To what extent can we predict the future?

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Published online: 29 December 2012
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Möricke et al. (this issue) are to be commended for their study on behavioral and developmental profiles of 14–15 months old children. The sample encompassing 6,330 children was derived from a birth cohort study which included children born between August 2000 and August 2001 in the province of Utrecht/The Netherlands. Parents filled in the 74-item Utrecht Screening Questionnaire, which is based on selected items of the Childhood Behavior Checklist, the Vineland Social-Emotional Early Childhood Scales and the Early Screening of Autistic Traits Questionnaire. All items were deemed as being suitable for children younger than 18 months and had to be specific for externalizing, internalizing or social-communicative problems. The investigators used exploratory factors and latent class analyses to identify subgroups of children with homogeneous behavioral and developmental profiles; the respective subgroups were compared with existing classifications on a descriptive level.

For the exploratory factor analysis, a solution with nine factors fitted the data best, which were termed as deviant communication, negative emotionality, deviant reactive behavior, deviant play behavior, demanding behavior, social anxiety/inhibition, advanced social interaction problems, basic social interaction, measures of fit and accuracy, and sleep problems. Measures of fit and accuracy indicated that a solution with five classes best fitted the data of the latent class analyses. These classes encompassed between 10.8 and 35.9 % of the children and partially differed with respect to age, gender distribution, familial

socio-economic status, and the proportions of children of Dutch and non-European origin.

Upon combination of both the exploratory and the latent class analyses, three main groups were identified: (1) normal children, (2) children with problems in communication and/or social interaction and (3) children with negative and demanding behavior. The authors discuss that the broad domain of internalizing and externalizing behaviors of the CBCL 1.5–5 are discernible; however, no separate factors for mood problems, anxiety problems, pervasive developmental disorders, attention problems or aggressive behavior were detected. According to the conclusions of the authors, the identified groups may represent predictors of disorders described in existing classification systems (DSM-IV TR, ICD-10, DC 0-3).

Obviously, the usefulness of such behavioral and developmental profiles rests upon their predictive value of future behavior. If prediction is poor, we can merely use profiles to characterize current behavior. If, however, prediction of future behavior is good in clinical terms, we can potentially base decisions regarding diagnostic issues, treatment, and prevention on such categorisations. It seems trivial to point out that as a general rule short-term is better than medium- and long-term prediction. In addition, age at assessment constitutes an important variable. Thus, the prediction of future behavior is better if the child is older at baseline. Fortunately, the authors will separately publish follow-up findings at the age of 3 years.

Weight adjusted for height (e.g. body mass index; BMI/kg/m²) represents a phenotype that has been studied extensively with respect to tracking over time. According to a US study published in 1994 [5], BMI at age 1 was only weakly correlated with BMI at age 35 ($r = 0.15$) and r values increased up to 0.5 and 0.7 for 10 and 18 year olds at baseline [5]. The prediction can be improved if parental

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BMI is co-assessed (e.g., [12]. Furthermore, the dynamics of BMI development over time are also important. For instance, rapid transition from a BMI in the lower percentile range to a BMI in the higher range during infancy and childhood predicts obesity and later metabolic disorders [3]; similarly, an early adiposity rebound also predicts future obesity [1]. Based on a Finnish cohort study and two validation studies from Italy and the USA, Morandi et al. [12] have recently introduced clinically useful equations estimating the risk of later obesity in newborns (<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3509134/#pone.0049919.s011>), which were based on pre-pregnancy parental BMI, parental professional category, single parenthood, gestational weight gain, pre-pregnancy maternal smoking, gestational smoking, number of household members, and birth weight. The simple to use calculator allows good prediction of childhood and adolescent obesity. Inclusion of genetic data based on 39 polymorphisms known to influence BMI only minimally (<1 %) improved the prediction. The clinically useful prediction of childhood and adolescent BMI upon birth leads to the question if we can similarly come up with calculations/models to predict development, future behaviour or personality. What variables are required to make a good prediction? Who should provide us with what kind of information at what time points to make the best prediction of the respective developmental trajectory?

Rutter [19] has provided an overview of our current knowledge of risk factors which can be assessed in longitudinal studies to assess developmental psychopathological trajectories. Family risks factors are of obvious importance for several disorders (e.g., for anxiety disorders see [8]) and can be extended to include prenatal factors [20]. Prediction can be improved via the incorporation of dimensional phenotypes that stem from imaging studies [11]. When looking at developmental trajectories, it is important to know if these differ between twins and singletons [16]. The sequence of specific disorders should be analyzed longitudinally; Reef et al. [14], for instance, have shown that symptoms of oppositional defiant disorder develop in parallel and are not precursors to those of conduct disorder. The value of children's as well as mothers' reports of children's aggression for predicting different types of serious antisocial behavior in adulthood has been supported [2] and serves as an example of research into the use of different informants for longitudinal studies. Developmental trajectories can be determined for children with a specific disorder as has recently been exemplified for the phenotypes attention and executive functions and intelligence deficits in patients with early onset schizophrenia [6, 7]. As in the study of Möricke et al. (this issue), the Childhood Behavior Checklist is a frequently used instrument used for predicting the development of psychiatric

disorders. A classical example is that mood disorders in adulthood are predicted by parent-reported internalizing behavior during childhood, whereas parent-reported social problems and externalizing behavior predict the development of anxiety disorders [17].

In comparison to behavioral phenotypes, the trajectory of motor development is comparatively easy to assess; nevertheless, conflicting results with respect to the stability of motor development have been obtained. In a study encompassing 2,850 probands, age at first walking was positively associated with adult physical performance in terms of chair rising, hand grip strength, and standing balance at age 53 [9, 10]. Earlier infant motor development has also been associated with higher physical education grade and higher frequency of participation in leisure time sports; the effect size of a 1 month delayed motor development on school PE grade was comparable to the effect of an increase of one BMI unit on school PE grade [15]. In other studies, the stability of motor development was poor: for example, the predictive value for this development at school age as based on standardized assessments of motor and neurologic performance during the neonatal period, early infancy, and toddler age was found to be low in a small sample encompassing 77 probands [18]. The respective authors concluded that caution is required upon use of only a single early measurement in outcome studies. According to another negative study [13], early fine and gross motor development in children at 4 to 48 months was not related to fine and gross motor development at 6–12 years.

The large bulk of research results pertaining to developmental aspects is on the one hand fascinating because these data allow us to grasp what the future might behold for a specific group of infants or children. On the other hand, these results are not easy to incorporate into clinical reasoning and decision making. For one, an individual prediction is not possible; we can merely refer to for instance odds ratios or hazard ratios. Furthermore, we need to consider the multiplicity of developmental trajectories, their inter-relationship, potential moderators [4], and modifiers. A clinician frequently lacks the statistical knowledge to comprehend the complexity of the modeling of specific outcomes. As such, the gap between the ever increasing knowledge of development trajectories and the clinical use of this information is becoming wider. Some of us may, however, view this widening gap as fortunate, because this prevents deterministic thinking and leaves room for therapeutic optimism, which in itself may indeed reduce the risk of a poor outcome.

The significance of traditional developmental research is highlighted by the aforementioned study on the clinically useful prediction of adult BMI via birth weight [12]. In comparison to the respective model which solely rests on

classical phenotypes, prediction based on common DNA polymorphisms known to influence BMI currently must be considered as too poor to make the addition of molecular genetic data to the model worthwhile. Similarly, because only few common polymorphisms with small effect sizes have been detected that predispose to specific psychiatric disorders, we currently rely on longitudinal developmental studies based on traditional phenotypes to further our predictive knowledge. This not only underscores the importance of such research but also the need for more systematic training of child and adolescent psychiatrists to make optimal use of such data for daily clinical judgments.

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