Obituary

Christa Einspieler[1]
Peter B. Marschik[1,2]
Arend F. Bos[3]
Fabrizio Ferrari[4]
Giovanni Cioni[5]

[1]Medical University Graz
Graz, Austria
E-mail: christa.einspieler@medunigraz.at

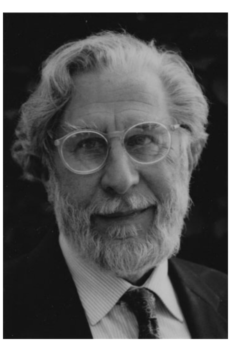
[2]Karolinska Institutet
Stockholm, Sweden

[3]Medical University Hospital Groningen
Groningen, The Netherlands

[4]University Hospital Modena
Modena, Italy

[5]IRCCS Fondazione Stella Maris
Pisa and University of Pisa
Pisa, Italy

Heinz F. R. Prechtl, 1927–2014 Crossing the Borders



Heinz F.R. Prechtl, a natural-born scientist and internationally known as the "father of developmental neurology" was a pioneer in understanding the fetal, preterm, and neonatal behavior. A man of vision and with unequaled passion for interdisciplinary scientific endeavors once said "research may not be able to create complete happiness and satisfaction for man, but a better understanding of the underlying mechanisms of development is needed if we were to promote optimal environmental conditions and prevent the devastating influence of hazardous ones" (Prechtl, 1968, p. 161; Editorial for the inaugural volume of Developmental Psychobiology).

Born in Vienna on the 6th of July 1927, Heinz studied medicine, zoology, and anthropology at the University of Vienna. In 1951, he followed his mentor, the founder of ethology and later Nobel Prize laureate Konrad Lorenz to the Max Planck Institute for Behavioural Physiology in Buldern, Germany. Within 5 years his observational focus had moved from birds, lizards, salamanders, and cats to human infants. In 1955 he published a series of films on the sucking, grasping, posture, and locomotion of human newborns and infants (Prechtl, 1955).

His groundbreaking ideas and scientific vision led him to Groningen, where he became Professor of experimental neurology at the age of 35. Under his aegis, developmental neurology was born 4 years later (1968) with ontogenetic adaptation as one of its basic principles: the functional repertoire of the developing neural structure must meet the requirements of the organism and its environment (Prechtl, 2001). It was essential to Heinz that immaturity (deriving from an irrelevant reference to later developmental stages) does not exist if the various developmental stages are studied in their own right. Consequently, already in 1968, he postulated that age-related vulnerability causes age-specific lesions and requires both age-adequate diagnostic procedures and interventions. In long-lasting discussions with close scientific friends, Heinz continuously refined this con-

Manuscript Received: 25 August 2014
Manuscript Accepted: 29 August 2014
Correspondence to: Christa Einspieler, Institute of Physiology, Medical University Graz, Graz, Austria.
Article first published online in Wiley Online Library (wileyonlinelibrary.com).
DOI 10.1002/dev.21255 • © 2014 Wiley Periodicals, Inc.

cept, and presented an essence of this process in his Ronnie Mac Keith Lecture (Prechtl, 2001).

In the early 1970s, Heinz was in the process of designing a standardized method of a neurological examination for neonates, and became interested in the question of behavioral states in neonates and infants. Wolff's (1959, 1966) first descriptions of behavioral states soon became a key issue in Prechtl's work on the neurology of the full term neonate and were a prerequisite for a quantitative neurological assessment. In his Duivenvoorde Lecture Heinz summarized the five behavioral states of the newborn infant as distinct—and not continual—modes of the nervous system (Prechtl, 1974). He strove to prove that the distinction of behavioral states is essential for the neurological examination of the newborn since, for example, reactions to proprioceptive stimulations are exaggerated during state 1 (i.e., eyes closed, respiration regular, gross movements absent, vocalizations absent) but can hardly be elicited during state 2 (i.e., eyes closed, respiration irregular, gross movements from time to time present, vocalizations absent). By contrast, reactions to exteroceptive stimulations cannot be seen during state 1 but typically occur during state 2 (e.g., Lenard, von Bernuth, & Prechtl, 1968; Prechtl, Vlach, Lenard, & Kerr Grant, 1967; Vlach, von Bernuth, & Prechtl, 1969). Thus, each manoeuvre of the Prechtl Neurological Examination of the Fullterm Newborn Infant is standardized for behavioral states (Prechtl, 1977).

Already in his Award Lecture of the Mental Health Research Fund in London, Heinz introduced another milestone of his scientific oeuvre, the optimality concept (Prechtl, 1967): for example, the delivery of a primigravida is in itself certainly within the realm of normality, but should not be considered as optimal, because of the well-known increased mortality rates as compared to the second and third delivery (Prechtl, 1980). In a study on 1,500 newborns, Heinz elaborated on this concept by defining optimal conditions for each perinatal variable as well as for the neurological examination, instead of using the normal/abnormal dichotomy (Prechtl, 1980).

Observing low-risk preterm infants, Heinz started wondering about the prenatal origin of the many spontaneous movement patterns (Prechtl, Fargel, Weinmann, & Bakker, 1979). In the early 1980s the ultrasound equipment in obstetrics had improved substantially enough to allow a detailed observation of the fetus (de Vries, Visser, & Prechtl, 1982; Nijhuis, Prechtl, Martin, & Bots, 1982). Their descriptions of fetal behavior were an eye-opener and revealed that fetal behavior is patterned right from the beginning (8 weeks postmenstrual age). Although very different in nature, abrupt startles and complex general movements (GMs) are among the first movements and emerge at the same time; they are followed by isolated limb movements a mere week later (de Vries et al., 1982). Already at 12 weeks, the fetus has a rich repertoire of spontaneous endogenously generated movements: startles, GMs, hiccup, isolated arm and leg movements, side-to-side movements of the head, ante-, and retroflexion of the head, breathing movements, opening and closing of the fingers, jaw movements, stretching and yawning (Einspieler, Prayer, & Prechtl, 2012).

In one of his books, Heinz and coworkers described the continuity of neural functions from prenatal to postnatal life. While birth is an environmental discontinuity par excellence, the complex behavioral repertoire displays an impressive continuity from intra-uterine to extra-uterine life (Prechtl, 1984). Only at 3 months of age, many behaviors such as movements, sucking, or vision change their appearance. Parents certainly perceive this change as gratifying: the infant becomes a more responsive partner in the triad (Prechtl, 1984, 1986).

The observation that high-risk infants move differently compared to typically developing infants marked a new approach to assessing the young nervous system: the assessment of general movements, or GMs (Prechtl, 1990; Prechtl et al., 1997). During the last 25 years it has been extensively proven that the patterns of GMs are sensitive indicators of certain neurological impairments, and are hence regarded as a keyhole into the developing brain (Bosanquet, Copeland, Ware, & Boyd, 2013).

Heinz received numerous honors and awards for his scientific achievements, including the Folke Bernadotte Award, the Heinrich Hoffmann Award, the Kenneth Craik Award, the Maternity Award of the European Society of Perinatal Medicine, the Cornelia de Lange Prize, and the Prize of the Dutch Science Foundation. He was a Mac Arthur and Ronnie Mac Keith lecturer, received honorary degrees in medicine from the Universities of Graz and Genoa, and became Honorary Fellow of the Royal Academy of Obstetrics and Gynaecology. In 1990, he was knighted by the Queen of the Netherlands.

Heinz was a polymath with a deep interest in music (from Monteverdi to Mahler), paintings (particularly the Flemish masters of the 15th and 16th centuries and Piero della Francesca, but also the "Twittering Machine" by Paul Klee) and books. He never read just one book at a time; the copies he left behind on his desk were Safranski's biography of Goethe, a crime story, two books about proverbs and their origin, and one about French Baroque masters. His influence on so many people was truly impressive. There was nothing pretentious about him. All of us who knew him well will sometimes—mostly when we struggle to explain our thoughts—hear him say: “What exactly do you mean?” or “Why do you think so?” Words like these will carry on his legacy in the studies of early human development.

REFERENCES

Bosanquet, M., Copeland, L., Ware, R., & Boyd, R. (2013). A systematic review of tests to predict cerebral palsy in young children. Developmental Medicine & Child Neurology, 43, 836–842.

de Vries, J. I. P., Visser, G. H. A., & Prechtl, H. F. R. (1982). The emergence of fetal behaviour. I. Qualitative aspects. Early Human Development, 7, 301–322.

Einspieler, C., Prayer, D., & Prechtl, H. F. R. (2012). Fetal behaviour: A neurodevelopmental approach. Clinics in developmental medicine 189. London: MacKeith Press.

Lenard, H. G., von Bernuth, H., & Prechtl, H. F. R. (1968). Reflexes and their relationship to behavioural state in the newborn. Acta Paediatrica Scandinavia, 3, 177–185.

Nijhuis, J. G., Prechtl, H. F. R., Martin, C. B., Jr., & Bots, R. S. G. M. (1982). Are there behavioural states in the human fetus? Early Human Development, 6, 177–195.

Prechtl, H. F. R. (1955). Die Entwicklung der frühkindlichen Motorik. I–III (C651–C653). Göttingen: Institut für den Wissenschaftlichen Film.

Prechtl, H. F. R. (1967). Neurological sequelae of prenatal and perinatal complications. British Medical Journal, 4, 763–767.

Prechtl, H. F. R. (1968). Crossing the borders. Editorial. Developmental Psychobiology, 1, 161.

Prechtl, H. F. R. (1974). The behavioural states of the newborn infant (a review). The Duidenvoorde Lecture 1973. Brain Research, 76, 185–212.

Prechtl, H. F. R. (1977). The neurological examination of the fullterm newborn infant. Second revised and enlarged edition. Clinics in developmental medicine 63. London: Heinemann.

Prechtl, H. F. R. (1980). The optimality concept. Editorial. Early Human Development, 4(3), 201–205.

Prechtl, H. F. R. (1984). Continuity of neural functions from prenatal to postnatal life. Clinics in developmental medicine 94. Oxford: Blackwell Scientific Publications Ltd. Philadelphia: J. B. Lippincott Co.

Prechtl, H. F. R. (1986). New perspectives in early human development. European Journal of Obstetrics, Gynaecology and Reproductive Biology, 21, 347–355.

Prechtl, H. F. R. (1990). Qualitative changes of spontaneous movements in fetus and preterm infants are a marker of neurological dysfunction. Early Human Development, 23, 151–159.

Prechtl, H. F. R. (2001). General movement assessment as a method of developmental neurology: New paradigms and their consequences. The 1999 Ronnie Mac Keith Lecture. Developmental Medicine & Child Neurology, 43, 836–842.

Prechtl, H. F. R., Einspieler, C., Cioni, G., Bos, A. F., Ferrari, F., & Sontheimer, D. (1997). An early marker of developing neurological handicaps after brain lesions. The Lancet, 349, 1361–1363.

Prechtl, H. F. R., Fargel, J. W., Weinmann, H. M., & Bakker, H. H. (1979). Postures, motility and respiration of low-risk pre-term infants. Developmental Medicine & Child Neurology, 21, 3–27.

Prechtl, H. F. R., Vlach, V., Lenard, H. G., & Kerr Grant, D. (1967). Exteroceptive and tendon reflexes in various behavioural states in the newborn infant. Biology of the Neonate, 11, 159–175.

Vlach, V., von Bernuth, H., & Prechtl, H. F. R. (1969). State dependency of exteroceptive skin reflexes in newborn infants. Developmental Medicine & Child Neurology, 11, 353–362.

Wolff, P. H. (1959). Observations on newborn infants. Psychosomatic Medicine, 221, 110–118.

Wolff, P. H. (1966). The causes, controls and organisation of behaviour in the neonate. Psychological issues, volume 5, no. 1, monograph 17. New York: International University Press.