Twin Research and Human Genetics
Volume 16 ▌ Number 1 ▌ pp. 404–411 ▌ © The Authors 2013 ▌ doi:10.1017/thg.2012.107

Arizona Twin Project: A Focus on Early Resilience

Kathryn Lemery-Chalfant, Sierra Clifford, Kristy McDonald, T. Caitlin O'Brien, and Carlos Valiente
Department of Psychology, Arizona State University, Tempe, AZ, USA

The Arizona Twin Project is an ongoing longitudinal study designed to elucidate the genetic and environmental influences underlying the development of early competence and resilience to common mental and physical health problems during infancy and childhood. Participants are a sample of 600 twins (25% Hispanic) recruited from birth records in the state of Arizona, United States. Primary caregivers were interviewed on twins' development and early social environments when twins were 12 and 30 months of age. Measures include indices of prenatal and obstetrical risk coded from hospital medical records, as well as primary caregiver-report questionnaires assessing multiple indicators of environmental risk and resilience (e.g., parental warmth and control, family and social support), twins' developmental maturity, temperament, health, behavior problems, and competencies. Preliminary findings highlight the importance of the early environment for infant and toddler health and well-being, both directly and as a moderator of genetic influences. Future directions include a third longitudinal assessment in middle childhood examining daily bidirectional relations between sleep, health behaviors, stress, and mood.

■ **Keywords:** Hispanic, resilience, parenting, health, internalizing, externalizing

The overarching goal of the Arizona Twin Project addresses a central question of developmental and clinical psychology — namely, how resilience (the capacity to bounce back following adversity) develops and affects the impact of early risk on child physical health and common mental health disorders such as anxiety, depression, conduct problems, and attention deficit hyperactivity disorder. The need to understand these relations is underscored by findings that 9–15% of toddlers and preschoolers exhibit clinical or sub-clinical emotional or behavioral problems (Briggs-Gowan et al., 2001; Campbell, 1995; Egger & Arnold, 2006) that interfere with daily family life, and tend to remain stable across childhood (Briggs-Gowan et al., 2006; Campbell, 1995; Keenan et al., 1998). There is a critical need for scientifically valid studies that can inform parents, policy makers, and practitioners about causal processes in child health and psychopathology. By focusing on components of early resilience within a representative twin study design, we can elucidate processes by which children bounce back after adversity and grow to be healthy and competent individuals.

The Arizona Twin Project is a longitudinal study focusing on the impact of the early environment (prenatal and infancy periods) on developing resilience across childhood. The primary goal of this research is to understand genetic and environmental influences on early resilience and physical and mental health, as well as the association between resilience and health problems and/or competencies. Early health problems considered in the Arizona Twin Project include dysregulated mood, sleep, and eating, as well as aggression, inattention, and hyperactivity. Aspects of early competency include positive mood, attentional focusing, inhibitory control, prosocial behaviors, empathy, compliance, imitative play, and motivation. Elucidating the important components of early resilience and how relations between resilience and health are developed and maintained by genes and environments informs our understanding of etiology, and aids in identifying specific genes and environments linked to problems and competencies.

Risk factor research has dominated efforts to predict and ultimately prevent child mental health problems across both phenotypic and genetically informed studies, and this work has been invaluable in identifying key sources of vulnerability. Nevertheless, there are levels of disorder that cannot be accounted for in the accumulation of risk indices. For example, genetically influenced traits, such as self-regulation, confer health advantage after accounting for multivariate risk ratios (Moffitt et al., 2011), and

RECEIVED 12 September 2012; ACCEPTED 17 September 2012.

ADDRESS FOR CORRESPONDENCE: Kathryn Lemery-Chalfant, Department of Psychology, Arizona State University, Box 871104, Tempe, AZ 85281, USA. Email: klemery@asu.edu

positive environmental influences, such as social support or positive family climate, may be instrumental in offsetting genetic or environmental risk for disorder (Silk et al., 2007). Thus, resilience theory leads researchers to develop indices of positive adaptation that complement the identification of risk factors, and emphasizes that to best predict health, both protective and risk factors must be considered. To this end, the Arizona Twin Project seeks to identify components of resilience across person, family, and cultural levels of analysis, and to determine their association with children's health.

Although numerous studies have established associations between risk factors and child mental health, research that considers resilience from a genetically informed perspective is still relatively rare (Lemery-Chalfant, 2010). As an early twin study assessing multiple aspects of the prenatal and early postnatal family and social environments, the Arizona Twin Project is in a position to examine both genetic and environmental contributions to the development of resilience across domains, including physiological health and regulation (e.g., sleep and eating), attention, emotional reactivity and regulation, and early pro-social behavior and empathy. In addition, we test models examining the complex interplay between heritability and environments, such as moderation by relevant environments (e.g., obstetrical complications, parenting warmth, cultural ecological context).

Another key aspect of the Arizona Twin Project is our focus on the development of early self-regulation. Self-regulation is a component of resilience that likely mediates or moderates the relations between risk and optimal functioning across a variety of domains. After reviewing a substantial body of literature linking regulation with developmental outcomes, the National Academy of Science committee report, *From Neurons to Neighborhoods*, noted that 'the growth of self-regulation is a cornerstone of early childhood development that cuts across all domains of behavior' (Shonkoff & Phillips, 2000, p. 3). Despite the importance of self-regulation to health and well-being, research devoted to understanding how self-regulation enhances health in the context of adversity is limited.

Given the importance of a representative sample for estimating heritability and genetic and environmental covariance, we recruited from state birth records, rather than volunteer organizations. As far as we know, this project is the only early childhood twin study in the United States with a large percentage of Mexican Americans (25%), the largest and the most rapidly growing ethnic group in the United States. This demographic affords the opportunity to consider the impact of acculturation, and the interaction of culture and genetics.

We began the longitudinal study in infancy because mounting evidence suggests the prenatal and early postnatal environment have instrumental roles in establishing biological set points of recovery from adversity or stress (Fox et al., 2010), and we hope to elucidate the relevant environments. The next longitudinal follow-up was at 30 months, because 30 months is an important age for the development of early resilience. A follow-up assessment at 30 months allows us to examine whether twins at risk at 12 months of age due to prematurity or developmental immaturity have now matured past these infancy issues, and to examine environmental factors that predict this recovery. Furthermore, 30-month-olds, unlike 12-month-olds, are able to use verbal communication to regulate their emotions and behavior and enhance their social relationships, two key components of resilience. Thirty months is also a time of behavioral and emotional transition, as children are in the process of developing a sense of self and a relationship with the world around them, gaining understanding of the standards, rules, and goals of their society, and developing self-conscious, secondary emotions that are central to resilience, such as empathy, pride, and shame. Thirty-month-olds are also just beginning to use more complex forms of play (e.g., cooperative play, dramatic play). Lastly, the toddler years are understudied, with infancy researchers focusing on under-24 months of age, and preschool researchers beginning at 36 months of age.

Twin Panel Recruitment

The families with twins were recruited from birth records through collaboration with the Arizona State Department of Health Services. Because Arizona is a closed-records state, we were not able to contact families directly because we did not have access to identifying information until the families provided it to us. Instead, the Division of Public Health Services, Office of Vital Records mailed letters (in English and Spanish) to a random sample of mothers over the age of 18 years who had given birth to live twins in an Arizona hospital between July 2007 and July 2008. Recruitment letters were mailed two months prior to the twins' 12-month birthday, including a postage-paid return letter where families could indicate their interest in participating. Follow-up letters were mailed one month after the first letter if we did not receive a response. Informed consent was obtained prior to all interviews, and participants were compensated a total of US$40 at each measurement occasion, as well as an additional US$10 for completing follow-up demographic and zygosity questionnaires.

As part of the initial assessment, we recruited and assessed a sample of 582 twins. As twins were turning 30 months of age, we re-contacted parents through telephone, e-mail, and mail to request continued participation in the study. Between assessments, we maintained contact with families and promoted interest by mailing birthday cards to twins and project newsletters three to four times a year to parents.

Five hundred and eighty-two twins (26% monozygotic (MZ) twins, 36% same-sex dizygotic (DZ), 38%

https://doi.org/10.1017/thg.2012.107 Published online by Cambridge University Press

opposite-sex DZ, making up 291 pairs) and their mothers participated when the twins were 12 months of age, and 520 (89%) also participated in the longitudinal follow-up assessment at 30 months. Of the 62 twins (31 families) who did not participate at 30 months, only four families declined to participate, while others did not participate because they were too busy or were traveling during the target window. Twin participants are 25% Hispanic, 66% Caucasian, 5% Asian American, and 4% African American. Income ranged from less than US$20k to over US$100k, with a median of US$60k–80k. Parental education ranged from less than a high school degree to a professional degree, with mean education of a college degree.

The Zygosity Questionnaire for Young Twins (Goldsmith, 1991) was used to determine whether twins were identical or fraternal. This questionnaire yields over 95% agreement with zygosity determined via genotyping (Forget-Dubois et al., 2003; Price et al., 2000). Zygosity was further verified with infant birth medical records.

History of Data Collection: Prenatal, 12-Month, and 30-Month Assessments

The pregnancy and birth records assessment consisted of three scales of obstetrical complications and neonatal risk factors, as well as maternal report of perceived prenatal stress. The Obstetrical Complications Scale (OCS; adapted from Littman & Parmalee, 1974) was used to measure a wide range of specific prenatal and obstetrical risks (e.g., history of stillbirth, prenatal substance use), labor and delivery information, and other maternal characteristics (e.g., maternal parity). We obtained information on chorionicity and twin-to-twin transfusion syndrome when possible. The Neonatal Complications Scale (NCS; adapted from Littman & Parmalee, 1974) was used to examine specific measures of infant health (e.g., birth weight, Apgar scores) and neonatal risks and complications (e.g., admission to the NICU), and The Neonatal Morbidity Scale (NMS; Minde et al., 1983) evaluated the presence and severity of health complications, including bradycardia, tachypnea, and whether twins were prohibited from feeding. These scales were completed using medical records collected from birth hospitals, and maternal perceived prenatal stress was assessed during the 12-month interview.

The 12-month assessment consisted of two, hour-long telephone or online interviews with the twins' primary caregiver. One doctoral student oversaw a team of five to eight undergraduate interviewers who were extensively trained in interviewing methodology. Bilingual research assistants also translated and back-translated the interviews into Spanish, and conducted interviews with Spanish-speaking participants.

As part of the first 12-month interview, primary caregivers answered detailed demographic and zygosity questionnaires, including questions assessing not only demographic characteristics, such as income, education, and racial or ethnic background, but also hours and days per week of in-home and out-of-home childcare, number of other adults in the home, and the country of origin of twins' primary caregiver and grandparents. Primary caregivers also reported on their twins' functioning in core developmental areas (e.g., motor, language, social), multiple dimensions of temperament, and twins' developmental competencies (e.g., social approach, imitative play) and internalizing, externalizing, and attentional problem behaviors.

The second 12-month interview assessed twins' regulation concerning sleep, eating, and sensory sensitivity, as well as several characteristics of the home and family environment, including chaos, emotional expressivity, and parenting-related stress and social and family support. In addition, multiple cognitive and behavioral aspects of parenting were assessed during the second interview, including emotional availability, parental warmth and control, overprotective and hostile behavioral tendencies, self-efficacy related to parenting, and bedtime routines. Finally, we assessed parental depression, and positive aspects of caregiver personality that serve as *resilience factors*: effortful control, empathy and perspective taking, self-compassion, optimism, personal mastery, and hope.

The 30-month follow-up assessment consisted of two, hour-long telephone or online interviews with the twins' primary caregiver when the twins were 30 months of age (adjusted for gestational age). Interviews were scheduled two weeks in advance and took place approximately a week apart. In addition, for families whose twins had indeterminate or missing zygosity questionnaires at 12 months, we scheduled zygosity interviews of approximately 15–20 min in length. Measures of child development and home and family environment carried over from the 12-month to the 30-month assessment include the assessments of chaos, social and family support, emotional availability, parenting daily hassles, parental depression, as well as twins' developmental maturity, problem behaviors, and competencies. New measures of twins' development introduced at 30 months include assessing the twins' general physical health, communication, and sense of self, positive affect, and additional dimensions of regulatory temperament. In addition, new measures of the home environment include parents' use of punitive and authoritative discipline, quality of stimulation and support available to twins in the home, and the number of hours and minutes per day twins spend being read to or looking at books, watching television, and being exposed to background television.

Table 1 lists completed assessments at 12 and 30 months. Demographic variables, such as ethnicity and number of adults and children in the home, are assessed at each occasion. All measures have been used in previous research and have acceptable levels of reliability and validity with Caucasian samples. Whenever possible, we used measures that have also been used with Hispanic samples.

https://doi.org/10.1017/thg.2012.107 Published online by Cambridge University Press

TABLE 1

Summary of Measures in the Arizona Twin Project

Construct	Measure	Reference	Occasion
Primary outcomes: social and emotional development			
Infant and toddler competencies	Infant Toddler Social and Emotional Assessment	Carter et al., 1999	12 months, 30 months
Prosocial behaviors			
Empathy			
Compliance			
Imitative play			
Motivation			
Communication and development of a sense of self	Ages and Stages Questionnaire	Bricker & Squires, 1999	30 months
Developmental maturity	Developmental Profile II	Alpern et al., 1986	12 months, 30 months
Physical maturity			
Self-help			
Social maturity			
Academic maturity			
Communication			
Temperament	Infant Behavior Questionnaire – revised	Gartstein & Rothbart, 2003	12 months
Duration of orienting			
Low intensity pleasure			
Soothability			
Activity level			
High-intensity pleasure			
Distress to limitations			
Distress to novelty			
Inhibitory control	Child Behavior Questionnaire – Short Form	Rothbart et al., 2001	30 months
Attentional focusing			
Soothability			
Smiling and laughter			
Impulsivity			
Distress to limitations			
Shyness			
Positive emotion	Positive and Negative Affect Schedule	Watson et al., 1988	30 months
Physical health	Health and Behavior Questionnaire	Armstrong et al., 2003	30 months
Behavior problems	Infant Toddler Social and Emotional Assessment	Carter et al., 1999	12 months, 30 months
Internalizing			
Externalizing			
Dysregulation			
Primary predictors:			
Prenatal and family context			
Prenatal environment	Obstetrical Complications Scale	Littman & Parmelee, 1974	Birth
Birth and neonatal environments	Neonatal Complications Scale	Pleasure et al., 1997	Birth
Stimulation, socio-emotional support and structure	Family Environment: HOME, short form	Caldwell & Bradley, 1979	30 months
Chaos in the home	Confusion, Hubbub, and Order Scale	Matheny et al., 1995	12 months, 30 months
Emotional expressivity	Self-Expressivity in the Family Questionnaire	Halberstadt et al., 1995	12 months
Media exposure	Hours watching TV, video games, computer		30 months
Parental resilience factors			
Positive parent personality			
Self-compassion	Self-Compassion Scale	Neff, 2003	12 months
Optimism	Life Orientation Test – revised	Scheier et al., 1994	12 months
Empathy	Interpersonal Reactivity Index	Davis, 1983	12 months
Hope	Herth Hope Scale	Herth, 1991	12 months
Personal mastery	Personal mastery	Pearlin & Schooler 1978	12 months
Social support	MOS Social Support Survey	Sherbourne & Stewart, 1991	12 months, 30 months
Family support	Family Support Scale	Dunst et al., 1984	12 months, 30 months
Parental health			
General health	Self-report of general health		12 months
Chronic illnesses	Coded from medical records		Birth
Depression	Center for Epidemiological Studies	Radloff, 1977	12 months, 30 months
Substance use and smoking	Coded from medical records		Birth
Parenting-related stressors	Parenting daily hassles	Crnic & Greenberg, 1990	12 months
Parenting			
Parental emotional availability	Emotional Availability Scale	Biringen & Robinson, 1991	12 months, 30 months
Parenting warmth & control	Child Rearing Practices Report	Block, 1965	12 months

https://doi.org/10.1017/thg.2012.107 Published online by Cambridge University Press

TABLE 1
Continued.

Construct	Measure	Reference	Occasion
Discipline strategies	Parental Responses to Child Misbehavior	Holden et al.,1995	30 months
Parental self-efficacy and Impact	Parental Cognitions Toward the Infant Scale	Boivin et al., 2005	12 months
Protective parenting behaviors	Parent Protection Scale	Thomasgard et al., 1995	12 months
Bedtime behavioral routines	Parental Interactive Bedtime Behavior Scale	Morrell & Cortina-Borja, 2002	12 months
Beliefs about infant sleep	Maternal cognitions about infant sleep	Morrell, 1999	12 months
Demographic characteristics			
Socioeconomic status	Family income, mother and father education		12 months, 30 months
Adults and children in home	Numbers of adults and children in the home		12 months, 30 months
Ethnicity and race	Primary caregiver report		12 months, 30 months
Generation	Country of origin of primary caregiver and primary caregiver's parents		
Childcare and preschool	Type and hours per day and days per week spent in childcare and/or preschool		12 months, 30 months
Zygosity	Zygosity Questionnaire for Young Twins	Goldsmith, 1991	12 months, 30 months
	Placentation lab report from medical records		

Preliminary Findings

We have begun to analyze data and below we highlight findings in three key domains: problem behaviors, health behaviors, and prenatal-birth environments.

Parenting and Infant Problem Behaviors

Positive parent personality may increase emotional availability (related to infant attachment security), which is protective for children's problem behaviors. We examined emotional availability as a mediator between maternal positive personality and infant problem behaviors (O'Brien et al., 2011). Using multilevel modeling to account for twin dependence, the mediated effect was significant, with positive personality relating negatively to infant problem behaviors, but not when accounting for emotional availability. Positive personality related positively to emotional availability, and emotional availability related negatively to infant problem behaviors. Furthermore, infant problem behaviors were moderately heritable ($h^2 = 0.36$), whereas maternal emotional availability was largely environmental ($h^2 = 0.10$). Emotionally available parents communicate an atmosphere of warmth and acceptance toward their children (Biringen & Robinson, 1991), a process through which parent positive personality may protect children from developing problem behaviors.

Heritability of Toddlers' Behavior Problems Varies by Early Parental Warmth

A lack of parental warmth and harsh verbal and physical punishment have been associated with childhood problem behaviors (McKee et al., 2007). Using Purcell's (2002) moderated ACE model, parental warmth in infancy significantly moderated the A and E paths such that heritability increased as parental warmth increased (Swann et al., 2012). Thus, problem behaviors are more heritable under optimal warm parenting conditions, whereas the environment has a larger impact when caregivers are more rejecting of their young children.

Protecting Infant Sleep

An estimated 25–41% of children aged 1 to 5 years do not get enough sleep (Lam et al., 2003), which is a major concern because early sleep difficulties are a strong predictor of later sleep problems, as well as behavioral and emotional problems (Gregory & O'Conner, 2002; Morrell & Steele, 2003; Wolke et al., 1995). Our goal was to examine three possible protective factors for infant sleep: parental optimism, parenting cognitions, and bedtime routines (Drake et al., 2010). First, infant sleep dysregulation was only modestly heritable ($h^2 = 0.22$). Next, we used multilevel modeling to test process models: both parenting cognitions and bedtime behaviors mediated the relation between parent optimism and infant sleep dysregulation. Optimistic parents may have infants who sleep better because of their positive cognitions and bedtime routines.

Temperament Predicts Infant Feeding Difficulties

Difficulties with feeding are one of the most common problems that occur in pediatrics, and in addition to being concurrently associated with higher behavior problems (Budd et al., 1992), severe or untreated feeding problems may lead to malnourishment or micronutrient deficiency (Chatoor, 2002), which are in turn risk factors for faltering growth, and cognitive problems (Branca & Ferrari, 2002; Reif et al., 1995). Using multilevel modeling, we found that proneness to anger, rate of recovery from distress, and duration of orienting all predicted feeding difficulties (Jeon et al., 2010). Furthermore, heritability of eating difficulties was non-significant, indicating that the associations with temperament were likely environmental in nature.

https://doi.org/10.1017/thg.2012.107 Published online by Cambridge University Press

Heritability of Infant Outcomes Varies by Obstetrical and Birth Conditions

We examined whether or not prenatal and obstetrical environmental conditions moderated the heritability of infant outcomes (McDonald, 2011). Maternal perceived prenatal stress and obstetrical complications (coded from medical records) moderated the heritability of infant developmental maturity and competence, while gestational age moderated the heritability of infant developmental maturity, dysregulation, and competence. Thus, obstetrical and birth conditions may be important nonlinear influences on infant outcomes.

These preliminary findings suggest the importance of early environmental conditions for infant health, development, and adjustment, both directly and as moderators of the expression of heritable traits. However, many models central to the Arizona Twin Project's primary aims have yet to be tested with the existing data, that is, components of resilience as moderators of the relations between environmental risks and negative outcomes. In addition, we have yet to consider self-regulation as a potential mediator or moderator of early environmental conditions and children's competency, or as a predictor of resilience under conditions of environmental risk. Testing these models, and examining predictors of recovery from health or behavioral problems between 12 and 30 months, both represent immediate next steps for the Arizona Twin Project.

Future Directions

Currently we are seeking funding for a third longitudinal assessment of the sample focused on the social environments, behaviors, and physiological processes that influence sleep and other health behaviors. Because of the widespread prevalence of sleep problems (25–40% for all ages, with 6% qualifying for a diagnosis of insomnia; Barclay et al., 2011; Ferber, 1995; Sadeh et al., 2000), and early sleep problems strongly predicting later sleep problems and disorders (Gregory & O'Connor, 2002), it is important to explicate their etiology and identify targets of preventive interventions. The new assessment includes day-to-day objective measures of sleep, artificial light exposure, physical activity, and diurnal cortisol, as well as diary assessment of mood, diet, and health behaviors to elucidate genetic and environmental mediation of dynamic bidirectional processes that characterize relations between the social environment and sleep. By focusing on the early social environment within a longitudinal twin study design, the proposed study elucidates social processes by which children develop healthy sleep habits that serve to promote physical and mental health.

We plan to add additional participants to the Arizona Twin Project by recruiting additional twin pairs through birth records from the same birth cohorts. There is also the opportunity to add additional birth cohorts to the sample as opportunities arise.

Conclusion

The Arizona Twin Project is a new twin panel that will likely increase in size and research focus. Twins were recruited through birth records, with significant representation of Mexican American, as well as European American participants. Multiple aspects of the prenatal, birth, infancy, and toddler environments have been assessed, creating an opportunity to study both genetic and environmental contributions to the development of resilience, and physical and mental health. In addition, our extensive phenotyping is ideal for addressing gene–environment interplay, such as gene–environment correlation, and moderation of heritability.

Acknowledgments

This research was supported by grants from the Institute for Mental Health Research and Arizona State University's Challenged Child Project and T. Denny Sanford School of Social and Family Dynamics.

References

Alpern, G., Boll, T., & Shearer, M. (1986). *Developmental Profile II manual.* Los Angeles, CA: Western Psychology Associates.

Armstrong, J. M., Goldstein, L. H., & The MacArthur Working Group on Outcome Assessment. (2003). *Manual for the MacArthur Health and Behavior Questionnaire (HBQ 1.0).* Pittsburgh, PA: MacArthur Foundation Research Network on Psychopathology and Development, University of Pittsburgh (David J. Kupfer, Chair).

Barclay, N. L., Eley, T. C., Rijsdijk, F. V., & Gregory, A. M. (2011). Dependent negative life events and sleep quality: An examination of gene-environment interplay. *Sleep Medicine, 12*, 403–409. doi: 10.1016/j.sleep.2010.09.009

Biringen, Z., & Robinson, J. (1991). Emotional availability in mother-child interactions: A reconceptualization for research. *American Journal of Orthopsychiatry*, *61*(2), 258–271. doi: 10.1037/h0079238

Block, J. H. (1965). *The child rearing practices report.* Berkeley, CA: Institute of Human Development, University of California.

Boivin, M., Pérusse, D., Dionne, G., Saysset, V., Zoccolillo, M., Tarabulsy, G. M., . . . Tremblay, R. E. (2005). The genetic-environmental etiology of parents' perceptions and self-assessed behaviours toward their 5-month-old infants in a large twin and singleton sample. *Journal of Child Psychology and Psychiatry*, *46*(6), 612–630. doi: 10.1111/j.1469-7610.2004.00375.x

Branca, F., & Ferrari, M. (2002). Impact of micronutrient deficiencies on growth: The stunting syndrome. *Annals of Nutrition and Metabolism*, *46*(1), 8–17. doi: 10.1159/000066397

Bricker, D., & Squires, J. (1999). *Ages and stages questionnaire (ASQ)* (2nd ed.). Baltimore, MD: Brookes.

Briggs-Gowan, M. J., Carter, A. S., Bosson-Heenan, J., Guyer, A. E., & Horwitz, S. M. (2006). Are infant-toddler social-emotional and behavioral problems transient? *Journal of*

the American Academy of Child and Adolescent Psychiatry, *45*(7), 849–858. doi: 10.1097/01.chi.0000220849.48650.59

Briggs-Gowan, M. J., Carter, A. S., Skuban, E. M., & Horowitz, S. M. (2001). Prevalence of social-emotional and behavioral problems in a community sample of 1- and 2-year-old children. *Journal of the American Academy of Child and Adolescent Psychiatry*, *40*, 811–819. doi: 10.1097/00004583-200107000-00016

Budd, K. S., McGraw, T. E., Farbisz, R., Murphy, T. B., Hawkins, D., Heilman, N., & Werle, M. (1992). Psychosocial concomitants of children's feeding disorders. *Journal of Pediatric Psychology*, *17*(1), 81–94. doi: 10.1093/jpepsy/17.1.81

Caldwell, B., & Bradley, R. (1979). Home observation for measurement of the environment: A revision of the preschool scale. *American Journal of Mental Deficiency*, *84*, 235–244.

Campbell, S. B. (1995). Behavior problems in preschool children: A review of recent research. *Journal of Child Psychology and Psychiatry*, *36*, 113–149. doi: 10.1111/j.1469-7610.1995.tb01657.x

Carter, A. S., Little, C., Briggs-Gowan, M. J., & Kogan, N. (1999). The infant-toddler social and emotional assessment (ITSEA): Comparing parent rating to laboratory observations of task mastery, emotion regulation, coping behaviors and attachment status. *Infant Mental Heath Journal*, *4*, 375–392. doi: 10.1002/(SICI)1097-0355(199924)20:4<375::AID-IMHJ2>3.0.CO;2-P

Chatoor, I. (2002). Feeding disorders in infants and toddlers: Diagnosis and treatment. *Child and Adolescent Psychiatric Clinics of North America*, *11*, 163–183. doi: 10.1016/S1056-4993(01)00002-5

Crnic, K. A., & Greenberg, M. T. (1990). Minor parenting stresses with young children. *Child Development*, *61*(5), 1628–1637. doi: 10.1111/j.1467-8624.1990.tb02889.x

Davis, M. H. (1983). Measuring individual differences in empathy: Evidence for a multidimensional approach. *Journal of Personality and Social Psychology*, *44*, 113–126. doi: 10.1037/0022-3514.44.1.113

Drake, L., O'Brien, T. C., McDonald, K., Valiente, C., & Lemery-Chalfant, K. (2010, March 11–14). *Parent characteristics, cognitions, and behaviors as predictors of infant sleep difficulties.* Proceedings of the International Conference on Infant Studies, Baltimore, MD.

Dunst, C. J., Jenkins, V., & Trivette, C. M. (1984). The Family Support Scales: Reliability and validity. *Health Perspectives*, *1*, 45–52.

Egger, H. L., & Angold, A. (2006). Common emotional and behavioral disorders in preschool children: Presentation, nosology, and epidemiology. *Journal of Child Psychology and Psychiatry*, *47*, 313–337. doi: 10.1111/j.1469-7610.2006.01618.x

Ferber, R. (1995). Assessment of sleep disorders in the child. In R. Ferber & M. Kryger (Eds.), *Principles and practice of sleep medicine in the child* (pp. 45–53). Philadelphia, PA: WB Saunders.

Forget-Dubois, N., Perusse, D., Turecki, G., Girard, A., Billette, J., Rouleau, G. ... Tremblay, R. E. (2003). Diagnosing zygosity in infant twins: Physical similarity, genotyping, and chorionicity. *Twin Research*, *6*, 479–485. doi: 10.1375/136905203322686464

Fox, S. E., Levitt, P., & Nelson, C. A. (2010). How the timing and quality of early experiences influence the development of brain architecture. *Child Development*, *81*, 28–40. doi: 10.1111/j.1467-8624.2009.01380.x

Gartstein, M., & Rothbart, M. K. (2003). Studying infant temperament via the Revised Infant Behavior Questionnaire. *Infant Behavior & Development*, *26*, 64–68. doi: 10.1016/S0163-6383(02)00169-8

Goldsmith, H. H. (1991). A zygosity questionnaire for young twins: A research note. *Behavior Genetics*, *21*, 257–269. doi: 10.1007/BF01065819

Gregory, A., & O'Connor, T. G. (2002). Sleep problems in childhood: A longitudinal study of developmental change and association with behavioral problems. *Journal of the American Academy of Child and Adolescent Psychiatry*, *41*, 964–971. doi: 10.1097/00004583-200208000-00015

Halberstadt, A., Cassidy, J., Stifer, C., Parke, R., & Fox, N. (1995). Self-expressiveness within the family context: Psychometric support for a new measure. *Psychological Assessment*, *7*, 93–103. doi: 10.1037/1040-3590.7.1.93

Herth, K. (1991). Development and refinement of an instrument to measure hope. *Scholarly Inquiry for Nursing Practice: An International Journal*, *5*, 39–56.

Holden, G. W., Coleman, S., & Schmidt, K. (1995). Why 3-year-old children get spanked: Parent and child determinants as reported by college-educated mothers. *Merrill-Palmer Quarterly*, *41*, 431–452.

Jeon, S., O'Brien, T. C., McDonald, K., Valiente, C., & Lemery-Chalfant, K. (2010, March 11–14). *Temperament and self-regulation in infant feeding difficulties.* Proceedings of the International Conference on Infant Studies, Baltimore, MA.

Keenan, K., Shaw, D., Delliquadri, E., Giovanelli, J., & Walsh, B. (1998). Evidence for the continuity of early problem behaviors: Application of a developmental model. *Journal of Abnormal Child Psychology*, *26*, 441–454. doi: 10.1023/A:1022647717926

Lam, P., Hiscock, H., & Wake, M. (2003). Outcomes of infant sleep problems: A longitudinal study of sleep, behavior and maternal well-being. *Pediatrics*, *111*(3), 203–207. doi: 10.1542/peds.111.3.e203

Lemery-Chalfant, K. (2010). How genes and environments work together to promote resilience. In J. Reich, A. J. Zautra, & J. S. Hall (Eds.), *Handbook of adult resilience* (pp. 55–80). New York, NY: Guilford.

Littman, B., & Parmalee, A. H. (1974). *Manual for obstetrical complications.* Los Angeles, CA: Department of Pediatrics, University of California at Los Angeles (UCLA).

Matheny, A. P., Wachs, T. D., Ludwig, J. L., & Phillips, K. (1995). Bringing order out of chaos – psychometric characteristics of the Confusion, Hubbub, and Order scale. *Journal of Applied Developmental Psychology*, *16*, 429–444. doi: 10.1016/0193-3973(95)90028-4

McDonald, K. (2011). Links between prenatal stress and obstetrical complications and infant behavior: A twin design. Unpublished doctoral dissertation, Arizona State University.

McKee, L., Roland, E., Coffelt, N., Olson, A. L., Forehand, R., Massari, C., ... Zens, M. S. (2007). Harsh discipline and child problem behaviors: The role of positive parenting and gender. *Journal of Family Violence*, *22*, 187–196. doi: 10.1007/s10896-007-9070-6

Minde, K., Whitelaw, A., Brown, J., & Fitzhardinge, P. (1983). Effect of neonatal complications in premature infants on early parent-infant interactions. *Developmental Medicine and Child Neurology*, *6*, 763–777. doi: 10.1111/j.1469-8749.1983.tb13845.x

Moffitt, T. E., Arsenault, L., Belsky, D., Dickson, N., Hancox, R. J., Harrington, H. ... Caspi, A. (2011). A gradient of childhood self-control predicts health, wealth and public safety. *Proceedings of the National Academy of Sciences*, *108*(7), 2693–2698. doi: 10.1073/pnas.1010076108

Morrell, J. (1999). The role of maternal cognitions in infant sleep problems as assessed by a new instrument, the Maternal Cognitions about Infant Sleep Questionnaire. *Journal of Child Psychology and Psychiatry*, *40*, 247–258. doi: 10.1111/1469-7610.00438

Morrell, J., & Cortina-Borja, M. (2002). The developmental change in strategies parents employ to settle young children to sleep, and their relationship to infant sleeping problems, as assessed by a new questionnaire: The parental interactive bedtime behaviour scale. *Infant and Child Development*, *11*, 17–41. doi: 10.1002/icd.251

Morrell, J., & Steele, H. (2003). The role of attachment security, temperament, maternal perception, and care-giving behavior in persistent infant sleeping problems. *Infant Mental Health Journal*, *24*, 447–468. doi: 10.1002/imhj.10072

Neff, K. (2003). Development and validation of a scale to measure self-compassion. *Self and Identity*, *2*, 223–250. doi: 10.1080/15298860309027

O'Brien, T. C., Kao, K., Valiente, C., & Lemery-Chalfant, K. (2011, March 31–April 2). *Happy parents have happy babies: Positive parent personality, emotional availability, and infant problem behaviors.* Paper presented at the 2011 Biennial Meeting of the Society for Research in Child Development, Montreal, Canada.

Pearlin, L. I., & Schooler, C. (1978). The structure of coping. *Journal of Health and Social Behavior*, *19*, 2–21.

Pleasure, J., Gennaro, S., Cnaan, A., & Wolf, F. (1997). An expanded neonatal morbidity scale for premature infants. *Journal of Nursing Measurement*, *5*, 119–138.

Price, T. S., Freeman, B., Craig, I. W., Petrill, S. A., Ebersole, L., & Plomin, R. (2000). Infant zygosity can be assigned by parental report questionnaire data. *Twin Research*, *3*, 129–133. doi: 10.1375/twin.3.3.129

Purcell, S. (2002). Variance components models for gene–environment interaction in twin analysis. *Twin Research*, *5*, 554–571. doi: 10.1375/twin.5.6.554

Radloff, L. S. (1977). The CES-D Scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement*, *1*, 385–401. doi: 10.1177/014662167700100306

Reif, S., Beler, B., Villa, Y., & Spirer, Z. (1995). Long-term follow-up and outcome of infants with non-organic failure to thrive. *Israel Journal of Medical Sciences*, *31*, 483–489.

Rothbart, M. K., Ahadi, S. A., Hershey, K. L., & Fisher, P. (2001). Investigations of temperament at three to seven years: The Children's Behavior Questionnaire. *Child Development*, *72*, 1394–1408. doi: 10.1111/1467-8624.00355

Sadeh, A., Raviv, A., & Gruber, R. (2000). Sleep patterns and sleep disruptions in school-age children. *Developmental Psychology*, *36*, 291–301. doi: 10.1037/0012-1649.36.3.291

Scheier, M. F., Carver, C. S., & Bridges, M. W. (1994). Distinguishing optimism from neuroticism (and trait anxiety, self-mastery, and self-esteem): A re-evaluation of the Life Orientation Test. *Journal of Personality and Social Psychology*, *67*, 1063–1078.

Sherbourne, C. D., & Stewart, A. L. (1991). The MOS Social Support Survey. *Social Science and Medicine*, *32*, 705–714. doi: 10.1016/0277-9536(91)90150-B

Shonkoff, J. P., & Phillips, D. A. (2000). *From neurons to neighborhoods: The science of early childhood development*. Washington, DC: National Academy Press.

Silk, J. S., Vanderbilt-Adriance, E., Shaw, D. S., Forbes, E. E., Whalen, D. J., Ryan, N. D., & Dahl, R. E. (2007). Resilience among children and adolescents at risk for depression: Mediation and moderation across social and neurobiological contexts. *Development and Psychopathology*, *19*, 841–865. doi: 10.1017/S0954579407000417

Swann, G., Araica, E., O'Brien, T. C., Kao, K., Valiente, C., & Lemery-Chalfant, K. (2012). Impact of early parental warmth and concurrent punitive discipline on the heritability of young children's problem behaviors. *Behavior Genetics* (abstract).

Thomasgard, M., Metz, P., Edelbrock, C., & Shonkoff, J. (1995). Parent-child relationship disorders. Part I. Parental overprotection and the development of the Parental Protection Scale. *Journal of Developmental & Behavioral Pediatrics*, *16*, 244–250.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology*, *54*, 1063–1070. doi: 10.1037/0022-3514.54.6.1063

Wolke, D., Meyer, R., Ohrt, B., & Riegel, K. (1995). Co-morbidity of crying and feeding problems with sleeping problems in infancy: Concurrent and predictive associations. *Early Development and Parenting*, *4*, 191–207. doi: 10.1002/edp.2430040405

https://doi.org/10.1017/thg.2012.107 Published online by Cambridge University Press