

ANNOTATED BIBLIOGRAPHY

THE EFFECTIVENESS OF EARLY INTERVENTION SERVICES

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Bedi, K.S. (1989). The combined effects of unilateral enucleation and rearing in a dim red light on synapse-to-neuron ratios in the rat visual cortex. *Journal of Anatomy*, 167, 71-84.

- An empirical investigation of the effects of dark rearing and unilateral enucleation (i.e. removal of one eye) on the synapse-to-neuron ratios in the visual cortex indicated a 30-35% decrease in synaptic density of dark-reared, non-enucleated rats as compared to light reared, non-enucleated rats. There were no differences observed due to enucleation. Thus, light stimulation from the environment is important in establishing normal interneuronal connectivity in the visual cortex, while the effects on synaptic density of having one eye removed are minimal.

Brooks-Gunn, J., Klebanov, P.K., Liaw, F. & Spiker, D. (1993). Enhancing the development of low birth weight, premature infants: Changes in cognition and behavior over the first three years. *Child Development*, 64, 736-753.

- The Infant Health and Development Program tested the impact of educational and family support services and pediatric follow-up offered in the first 3 years of life on the development of 985 children in a randomized clinical trial. Compared to the control group, the intervention group showed significant increases in cognitive scores on Bayley Scales of Infant Development at 2 years old and again at 3 years using the Stanford-Binet IQ Test ($\Delta M = 9.53$). The intervention was more efficacious for children with higher initial problem behavior.

Calderon, R. & Greenberg, M. (1997). The effectiveness of early intervention for deaf children and children with hearing loss. In M.J. Guralnick (Ed.), *The effectiveness of early intervention*, (pp. 455 – 482). Baltimore, MD: Paul H. Brookes Publishing Co.

- The authors reviewed research on the effect of early intervention on the development of children with hearing impairments. One study by Strong and colleagues (1992) indicated that a parent-administered, home-based intervention was related to an improvement in receptive and expressive language over what maturation would predict, and a developmental rate that was 1.8 times the pre-intervention rate.

Chugani, H.T. (1998). A critical period of brain development: Studies of cerebral glucose utilization with PET. *Preventive Medicine*, 27, 184-188.

- Studies with positron emission tomography (PET) indicate that the brain's rate of glucose utilization rises from birth until about age 4, when metabolic rate

reaches two times that of an adult. These high rates are maintained until around 10 years, and then there is a gradual decline to adult levels at 16 to 18 years of age. This pattern correlates with rates of synapse formation and supports the idea of critical periods for maximal learning capacity.

Committee on Children with Disabilities Policy Statement (1994). Screening infants and young children for developmental disabilities. *Pediatrics*, 93(5), 863 – 65.

- Discussing skills, procedures, the screening process, and the importance of screening young children for developmental delays, the committee concluded that early identification of children with disabilities through screening can lead to effective therapies that may reverse or ameliorate conditions and improve family functioning.

Crnic, K.A. & Greenberg, M.T. (1990). Minor parenting stresses with young children. *Child Development*, 61, 1628 – 1637.

- The influence of major life stress and minor daily hassles of parenting on 74 mother-infant dyads was examined when the 34 pre-term and 70 full-term infants were 5 years old. Life stress was negatively related to child social competence and parenting daily hassles were related to child behavior problems. The effects of stress on maternal interaction styles were buffered by friendship, community, and intimate support.

Crnic, K.A., Greenberg, M.T., & Slough, N.M. (1986). Early stress and social support influences on mothers' and high-risk infants' functioning in late infancy. *Infant Mental Health Journal*, 7(1), 19 – 33.

- The interactions of stress and social support on mother-infant interactions and infant behavior for pre-term, very low birth-weight infants were examined when the infants were 8 and 12 months old. Higher stress reduced positive maternal affect and dyadic synchrony and was also related negatively to child socio-emotional behavior. Professional, intimate, and community support were positively related to maternal affect; intimate and community support improved mother-infant interactions; and community support was related to better infant behavior and language use.

Crnic, K.A., Greenberg, M.T., Ragozin, A.S., Robinson, N.M., & Basham, R.B. (1983). Effects of stress and social support on mothers and premature and full-term infants. *Child Development*, 54, 209 – 217.

- Authors examined the effects of stress and social support on mothers when infants were 1 month on mother-infant interactions at 4 months, and pre-term infants were compared to full-term infants and their mothers. Intimate support had a positive relation to mother's positive affect, and there was a trend for community support to improve mother's social-emotional-growth fostering and mothers' sensitivity to cues. Intimate and friendship support also buffered the effect of stress on infant socio-emotional behavior.

Dunst, C.J., Trivette, C.M., & Jodry, W. (1997). Influences of social support on children with disabilities and their families. In M.J. Guralnick (Ed.), *The Effectiveness of early intervention* (pp. 499 – 522). Baltimore, MD: Paul H. Brookes Publishing Co.

- Reviewing evidence from first generation and contemporary, or second generation, research on the role of social support in early intervention, the authors discussed flaws, posed questions about the former research, and presented more rigorous data from the latter. In general, depending on source of support and child and family characteristics, data have shown that social support has a positive effect on families. The authors concluded that social support functions as early intervention.

Dunst, C.J. & Trivette, C.M. (1988). Toward experimental evaluation of the family, infant and preschool program. (pp. 315 – 346). In H. Weiss & F. Jacobs (Eds.) *Evaluating preschool programs*. Aldine De Gruyter: NY.

- The authors reviewed evaluation research on the Family, Infant, and Preschool Program for children with or at risk for delays and their families. Maternal interaction styles were related positively to children's development. Maternal psychological, emotional, and physical health were related positively to maternal interaction styles. Informal social support positively affected child behavior and development in their research, but other research reports little or differential effects. Taken together, the evidence suggested that support has an indirect effect on child behavior

Greenough, W.T., Black, J.E., & Wallace, C. (1987). Experience and brain development. *Child Development*, 58, 539-559.

- Reviewing neurological and psychological research, the authors advanced the idea that experience effects neurological structure through two mechanisms: experience-expectant, which can be described as a biologically driven overproduction of synapses which prepares the brain to receive information from the environment, followed by the elimination of synapses that are not stimulated by environmental experience; and experience-dependent, which involves the active formation of synapses in response to the experience which is to be stored. Although these mechanisms are probably not mutually exclusive, they provide a better description of the neural processes involved in learning and can explain both the accelerated learning ability of infants and children, and the ability for adults to learn and for victims of brain injury to recover.

Gunnar, M.R. (1996, December). *Quality of care and the buffering of stress physiology: Its potential role in protecting the developing brain*. Paper presented at the National center for Clinical Infant Programs Conference, Washington, D.C.

- This paper discussed an example of the brain's ability to change with experience in the functioning of the hypothalamic-pituitary-adrenocortical (HPA) system. Stressful experiences stimulate this system, which produces cortisol, a hormone which facilitates neural death and synapse elimination; chronic stimulation can cause shrinkage of brain areas like the hippocampus

(memory), impair selective attention, and ultimately cause the HPA to remain overactive, resulting in hypervigilant, anxious behavior. The HPA system is buffered through secure interpersonal relationships with caregivers, suggesting a method of dampening the deleterious effects of stress on neurological development.

Guralnick, M.J. (1989). Recent developments in early intervention efficacy research: Implications for family involvement in P.L. 99-457. *Topics in Early Childhood Special Education, 9(3)*, 1 – 17.

- Describing recent investigations on the effectiveness of family involvement in early intervention, focusing on children with different delays or at risk for delays, the author concluded that future research must investigate the various facets of family involvement, current developmental principles established by research should be translated into practice, and research should be more rigorous. Implications for the implementation of P.L. 99-457 are also discussed.

Haber, J. (1991). Early diagnosis and referral of children with developmental disabilities. *American Family Physician, 43(1)*, 132 – 140.

- The author discussed prevalence of developmental disabilities and risk for such disabilities, as well as recent legislation, P.L. 99-457, which created programs for providing early intervention. Since a physician's knowledge of the family can be essential in providing the best services, the author presented a practical, four-stage approach to primary care participation in identification, referral, and follow-up of developmentally delayed children.

Hulme, J.B., Shaver, J., Acher, S., Mullette, L., & Eggert, C. (1987). Effects of adaptive seating devices on the eating and drinking of children with multiple handicaps. *American Journal of Occupational Therapy, 41(2)*, 81 – 85.

- Sitting posture, head alignment, and food/fluid retention were examined for 11 children with multiple handicaps, most notably cerebral palsy. All of these factors improved significantly with the use of an adaptive seating device. The children were also included during family meal-times more than they had been before using the adaptive seating device, providing social and language stimulation for the children.

Huttenlocher, P.R. (1994). Synaptogenesis, synapse elimination, and neural plasticity in human cerebral cortex. In C.A. Nelson (Ed.), *Threats to Optimal Development: Integrating Biological, Psychological, and Social Risk Factors. The Minnesota Symposia in Child Psychology* (pp. 35-54), Vol. 27. Moffat Place, South Africa: The Analytic Press.

- Evidence from several lines of research on brain development has indicated that genes signal for the creation and migration of most cortical neurons before the child is born. After birth, genes code for the proliferation of connections between neurons, peaking at twice adult levels between 1 and 3 years of age, depending on the cortical region, before slowly declining to adult

levels in adolescence. Which circuits will persist depends upon sensory experience from the environment, and synapse formation is directly linked to the emergence of skills and behaviors. The increased functional plasticity of infants' and young children's brains may result in increased efficacy of education on cognitive development during this period, and also account for the remarkable recovery of ability after brain injuries sustained early in life.

Infant Health and Development Program (1990). Enhancing the outcomes of low-birth-weight, premature infants: A multisite, randomized trial. *Journal of the American Medical Association*, 263(22), 3035 – 3042.

- The Infant Health and Development Program tested the impact of educational and family support services and pediatric follow-up offered in the first 3 years of life on the development of 985 children in a randomized clinical trial. Compared to the control group, the intervention group showed significant increases in cognitive scores on Bayley Scales of Infant Development were seen at 2 years old and again at 3 years using the Stanford-Binet IQ Test ($\Delta M = 9.53$). The intervention was twice as effective for children with birth-weights from 2001 – 2005 grams than for children with birth-weights below 2001 grams.

Kupfermann, I. (1991). Hypothalamus and limbic system: Peptidergic neurons, homeostasis, and emotional behavior. In E.R. Kandel, J.H. Schwartz, & T.M. Jessell (Eds.), *Principles of Neural Science* (3rd ed., pp. 735-749). New York, NY: Elsevier.

- The author examined the anatomy of the hypothalamus and limbic system and discussed of the role of this system in regulating endocrine and autonomic systems and emotional behavior. Studies have indicated that the limbic system undergoes structural and biochemical changes in response to behavioral demands, for example, neuronal degeneration occurs in response to chronically circulating hormones which are released in response to stress.

Leib, S.A., Benfield, D.G., & Guidubaldi, J. (1980). Effects of early intervention and stimulation on the preterm infant. *Pediatrics*, 66(1), 83 – 90.

- The effects of an enrichment program compared to traditional care were examined for 28 premature infants in the NICU. Infants in the enrichment intervention group scored significantly higher than infants in the traditional care control group on both mental and physical scales of the BSID. These differences remained after controlling for initial differences between enrichment and control groups on a measure of interactive processes.

Lovaas, O.I. (1987). Behavioral treatment and normal educational and intellectual functioning in young autistic children. *Journal of Consulting and Clinical Psychology*, 55(1), 3 – 9.

- Children with autism who were enrolled in an intensive behavioral modification treatment at 40 months of age for 2 or more years were compared to children who received less intensive treatment or no behavioral treatment. Between 6 and 7 years of age, the experimental group had a higher level of educational placement and higher IQs than the control groups, who did not differ from one another. Nine

children in the experimental group (47%) were in regular education classes and had IQs at or above average, compared to 1 child (2%) in both control groups. Only 2 children (10%) in the experimental group were profoundly mentally retarded and in specialized classes, while 21 (53%) of the children in the control groups were profoundly mentally retarded and in specialized classes.

MacTurk, R.H., Meadow-Orlans, K.P., Koester, L.S., & Spencer, P.E. (1993). Social support, motivation, language, and interaction. *Annals of the Deaf, 138*, 19 – 25.

- The interactions of 20 hearing mothers and their deaf children and 20 hearing mothers and hearing children were compared when the children were between 3 and 18 months old. Mothers with hearing children exhibited greater maternal responsiveness at 9 months than mothers of deaf children. At 18 months, mother-deaf infant interactions were more dissynchronous than interactions of mothers and hearing infants. The relationship between maternal interaction styles and child socio-emotional and cognitive development were also discussed.

Martin, S.L., Ramey, C.T., & Ramey, S. (1990). The prevention of intellectual impairment in children of impoverished families: Findings of a randomized trial of educational day care. *American Journal of Public Health, 80(7)*, 844 – 847.

- Eighty-six families with low maternal IQ and education level were followed in a randomly allocated, longitudinal study of the effects on child IQ. Forty-one of these children were classified as having a more stimulating home environment. By 54 months, these children scored an average of 7.9 points higher on the McCarthy Scales of Children's Ability than children from less stimulating homes, controlling for maternal IQ and participation in educational day care.

McEachin, J.J, Smith, T., & Lovaas, O.I. (1993). Long-term outcome for children with autism who received early intensive behavioral treatment. *American Journal on Mental Retardation, 97(4)*, 359 – 372.

- A long-term follow-up of children with autism who participated in the behavioral modification quasi-experimental study by Lovaas (1987), this study revealed that the experimental group continued to be placed in regular education and to have IQ scores in the normal range and to exhibit behavior typical of their peers, whereas control group children continued to require extensive special education services.

McLean, L.K. & Cripe, J.W. (1997). The effectiveness of early intervention for children with communication disorders. In M.J. Guralnick (Ed.), *The effectiveness of early intervention* (pp. 349 – 428). Baltimore, MD: Paul H. Brookes Publishing Co.

- The authors reviewed 56 studies on the effect of early intervention on language development. Although the studies exhibited varying results and presented varying methodological limitations, they concluded that early intervention for different communication disorders can be very effective in eliminating or mitigating the level of delay.

Meadow-Orlans, K.P. & Steinberg, A.G. (1993). Effects of infant hearing loss and maternal support on mother–infant interactions at 18 months. *Journal of Applied Developmental Psychology, 14*, 407 – 426.

- In a study of the interactions of mothers and 20 hearing infants compared to 20 deaf infants at 18 months, the data indicated that mothers of deaf infants were significantly less likely to exhibit positive maternal interaction styles. Results corroborated those of MacTurk and associates (1993), indicating dissynchronous interactions were more common in hearing-deaf dyads than in hearing-hearing dyads.

Meins, E., Fernyhough, C. Fradley, E., & Tuckey, M. (2001) Rethinking maternal sensitivity: Mothers' comments on infants mental processes predict security of attachment at 12 months. *Journal of Child Psychology and Psychiatry, 42(5)*, 637-648.

- This study investigated predictors of attachment security in a play context using a sample of 71 mothers and their 6-month-old infants. In attempting to rethink the concept of maternal sensitivity by focusing on mothers' ability accurately to read the mental states governing infant behavior, five categories were devised. The fifth, mothers' appropriate mind-related comments, assessed individual differences in mothers' proclivity to comment appropriately on their infants' mental states and processes. Higher scores in this fifth category related to a secure attachment relationship at 12 months.

Palmer, F.B., Shapiro, B.K., Wachtel, R.C., Allen, M.C., Hiller, J.E., Harryman, S.E., et al. (1988). The effects of physical therapy on cerebral palsy. *The New England Journal of Medicine, 318(13)*, 803 – 808.

- The effects of two types of therapy on motor and cognitive development were examined for children aged 12-19 months with spastic diplegia cerebral palsy. Twenty-five children received 12 months of neurodevelopmental physical therapy (NDT), and 23 received 6 months of infant stimulation followed by 6 months of NDT. Evaluation after the first 6 months of the programs indicated children receiving infant stimulation performed better on motor and mental areas. This difference persisted at twelve months on the motor skills but not for mental skills. The authors proposed that infant stimulation may benefit motor performance for children with cerebral palsy, but this benefit declines with withdrawal of stimulation.

Perry, B., & Azad, I. (1999). Posttraumatic stress disorder in children and adolescents. *Current Opinion in Pediatrics, 11*, 310-316.

- Over 30% of children exposed to traumatic experiences develop posttraumatic stress disorder, which can lead to depression, suicidal behavior, alcoholism, organic disease, and poor health as an adult, to name but a few. Trauma alters the structure and functioning of the limbic system, causing damage to memory and circuits linking brain to body, and decreased emotional regulatory capacity. A self-promoting negative cycle can ensue leading to additional physical, cognitive, and emotional pathology, which is not likely to remit without treatment. Four

treatment approaches were described in this article, along with the idea of resiliency to the noxious effects of trauma on the nervous system afforded by a secure relationship with a caregiver.

Porter, F.L., Grunau, R.E., & Anand, K.J. (1999). Long-term effects of pain in infants. *Journal of Developmental Behavioral Pediatrics, 20(4)*, 253-261.

- The growing body of evidence that early pain and stress have long-term effects on human neural development was examined. The explosion of synapse formation in the early postnatal period makes the brain most plastic and provides a critical period that maximizes environmental influence on the brain, and therefore on subsequent behavior. Repetitive exposure to stress early in life causes structural and functional change in the developing nervous system which can lead to anxiety, depression, hyper-responsivity to pain and stress, cognitive deficits, morbidity, and early mortality. The provision of pain-management could be an important buffer for the deleterious effects of early pain and stress on neural development.

Raval, V., Goldberg, S., Atkinson, L., Benoit, D., Myhal, N., Poulton, L., et al. (2001) Maternal attachment, maternal responsiveness and infant attachment. *Infant Behavior & Development, 24*, 281-304.

- Sensitivity/responsiveness as traditionally measured is only one aspect of early adult-infant interactions. Alternative domains may contribute to the transmission processes, such as openness of communication (van IJzendoorn, 1995), emotion regulation and cognitive scaffolding (Pederson et al., 1998) in mother-infant interactions. In order to understand both the origins of infant attachment patterns and the transmission of maternal attachment, we must continue to explore such domains, as well as other psychological and social variables but in a theoretical and statistical context that acknowledges the partially independent status of maternal state of mind and sensitivity/responsiveness.

Resnick, M.B.; Eyler, F.D.; Nelson, R.M.; Eitzman, D.V., & Bucciarelli, R.L. (1987). Developmental intervention for low birth weight infants: Improved early developmental outcome. *Pediatrics, 80(1)*, 68 – 74.

- The effects of a multidisciplinary infant development program (IDP) on the physical and mental development of low birthweight infants were studied. Findings were that the IDP group, as compared to a control group, had significantly lower incidence of developmental delays (4% prevalence at age 2 compared to 26% prevalence, respectively).

Sengpiel, F., Stawinski, P., & Bonhoeffer, T. (1999). Influence of experience on orientation maps in cat visual cortex. *Nature Neuroscience, 2(8)*, 727 – 732.

- This study considered the effects of rearing kittens in a striped environment on the development of ocular dominance columns in the visual cortex. Data indicated that experience played an instructive role whereby some neurons shift their genetically predisposed orientation preference to a preference for the orientations

experienced by the young kitten, supporting the idea that genetically predetermined functioning of neurons can be altered by experience.

Shonkoff, J.P. (2003). From neurons to neighborhoods: Old and new challenges for developmental and behavioral pediatrics. *Developmental and Behavioral Pediatrics, 24(1)*, 70-76.

- Rapidly advancing research in neurobiology and the behavioral and social sciences, coupled with dramatic changes in the social and economic circumstances under which families are raising young children, has created a highly dynamic context for early childhood policy, service delivery, and child rearing in the United States. This article examines the report from the National Research Council and the Institute of Medicine, *From Neurons to Neighborhoods: The Science of Early Childhood Development*, through the lens of developmental and behavioral pediatrics.

Siegel, D.J. (1999). *The developing mind*. New York: Guilford Press.

- This book provides an in-depth look at the neurodevelopmental processes of the brain, including the biology of memory, attachment, emotion, modes of processing, states of mind, self-regulation, interpersonal connections, and integration. Since the brain is undergoing rapid, experience-dependent development for the first several years of life, this suggests that intervention will be most influential on the neuroanatomy of the brain if provided early.

Spiker, D. & Hopmann, M.R. (1997). The effectiveness of early intervention for children with Down syndrome. In M.J. Guralnick (Ed.) (pp. 271 – 306). *The effectiveness of early intervention*. Baltimore, MD: Paul H. Brookes Publishing Co.

- The authors reviewed studies involving children with Down syndrome on cognition, play, attention, attachment, temperament, and parent-child interactions, and the effectiveness of early intervention. Data on specific program models, such as specific motor training, indicated benefits of early intervention on the different developmental domains, and the authors encouraged rigorous empirical studies to understand the many complex relationships involved in these questions.

Sonksen, P.M., Petrie, A., & Drew, K.J. (1991). Promotion of visual development of severely visually impaired babies: Evaluation of a developmentally based programme. *Developmental Medicine and Child Neurology, 33*, 320-335.

- Compared to children with visual impairments receiving a treatment program for general development, children with visual impairments benefited more from a year-long, individualized program implemented by the parents during the first and second years of life focusing on visual and general development. Since vision subserves cognitive and motor skills, early treatment of visual impairments may not only enhance a child's visual skills, but also remove risk factors countering optimal development in other developmental domains.

Whitehurst, G.J., Fischel, J.E., Caulfield, M., DeBaryshe, B.D., & Valdez-Menchaca, M.C. (1989). Assessment and treatment of early expressive language delay. In P.R.

Zelazo & R.G. Barr (Eds.), *Challenges to Developmental Paradigms: Implications for theory, assessment, and treatment* (pp. 113 – 135). Lawrence Erlbaum Associates: Hillsdale, NJ.

- The authors investigated the use of social interactions between the parent and child as an intervention medium to improve expressive language development. Children with expressive language delay (ELD) at 24 – 40 months of age who received the treatment performed better on language skill tests than age-matched children with ELD who did not receive treatment. For children in the treatment group, 72% were in the normal range and 8% were in the no improvement range, as compared to 31% and 28% for the control group, respectively. Since parents are a primary source of linguistic stimulation for children, it is noteworthy that they were able to implement a successful intervention, especially given other research showing a relation between language stimulation and cognitive development as well.

Yim, G. (1998, November). Early brain development and windows of opportunity. *Hawai'i Association for the Education of Young Children (HAEYC) Conference*, Honolulu, Hawai'i.

- Basic principals of brain development, neuroanatomy, functional control of specific brain regions, and the existence of windows of opportunity for promoting optimal development are presented. The author discusses the ages where these windows are "wide-open" to allow experience to influence development of different developmental skills, as well as activities that a caregiver can provide for a child to promote development by taking advantage of these windows. Also discussed is a specific application of these ideas to attention deficit disorder.