, p < .0001$ , and distressing,  $F(1, 420) = 100.68, p < .0001$ , increased as well. These results provide clear support for the hypothesis that high cry pitch is associated with the most negative ratings by participants. Linear trends in the descriptor variables also showed that high pitch cries were rated as younger;  $F(1, 420) = 72.40, p < .0001$ , more female,  $F(1, 420) = 307.38, p < .0001$ , less natural,  $F(1, 420) = 70.66, p < .0001$ , and less human,  $F(1, 420) = 100.66, p < .0001$ , than were low pitch cries.

Significant main effects of duration were found for four of the eleven measures (see Table 1). Ratings of perceived urgency showed a significant linear trend,  $F(1, 420) = 18.80, p < .0001$ . Examination of the means revealed that longer cry durations were associated with higher ratings of urgency. The participants' ratings of the age of the crying infant also showed a significant linear trend,  $F(1, 420) = 7.78, p < .006$ , which indicated that long duration cries were rated as older than short duration cries.

No interaction effects were found for any of the thirteen dependent measures.

These results are consistent with many past demonstrations that high cry pitch is associated with more negative perceptions of cries by groups of adults. The finding that participant ratings for all six of the adult reaction variables increased in a linear fashion as the pitch of the cry increased strongly supports the conclusion that cry pitch *per se* is of central importance in mediating adults' reactions to infant cry sounds. The fact that all of the cry stimuli used in the present study were derived from the cry of a single infant assures that these effects cannot be attributed to spurious individual differences between cries and supports the conclusion that the pitch of the infant cry is indeed being monitored by adults and is instrumental in helping to determine their reactions.

The effect of variations in duration on adults' perceptions of cry urgency is consistent with the view that long cries with long pauses are more alarming to adults than short cries with short pauses. Further research is needed to integrate this result with earlier ones that relate adult response to the relationship between inspiratory and expiratory phases of the cry (Zeskind & Lester, 1978; Gustafson & Green, 1989; Zeskind, Klein, & Marshall, 1992).

In conclusion, the technological manipulation of cry sounds offers an effective methodology for examining the effect of specific characteristics of infants' cries on adult listeners. In the current study this methodology verified the importance of pitch in adults' responses to infants' cries. This form of manipulation can also be used to determine whether similar results are obtained when using the cries of multiple infants. This alternative methodology would also be an effective means of comparing the response patterns of different populations of listeners. This study focused on the responses of female college students but other groups of individuals, such as fathers or adolescents, may yield different patterns of responses to variations in infants' cries.

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