

## Human Infants' Crying – Research aspects

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### Resumé:

*Lidský novorozenec je schopen podporovat a udržovat interakce s matkou už krátce po porodu. Novorozenec se rodí s předprogramovaným repertoárem odpovědí uspořádaným tak, aby maximalizoval přežití jedince a druhu. Jak matku tak novorozenec modifikují svoje konání v závislosti na zpětnovazebné odpovědi partnera. Matky nepotřebují pro zacházení s dítětem explicitní instrukce, a při svém jednání využívají strategie adekvátní svému věku, které jsou založeny také na fylogeneticky předprogramovaných vzorcích chování („intuitive parenting“). Vzhledem k motorické bezmocnosti lidského kojence jsou nezbytné velmi silné sociální kontakty s matkou nebo jiným pečujícím jedincem. Tyto rané interakce podporuje řada signálů, které umožňují vazbu matka-dítě. Vazbu podporující chování se zakládá zvláště na vizuálních signálech (např. kontakt očí, smích, typické charakteristiky obličeje a těla). Matky jsou na takové signály svého dítěte velmi citlivé.*

### **Infant crying as a salient and powerful trigger of parenting behaviour**

The human new-born baby is able to support and maintain interactions with its mother already shortly after birth. The neonate emerges with a pre-programmed response repertoire designed to maximise the survival of the individual and the species. Both, mother and infant modify what they do depending upon the feedback received from the other partner. In handling her baby, mothers do not need explicit instructions, they act using age-adequate strategies, which base also on phylogenetically pre-programmed patterns (“intuitive parenting” Papousek et al. 1996). Because of its motor helplessness the human infant needs a very strong social contact to its mother or another caregiver. A variety of signals supports this early interaction and enables the development of infant-mother attachment. Attachment-promoting behaviours base partially on visual signals

(e.g. eye contact, smiling, face and body characteristics – 'Kindchenschema'; Lorenz 1943). Mothers are very responsive to such signals in their infants (Robson/Moss 1970, Eibl-Eibesfeldt 1986, Hassenstein 1987).

Beside visual signals, the best-known and very powerful acoustical signal is crying (see review about different aspects of early infant crying in Soltis 2004). Magnetic resonance imaging in mothers revealed brain activity caused by infant cries in areas hypothesised to be involved in mammalian parenting behaviour (Lorberbaum et al. 2002). Crying not only promotes physical survival but may also help to establish a relationship that guarantees social interaction: Among several strategies, picking up, cuddling and holding a baby upright on the shoulder, hence enabling eye contact, smiling, talking etc., seems to be the most effective strategy of mothers in terminating crying of her baby (Korner/ Grobstein 1976, Lester/Zeskind 1982). Crying is very important in the development of early infant-mother attachment from an ethological perspective as a proximity-promoting behaviour (Bowlby 1969). In a recent study, F. D'Amato of the CNR Institute of Neuroscience in Rome demonstrated in animals that cries trigger bonding: Mice that lacked a gene that lets them feel pain relief from opiates had severe difficulty establishing bonds with their mothers (Moles et al. 2004). The study provided strong arguments that maternal support has an opiate component, which was first proposed by J. Panksepp already two decades ago. Scientists from the McGill University in Montreal demonstrated that physical mothering (e.g. increased pup licking and grooming) early in life altered the offspring epigenome at a glucocorticoid receptor gene promoter in the hippocampus (Weaver et al. 2004).

### **Why is the infant cry such a powerful signal?**

A long evolutionary process has developed certain physical characteristics of the cry in a way that it became a very effective alarm signal, a bio-siren:

During the long evolution of primates, the rising complexity of social interactions, the importance of acoustical signals for co-operation, and necessary information about internal states within groups of individuals led to improved performance of differentiation for producing sounds and perceiving them (Mende/Wermke 1988). Surely, it is not coincidental that the region of the best frequency discrimination performance and the frequency region of the most common social sounds are identical within the mammals. From this perspective, the history of sound production of vertebrates is a path from broad-banded noisy sounds to increasingly frequency controlled and finally, frequency

modulated sound patterns with a high penetrative force. The alerting characteristics of the infants' cries are caused by their frequency modulation content and their harmonic character (high harmonic-to-noise ratio).

### **Infant crying as a releaser of negative emotions**

The powerful alerting characteristics of infant cries serve its basic signalling function of emergency, but at the same time these sound characteristics also carry the potential for triggering violence against the infant under certain conditions. The significance of crying in this respect is well-described by several authors (e.g. Parke/Collmer 1975, Lester/Zeskind 1982, Michelsson/Rinne 1987, Volkin 1987, Wilkes 1987). A cry that is perceived as particularly annoying or grating may exceed the caregiver's capacity to respond with appropriate care-giving behaviour. Excessive crying may under certain conditions evoke responses of extreme hostility, rejection or abuse. Crying is one of the major perceived precipitants of abuse for infants (Murray 1979, Wiessbluth 1984, Kirkland 1985, Gray 1987, Wilkes 1987, Baildam et al. 1995).

In a study evaluating parents who abused their infants, 80% of the physically abusing parents cited intolerable crying as the reason for their battering the infant (Weston et al. 1993).

"Difficulty in coping with crying in early infancy is probably the major complaint of parents to paediatricians and is one of the most frequent reasons for visits to the hospital emergency room in the first few weeks of life. Infants who cry often and are difficult to soothe may place extreme demands on their parents which may in turn raise doubts in the parents about their own competence, thus jeopardising the early development of the infant-caregiver relationship. The often-cited role of crying in child abuse may be one indicator of such interactive failures in which infant and parent both contribute to the child's maltreatment. Infant crying that is excessive and particularly aversive-sounding may set the stage for the development of nonoptimal childrearing practices which, in an extremely stressed environment, could lead to abuse or neglect." (Lester/Zeskind 1982:133–134)

Excessive and persistent, but even more often 'abnormal' crying is a trigger of maltreatment and violence against the child. According to this there exists a 'high-risk-for-abuse' population (Gil 1970, Light 1974, Lester/Zeskind 1982, Michelsson/Rinne 1987, Bax 1985, Wilkes 1987). The term abnormal crying is used

for describing modifications of cry features, e.g. in form of a very high fundamental frequency, occurrence of frequency shifts combined with noise-like components (compare parameter definitions and cry examples in Wasz-Höckert et al. 1968, Lester/Boukydis 1985). For many years paediatricians have been searching for non-invasive tools to measure brain function of infants, because they had strong hints for typical changes in cry features in case of brain disorders (see review in Lester/Boukydis 1986 and Soltis 2004). In our studies in infants with mild brain disorders, we observed a greater micro-variability of the fundamental frequency of their cries compared to the cries of healthy infants (Wernke et al. 1988, Mende et al. 1990a). High-pitched and noisy cries are very often observable in infants with transitory or permanent neuro-physiological disorders (Mende et al. 1990B, see review in Lester/Boukydis 1985).

In ratings of perceived sound qualities adults, regardless of child care experience, rated the high-risk infant cries (e.g. premature infants, low birthweight and small-for-gestational-age babies, brain disordered infants) as more urgent, aversive and distressing (Lester/Zeskind 1982). This matches the fact that low birthweight and small-for-gestational-age babies are over-represented in the population of failure-to-thrive, abused, and adopted infants (Gil 1970, Light 1974, Weston et al. 1993). Fundamental investigations are necessary to decide whether or not differences in care-giving may affect frequency patterns of cries and which parenting strategies are able to reduce 'violence-releasing features' of cry signals.

During their interactions, the mother as well as the infant develops special expectations of how the behaviour of the other should be in the next moment. A non-verbal misunderstanding or bad tuning between both will produce a stressed relationship. A mistuning in social signals underlying early interaction patterns can cause tremendous problems between mother and child. Miller et al. (1993:551) for instance found, that postpartum disturbances in maternal mood have been associated with differences in maternal behaviour toward their infants and in the behaviour of infants themselves. This vicious circle is caused by changes of acoustical cry features in the case of severe neuro-physiological disorders and the related perceptive effects of listeners.

There is another aspect to be mentioned in this framework. Most of the information material on infant development for young mothers supports wrong expectations and puts mothers under pressure to succeed: particularly, because of the propagation of age-related normative values for several physical

and cognitive performances of the infant without pointing to the large variability among infants or to phases of re-organisation. The prevailing opinion is that growth and development are processes that reach a new stage step by step on the scale of progress. This opinion ignores the existence of re-organisational phases during ontogenesis (Van de Rijt/Plooij 1992, Wermke/Mende 1993, 1994; Wermke/Siegmund 2000). Among the variety of textbooks for young mothers there is hardly any which informs mothers about such critical phases and explains the changes of child behaviour occurring during this time (more frequent crying, demand for more body contact, sleep disorders).

From an ethological perspective, a successful treatment of the infant depends on treatment of the mother/parent-child interaction. Parents, especially parents of infants with special needs, should know the trigger-function of biological signals. This seems at least to be one method of preventing certain kinds of violence. We cannot abrogate our phylogenetic gifts in case we find them no longer helpful or even counterproductive but we could use cultural means to cope with them. Research dealing with legal consequences of this problematic is among many other interesting fields supported by the Gruter Institute for Law and Behavioral Research ([www.gruterinstitute.org](http://www.gruterinstitute.org)).

### **Infant crying as the first stage of pre-speech development**

The characteristics of the human infant cry go far beyond the needs of a simple alarming function. The infant cry is a powerful social stimulus and serves as a communicative signal to the caregiver. However, one important aspect has been understated often, namely the cry development and its significance as a preparatory function for language (Borschberg/Ruppert 1998, Mende et al. 1990A, Wermke/Mende 1992, 1993, 1994, 2000; Wermke et al. 1996, Wermke 2002, Wermke et al. 2002b, Wermke/Friederici 2004). Spontaneous infants' cries (e.g. excluding pain cries) exhibit a uni-directional development toward language. For example, our longitudinal cry studies in singleton and twins provided strong arguments for a precursor role of the cry melody for prosody (Wermke 2002, Wermke et al. 2002b, Wermke/Friederici 2004). Cry melodies undergo certain developmental changes in the form of an increasing short-time stability of the fundamental frequency and continuously sharpening transitions between different monotonous stages of the melody. Parallel to the maturation of these more local properties of the melody, we also found a clear structural maturation of the different melody types towards autonomous building blocks. Moreover, we found that the sequence of stages of pre-speech development is a good example

for the evolutionary principle of modular composition of complexity and the principle of repetition and specialisation (Mende et al. 1990, Mende/Wermke 1992, Wermke/Mende 1994, Wermke et al. 1996, Wermke 2002). One of the first building blocks (module) of development is a simple rising-falling cry melody. During later developmental stages complex cry melodies increasingly consist of combinations of these building blocks. Modules of the same type as well as different modules are combined. The simplest form of such a combination consists in a module duplication resulting in typical double-arc cry melodies. Besides duplication, we also found 3- and 4-fold repetitions of the same or different modules. The same combination principle is obvious during later development in the construction of reduplicated babbling and in the construction of the first words and sentences. This strategy of repetition and specialization of the reduplicated elements follows a general evolutionary principle for composing complex structures and is found in biological evolution and other fields involving the evolution of complex entities (Maynard Smith/Szathmáry 1999, Riedl 1975).

The developmental changes of cry melody seem to follow an inborn universal program (Wermke 2002). Following the same architectural principle a variety of other vocalisation modules are created and combined. The creation of increasingly complex cry sounds in the described way means also to develop, stabilise and provide building blocks essential for later speech and language acquisition. Further refinement of laryngeal co-ordination during the first months of life and the step-by-step addition of upper pharyngeal and oral controls constitute several elementary abilities (modules) used for other pre-speech sounds and language.

In applying the new findings of early pre-speech development in the department of orthodontics, the focus of our research is shifted to infants with malformations of the vocal tract, patients with cleft lip and palate ([www.lkg-zentrum.de](http://www.lkg-zentrum.de)). We investigate differences of parameters of cries and later pre-speech sounds (e.g. babbling) of these patients using our reference data bank from healthy, non-cleft infants. Deviations between both groups have been investigated with regard to orthodontic treatment, hearing performances as well as somatic, motor and neuro-physiological development of the CLP-infants (Wermke et al. 2002a). The aim of these investigations is the search for early predictors for an at-risk status for the development of speech and/or language disorders in CLP-infants as well as the development of early pre-speech therapies to minimize or even avoid such disorders.

A "training" directed to speech and language acquisition during the first months of life seems to be an important prerequisite for later speech and

language performances. Our studies on human infants' cries and non-cry vocalisations strongly support a continuous development from early crying via babbling toward language.

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