Fetal behavioral state organization is associated with ADHD in adolescence (Abstract International Society for Developmental Psychobiology, 38th Annual Meeting, November 9–12, 2005 Washington, D.C.)
Van den Bergh, B.R.H.; Debruyne, M.; Hubert, M.; Lagae, L.

Published in: Developmental Psychobiology

Publication date: 2005

Citation for published version (APA):

1 EFFECT OF ERYTHROPOIETIN (EPO) ON SPATIAL MEMORY AND SENSORY MOTOR BEHAVIOR FOLLOWING NEONATAL MIDDLE CEREBRAL ARTERY OCCLUSION (MCAO)
R. A. Abel,1 Y. Chang,2 D. Mu,2 P. S. McQuillen,2 Z. Vexler,2 M. F. Wendland,2 D. M. Ferriero,2 & C. R. Almli1
1Washington U. School of Med, St. Louis, MO, U.S.A.
2UCSF, San Francisco, CA, U.S.A.

EPO has been shown to be neuroprotective and to improve functional outcome 2 weeks postsurgery in a rodent model of neonatal focal ischemia. In the present study, we examine whether the same dosing regimen (single postischemic dose of EPO) might provide long-term neural/behavioral protection when administered immediately following MCAO in neonatal rats. Neonatal stroke was induced in postnatal day (P)10 rats via transient (45 min) MCAO; injury was confirmed using diffusion weighted MRI. Immediately following reperfusion, EPO (5 IU/g in BSA) or vehicle (Veh) was administered i.p. Experimental groups included MCAO + EPO (N = 9), MCAO + Veh (N = 7), Sham + EPO (N = 7), Sham + Veh (N = 7). Behavioral testing was performed in adult rats (approx P65) that had been treated at P10. Spatial learning and memory were assessed in the Morris water maze using six escape trials and one probe trial/day for 6 days. MCAO-treated rats took significantly longer to escape to the hidden platform than sham rats, regardless of EPO treatment. When the platform was removed, MCAO-treated rats spent significantly less time in the platform (probe) quadrant than sham rats, regardless of EPO treatment. There were no significant differences in escape latency or probe time of MCAO + EPO rats compared to MCAO + Veh rats. Forepaw use was disrupted in MCAO-treated rats, regardless of EPO treatment. These findings suggest that the neural/behavioral protective effects of a single dose of EPO observed 2 weeks after injury and treatment may not persist into adulthood. Increased dosing and prolonged dosing intervals beyond the immediate stroke period may be necessary for a sustainable effect. [Support contributed by: OrthoMcNeil Johnson and Johnson, NS35902.]

2 AN INVESTIGATION OF ATTENTION IN MIDDLE CHILDHOOD
Denise R. Adkins & Martha Ann Bell
Virginia Polytechnic Institute and State University, Virginia, U.S.A.

In line with recent work exploring relations between temperament and cognition (Blair, 2002; Wolfe & Bell, 2004), the current study examined temperament-based attention and lab-based attention in middle childhood. Thirty-three 8 years old participated in a child Attentional Network Task designed to tap Posner’s attentional networks (alerting-frontal, parietal; orienting-frontal, parietal; conflict-frontal; Rueda, et al., 2004). They also responded to an age-appropriate temperament questionnaire (EATQ-R; Ellis & Rothbart, 1999; McKeen & Campbell, 2001). EEG was recorded during baseline and ANT task and power values were calculated for the alpha frequency band (8–13 Hz). Participants were divided into high and low performance groups on the ANT using a median split in order to examine EEG differences associated with task performance. The high performing group on the ANT exhibited greater EEG activation during baseline and task, F(1,28) = 8.53, p = 0.007. There was also a trend for a group/condition hemisphere interaction, F(7,22) = 2.29, p = 0.066. Then EEG for each region was examined separately to reveal a group/condition interaction at lateral frontal (F(1,28) = 4.13, p = 0.05), with the high-performing group exhibiting changes in activation from baseline to task. There was a trend for the same interaction at the parietal region, F(1,28) = 2.80, p = 0.10. Last, the self-report ratings of Effortful Control dimension of temperament (comprising attention, inhibitory control, activation control) were correlated with ANT performance, r = 0.44, p = 0.01. Thus, the results support a relation between temperament-attention and lab-attention.

Contact Information: Gordon A. Barr, Ph.D., Program Director, Department of Psychology, Hunter College, CUNY, 695 Park Avenue, New York, New York 10021, 212-772-5610, 212-543-5694, E-mail: gbarr@hunter.cuny.edu

Abstracts are presented in alphabetical order, by last name of the first author. Symposia are listed separately from posters and individual presentations.

© 2005 Wiley Periodicals, Inc.
IS LATE FUNCTIONAL DEFICIT DUE TO VARIOUS SEVERE EARLY BRAIN INSULTS INEVITABLY ASSOCIATED WITH STRUCTURAL DAMAGE IN RATS
M. Alaverdashvili, R. Haugvicova, & Y. Kaminskiy
Institute of Physiology, ASCZ, Prague, 142 20 CZ

Late behavioral and cognitive deficit is the sequela of early brain insults of various etiologies such as traumatic brain injury (TBI) and status epilepticus (SE). However, these undesirable functional sequels might be absent or diminished as a result of functional regeneration processes peculiar for immature brain. Structural damage is often associated to early brain injuries and consequently to late behavioral and cognitive alteration, nevertheless functional deficit occurs in the absence of cell death as well. The aim of our study was evaluation of late functional consequences of early-life penetrating TBI and SE. Penetrating TBI and SE were induced by intracerebroventricular (icv) infusion procedure and icv homocysteic acid (HCA) administration, respectively in 12-day-old Wistar rats. Spatial working and emotional memories, anxiety/fear level, adaptation, and motor ability was evaluated by means of spontaneous alternation behavior (SAB) in Y-maze and EPM in adult rats (>60 days). Late functional deficit was revealed in TBI and SE groups. SAB level was significantly reduced in TBI and was absent in SE rats. Emotional memory was compromised in both groups. However, severe structural damage was seen only in SE rats (J. Folbergrová et al., 2005, Exp Neurol, 192: 420–436). We suppose that disassociation of late functional malformation from structural deficit seems highly important to optimize preventive and treatment strategies against late undesirable neurological consequences of early severe brain insults.

ONTOGENY OF SEX DIFFERENCES IN DEFENSIVE BURYING BEHAVIOR IN RATS: EFFECTS OF SOCIAL ISOLATION AND REHOUSING
Hiroyuki Arakawa
Department of Psychology, Chukyo University

Sex differences in the defensive burying behavior of rats, and related social factors, were explored in three developmental stages: juvenile, puberty, and adult. The duration of burying was measured in a shock-prod test. For males, the duration of burying was longer in the juvenile and pubertal stages than in adulthood. For females, no age differences in the duration of burying were found. Males showed longer burying durations than females in both the juvenile and pubertal stages. Both male and female rats isolated during the juvenile stage showed less frequent burying behavior compared to pair-reared rats. This effect of juvenile isolation was maintained among both adult males and females even when they were returned to pair rearing after isolation, but attenuated when females (not males) were rehoused with a non-isolated same-age conspecific. Isolation during adulthood increased burying behavior in males, but decreased it in females. However, this effect of adult isolation did not find in male rats isolated during the juvenile stage. The decrease in defensive burying in male rats in adulthood suggests that the emergence of social dominance relationships during adult males suppresses the duration of burying. The inhibition of burying behavior in male and female rats isolated during the juvenile stage suggests that social experiences as juveniles are important for the ontogenetic emergence of defensive burying behavior and adaptation for social relationships with adults. In addition, underlying mechanism in ontogeny of defensive burying behavior would differ between males and females. [Grant-in-Aid for Scientific Research from Ministry of Education, Culture, Sports, Science.]

CONDITIONED PREFERENCES FOR ALCOHOL AFTER ITS ASSOCIATION WITH AMNIOTIC FLUID IN INFANT RATS
C. Arias & M. G. Chotro
Universidad del País Vasco, 20018 San Sebastian, Spain

Studies in humans and animals indicate that exposure to flavors into the amniotic fluid during the last gestational period may induce preferences for those flavors. Considering that during the last prenatal period, the amniotic fluid contains substances that activate the opioid system, and that this system plays a critical role in the acquisition of olfactory preferences early in life, it has been hypothesized that the amniotic fluid may acquire appetitive unconditioned properties during this period. This has been tested in an experiment in which preweanling rats were exposed to alcohol odor (CS) paired or unpaired with the intraoral infusion of amniotic fluid (US) collected on gestational day 20. Pairing of these two stimuli induced an enhanced palatability of alcohol’s flavor and also an increased intake of the drug. These results support the idea that the amniotic fluid acquires appetitive unconditioned properties during the last days of gestation. [Vicerrectorado de Investigación. Universidad del País Vasco (UPV/EHU).]
Sources of Individual Differences in Spontaneous Eye Blinking

L. F. Bacher, K. J. Wallace, N. Zielinski, K. Lewis, & K. Wynkoop
Department of Psychology, SUNY Oswego, Oswego, NY 13126, U.S.A.

Many factors affect an individual’s rate of spontaneous eye blinking (SB). However, the wide individual differences in SB rate are not well understood. Given that (a) DA system functioning underlies in part SB rate and (b) DA may be related to some dimensions of personality, we compared SB rate to personality traits under several conditions. Seventeen adults (9 males) were observed across 3, 3-min periods using tasks designed to elicit successively greater attention to presented stimuli. Phases were: baseline (no stimuli presented), moving stimuli (recognition memory task), and moving stimuli (recall memory task). SB rate and heart rate (HR) were measured throughout. A standardized assessment of the Big 5 dimensions of personality was completed afterward. Individual differences in SB rate were wide: 3.2–38.4 blinks/min (M = 13.2, SD = 8.2). No sex differences in SB rate were found. SB rate increased across phase when two personality variables were controlled: openness and agreeableness. Also, a marginally significant interaction between openness and phase was found. HR increased across phase but HR and HRV were unrelated to SB rate and personality. Results support the theory that SB rate reflects some aspects of personality. However, extraversion (believed to be linked to a specific DA subsystem) was not related to SB rate in this task. Infants will be tested under very similar conditions to investigate developmental patterns of SB, factors that alter SB rates and source of individual differences in features of SB.

Supported by NIH/NEI 16238 to LFB.

Fetal Programming of Adult Overweight in Male Rats Induced by 2-G Centrifugation

L. A. Baer,1 J. Piper,2 L. M. Conaster,2 L. S. Rushing,4 C. E. Wade,3 & A. E. Ronca2
1Life Sciences Division, NASA Ames Research Center, Moffett Field, CA, 94035, U.S.A.
2Department of Obstetrics & Gynecology, Wake Forest University School of Medicine, Winston-Salem, NC 27157, U.S.A.
3US Army Institute of Surgical Research, Fort Sam Houston, TX, 78234, U.S.A.

Studies of ‘fetal programming’ are revealing astounding insights into the prenatal origins of adult disease, including metabolic and endocrine pathophysiologies. In the present study, we tested the hypothesis that rat pups conceived, gestated, and born during centrifugation (CF) are characterized by low birth weight and adult overweight relative to non-centrifuged (nCF) controls. For the CF group, young adult male and female rats were adapted to 2g centrifugation for 1 week prior to mating. Their offspring were centrifuged throughout birth and postnatal development. (at each time both CF and nCF pups were fostered to non-centrifuged, newly parturient dams. Birth weights of CF pups were significantly lower than those of nCF pups (Mean ± s.e.: CF: 6.30 ± 0.11 gm; nCF: 7.49 ± 0.22 gm, p < 0.01). CF pups remained significantly (p < 0.05) lower in body weight than nCF pups until postnatal day (P)12. On P63 and throughout the completion of the study on P90, body weights of CF males significantly (p < 0.05) exceeded those of nCF males (P90 body weights, Mean ± s.e.: CF: 511 ± 48 gm, nCF: 477 ± 27 gm; p < 0.05). On P90, CF males exhibited significantly (p < 0.05) reduced spontaneous rearing relative to nCF males. The appetite hormone, leptin, was significantly (p < 0.05) elevated in CF relative to nCF males. Taken together, our data suggest that prenatal centrifugation alters the intrauterine milieu, thereby ‘programming’ persistent adult overweight with correlated changes in spontaneous rearing and leptin. These results establish 2g centrifugation as a useful experimental paradigm for inducing intrauterine growth retardation and programming of adult body weight. [Supported by NIH Grant MH46485 and NASA Grant NNA04CK853.]

Natural Variations in Maternal Care and Development of Fear Learning in the Adult Rat

Rosemary C. Bagot & Michael J. Meaney
Douglas Hospital Research Centre, McGill University

Natural variations in maternal care exert enduring influences on the development of stress responses and cognitive function in the rat. As adults, rats that received lower levels of maternal licking and grooming (LG) in the first week of life exhibit greater fear responses to novel and unconditioned aversive stimuli than do those that received higher amounts of LG. Offspring of low LG mothers also exhibit deficits in spatial learning and memory relative to high LG offspring. It is not known if variations in maternal LG influence development of emotional learning in the rat. The current experiments investigated the effect of natural variations in maternal care on learning involving fear evoking stimuli in adult offspring of high and low LG mothers. The hypothesis that low levels of maternal LG could result in an enhancement of fear learning was assessed in simple Pavlovian conditioning tasks. Low LG offspring displayed greater freezing, a measure of learned fear, when returned to a context in which a single shock had been previously presented than did high LG offspring. In contrast, high and low LG offspring displayed equivalent levels of freezing to a tone previously paired with a single shock as well as in a context in which multiple shocks had been presented. These results suggest that low levels of maternal LG may result in a specific enhancement of contextual fear learning that is not simply the result of greater unlearned fear or a propensity to learn about fear evoking stimuli in general. We are currently investigating whether variations in maternal care may support development of a bias towards learning about events of negative emotional significance in ambiguous situations. [CIHR, NSERC.]

The Development of Infant Voice Discrimination: From Unimodal Auditory to Bimodal Audiovisual Stimulation

Lorraine E. Bahrick, Robert Lickliter, Melissa A. Shuman, Laura C. Batista, Irina Castellanos, & Lisa Newell
Florida International University

Bahrick and Lickliter (2000, 2002) proposed an intersensory redundancy hypothesis, which holds that in early development, experiencing an event redundantly across two senses facilitates perception of amodal properties (e.g., synchrony, tempo, rhythm) whereas experiencing an event in one sense modality alone facilitates perception of modality specific aspects of stimulation (e.g., pitch, timbre, color). Therefore, in early development, discrimination of individual voices (modality specific information) should be enhanced when voices are presented unimodally, in the absence of intersensory redundancy, and attenuated when they are presented bimodally, in the presence of intersensory redundancy. A prior study with 3 months old supported this prediction. Further, with experience, attention becomes more flexible and perception of modality specific properties extends from unimodal, nonredundant contexts to multimodal, redundant contexts. The present study tested this developmental prediction by replicating our prior study using older infants. Thirty-two 6 months old were habituated to the voice of a woman speaking along with the redundant, synchronously moving face, or with a static face (no redundancy). Test trials played the voice of a novel woman. Results supported our prediction and demonstrated significant discrimination (visual recovery to the novel voice) in both the redundant and nonredundant conditions. These findings contrast with those of younger infants and demonstrate that with experience infants extend their detection of modality specific information (such as pitch and timbre of voice) from unimodal auditory to bimodal audiovisual stimulation. [NIMH grants RO1 MH 62226 and RO1 MH 62225 to the first and second author.]
EARLY MEDIA EXPOSURE AND SUBSEQUENT EXECUTIVE FUNCTIONING
Rachel Barr, Beverly Good, Nancy Miller, Kim Nyugen, Gabrielle Strouse, Lorena Valencia, & Sandra Calvert
Georgetown University

The American Academy of Pediatrics (1999) recommended that parents should not expose children under the age of 2 to any type of screen media. One factor that could make infants particularly vulnerable to detrimental effects of early media is exposure to background television, i.e., content that is designed for an older audience. Background television has been found to interrupt the duration of play bouts in 1 year olds. Moreover, a recent study found a relationship between heavy early television use and subsequent attention problems that resembled Attention Deficit Hyperactivity Disorder. The study was, however, limited by several methodological problems including a major delay in follow-up testing and the use of indirect measures. The current study compared infant exposure to television with a direct measure of executive functioning when children were aged 4. Fifteen infants have so far been tracked from infancy to preschool in an ongoing follow-up study. During infancy, we measured infant exposure to television using a diary and questionnaire. In preschoolers, we measured executive function using the Shape School. Early findings indicate a positive relationship between the hours of household television during infancy (mean = 4.46 hr/day, range 0–10 hr) and the ability to divide attention as measured by the switching subscale of Shape School. That is, moderate levels of exposure to television during infancy are predicting better performance on an executive functioning measure in preschoolers. The current findings contradict earlier findings linking infant media exposure to attention deficits. [NSF, Stuart Family Foundation, and Georgetown University.]

DEVELOPMENT OF BODY EQUILIBRIUM IN THE NEWBORN RABBIT
A. Bautista, M. Martínez-Gómez, & R. Hudson

Body equilibrium is necessary for individuals to maintain a posture adequate for efficient locomotion, and thus is fundamental for the performance of a wide range of behaviors. Although the rabbit is a common laboratory animal, little is known about the maintenance of posture and control of locomotion in adults, and still less during early development. Littermates differ in birth weight by up to 50%, and we have found that birth weight is a good predictor of individual pups ability to obtain milk during the highly competitive, once-daily suckling episodes, and to obtain a thermally advantageous position in the litter huddle. Here we investigated the development of the ability to maintain body equilibrium by the heaviest and lightest littermates in seven litters during the first critical postnatal week. On postnatal days 1 to 8, pups were placed individually for 2 min on a ramp inclined at 15°. Loss of balance was measured by scoring rates of full, half, and quarter body rolls. Rates decreased gradually with age but more rapidly in heavier pups, and by day 8 were no longer seen. This difference in motor control might help explain the competitive advantage shown by heavier pups in competing for nipples and for central positions in the litter huddle. [CONACyT 25889-N and 153788. PAPIIT-UNAM IN 217100, PIFOP 2002-30-03.]

PRINCIPLES OF BEHAVIOURAL DEVELOPMENT
Patrick Bateson
Sub-Department of Animal Behaviour, University of Cambridge, High Street, Madingley, Cambridge, U.K.

An understanding of behavioral imprinting depended on postulating features of the organism that had developed prior to the stage when the learning occurred. However, analysis also showed how subsequent development depends on current conditions external to the organism. Understanding the nature of the process drew attention to the advantage of separating motivational state, stimulus analysis, the capacity for plastic change and the executive control of behavior. Above all it showed how the old either/or oppositions applied to behavior simply evaporated when knowledge started to advance. The predispositions and the rules for change were almost certainly fine-tuned to the conditions in which the animals evolved. Once understood, the principles enabled us to understand the enormous species differences in patterns of development. Principles like “store a representation of the input and then compare output against it” have been important in obtaining understanding of the development of song in birds. Feedback with a shifting set-point explains the ordered way in which a developmental process can arrive by different routes at a common adult endpoint. The induction processes of developmental plasticity seem to rely on conditional rules. The competitive exclusion rule explains the dynamics of many sensitive periods. In their different ways all these ideas when applied to development at the right level provide some of useful ways to reduce the complexity. They will probably provide our best approximation to a unified theory of development.
INDIVIDUAL DIFFERENCES IN SPATIAL WORKING MEMORY DURING INFANCY: CONTRIBUTIONS FROM EEG, ECG, AND TEMPERAMENT

Martha Ann Bell
Virginia Polytechnic Institute and State University, Virginia, U.S.A.

Individual differences in cognitive performance during infancy have been attributed to multiple sources, including individual electrophysiology and temperament. The purpose of this study was to investigate three specific foundations for individual differences in performance on an infant spatial working memory task. Fifty infants healthy, full-term 8-month-old infants were recruited and contributed EEG, ECG, working memory, and parent-report of temperament (IBQ) data. Working memory performance was assessed on a looking version of the A-not-B task. EEG and ECG were recorded during baseline and during task performance. Task performance group (high, low) was determined using cluster analysis on the number of correct responses on same side and reversal trials on the spatial working memory task. Analyses showed that the high performance group exhibited task-related changes in EEG at frontal and parietal locations, much as adults do in spatial working memory tasks. The high group also exhibited increases in heart rate from baseline to task, much as older children do on a challenging mental task. High performance group also had higher Activity Level and Distress to Limitations, as rated by mothers on the IBQ. Collectively, these EEG, ECG, and temperament factors were examined together in a discriminant function analysis predicting working memory performance group (high, low), with canonical correlation = 0.73, Wilks Lambda = 0.47 (p < 0.001). Together these factors correctly classified 88% of the infants into working memory performance groups. Thus, EEG, ECG, and temperament factors were related to specific cognitive functioning in 8-month-old infants. [HD043057.]

GENDER-SPECIFIC EFFECTS OF PRENATAL STRESS ON DENDRITIC MORPHOLOGY OF HIPPOCAMPAL NEURONS

J. Bock,1 M. S. Murmu,1 S. Salomen,2 Y. Biala,2 M. Weinstock,2 & K. Braun1
1Institute of Biology, Otto von Guericke, University of Magdeburg, Germany
2Hebrew University Medical Center, Jerusalem, Israel

There is clear evidence that the exposure to an unborn organism to high levels of stress, experienced by the mother during pregnancy, can affect its behavioral development and thereby increase its susceptibility to develop anxiety and mood disorders. In the present study, we investigated the influence of prenatal stress on the development of neurons in the hippocampal formation in rat pups at postnatal day 23. Two types of hippocampal neurons were quantitatively analyzed: (i) pyramidal neurons of the CA3 region; (ii) granular neurons of the infra- and suprapyramidal layer of the dentate gyrus. In the CA3 region, prenatally stressed males and females showed significant dendritic atrophy and a lower number of dendritic intersections in both the apical and dendritic trees. Changes of dendritic spines on CA3 pyramidal neurons were found only on basal dendrites and solely in females that displayed a significantly lower density of dendritic spines. In the infrapyramidal layer of the dentate gyrus, prenatal stress induced dendritic atrophy and a lower spine density in females but an increased dendritic length and spine density in males. Similar effects were found in the suprapyramidal part of the dentate gyrus, in which the prenatally stressed females also displayed dendritic atrophy and reduced spine density, in contrast to males who showed increased spine density and no changes of dendritic length.

Our results reveal that prenatal stress dramatically influences the development of neurons in the hippocampus and dentate gyrus. Moreover, our data provide further evidence that male and female animals are differentially influenced by prenatal stress. [Supported by grants from the German Science Foundation (SFB 426).]
EARLY SOCIAL EXPERIENCE AFFECTS SOCIAL BEHAVIOR, EMOTIONAL RESPONSE, AND NEUROTROPHIN LEVELS AT ADULTHOOD

I. Branchi,1 I. D. Andrea,1 J. Sietzema,1 M. Fiore,2 V. Di Fausto,2 L. Aloe,2 & E. Alleva2
1Depatment Cell Biol Neurosci, Istituto Superiore di Sanità, Rome, Italy
2Ist. Neurobiol & Mol Med, CNR, Rome, Italy

Early experiences such as maternal deprivation or handling have been reported to produce persistent changes in brain and behavioral functions. Here we investigate whether a different type of early experience, communal nesting (CN), affects brain and behavior development, producing long-lasting changes. CN consisted in letting three mothers mice rear their litters in a single nest from birth to weaning (postnatal day 25). Such mothers share milk and caregiving behavior with the offspring of the others. The control group (standard nesting, SN) consisted in a single mother rearing its own litter. The results show that, at adulthood, nesting condition has important long-term effects on both brain and behavior. In particular, NGF and BDNF protein levels were increased in the brain of CN mice compared to SN mice. Open field and plus maze results show that CN mice display levels of exploratory and locomotor activity similar to those of SN mice but an increased emotional response, performing more thigmotaxis in the open field and spending less time in the open arms of the plus maze. Furthermore, CN mice displayed higher levels of immobility in the forced swim test. Finally, CN mice displayed a more defined social behavior showing a behavioral profile typical of a dominant or subordinate male and displayed higher levels of social behaviors, suggesting a stronger motivation to interact with same-sex conspecifics. Overall, our results show that early social experiences, such as CN, deeply affect social and non-social behavior, NGF and BDNF levels at adulthood. [Support by NIH-ISS Rif. 0F14 to E. A. and ISS N. 23 to L. A. and E. A.]

ADULT STARTLE RESPONSES IN RATS SELECTIVELY BRED FOR EXTREME SEPARATION RESPONSES AT P10

Susan A. Brunelli, Vanessa Winniger, & Aron D. Branscombe
Department of Developmental Psychobiology, New York State Psychiatric Institute, NY, U.S.A.

Artificial selection for vocal response to early separation is known to have life-long effects. Here we demonstrate that adult rats from lines selected for high and low ultrasonic distress vocalizations (USV) at day 10 show marked differences in startle responses, both relative to one another, and relative to a random control line. All animals were subjected to a 3-day fear conditioning task. Subjects receiving fear conditioning were primarily due to cerebellar damage. [Supported by RO1 AA014288-01.]

DIFFERENTIAL EFFECTS OF NEONATAL ALCOHOL EXPOSURE ON EYEBLINK CONDITIONING AND SPATIAL DELAYED ALTERNATION

K. L. Brown, L. H. Calizo, & M. E. Stanton
Department of Psychology, University of Delaware, Newark, DE, U.S.A.

During ontogeny, cerebellum and brainstem circuitry are necessary for the acquisition and performance of conditioned eyelink responses whereas higher-order learning paradigms such as trace eyelink conditioning depend on hippocampal interactions with this circuitry (Ivkovich & Stanton, 2001, Neurobiol Learn Mem, 76, 426–446). Spatial delayed alternation, in contrast, depends on the hippocampus (ibid) but not the cerebellum (Freeman et al., 1995, J Neurosci, 15, 7301–7314). Neonatal exposure to a binge dose of ethanol damages the cerebellum and hippocampus and impairs cerebellar- and hippocampal-dependent learning tasks. The present study explored the effects of neonatal ethanol exposure on tasks requiring the functional integrity of one or both of the aforementioned structures. Long-Evans littermates were intubated with ethanol at doses of 0 or 5 g/kg/day, delivered as a 11.9% (v/v) solution in two daily administrations on postnatal day (PD) 4–9. An additional, undisturbed (non-intubated) control group was included as well. On PD 26–28, subjects were tested on long delay or trace eyelink conditioning, matched for ISI (880 ms). Subjects receiving trace eyelink conditioning were then trained on spatial delayed alternation on PD30 (using methods similar to Ivkovich & Stanton, 2001, ibid). Alcohol-exposed subjects were significantly impaired in both eyelink conditioning tasks relative to controls but were unimpaired in delayed alternation performance, suggesting that the functional deficits in eyelink conditioning were primarily due to cerebellar damage. [Supported by RO1 AA014288-01.]
5-HT-INDUCED STEPPING AT TERM I. POSTNATAL EXPERIENCE POTENTIATES PERINATAL DEVELOPMENT OF HINDLIMB COORDINATION IN THE RAT I. POSTNATAL EXPERIENCE POTENTIATES 5-HT-INDUCED STEPPING AT TERM

Richard E. Brown, Rhian Gunn, & Natalie Parks
Psychology Department & Neuroscience Institute, Dalhousie University, Halifax N.S., Canada B3H 4J1

Coloboma mice have been proposed as an animal model of ADHD as they show high levels of spontaneous motor behavior as measured in an automated activity recorder (Hess et al., 1992, J Neurosci, 12, 2865−2874). We observed that Coloboma mice had motor control problems resembling ataxia (Tarons & DiiDonato, 2004, Nature Rev Neurosci, 5, 641−655) and tested motor control in aged Coloboma mice and their standard controls (C3H/HeSnJ). Colobomas showed more head bobbing, circling, and digging in their home cage than C3H. In an open field, C3H reared more than Colobomas. In an elevated plus maze, Colobomas had a higher frequency of line crosses and head dips than C3H. Colobomas fell off of the balance beam and Rotarod sooner than C3H, had more foot slips in the grid test and a short hindlimb stride and wider hindlimb linear splay. Colobomas also had more reaches to obtain a food reward in a reaching task. There were no strain differences in grip strength or in olfactory learning. These results suggest that Colobomas, which have a number of known genes deleted, may be a better model for ataxia than for ADHD. The problem of developing test batteries, which can dissociate between mouse models of ADHD, ataxia, Alzheimer’s, and other diseases will be discussed. [Supported by NSERC of Canada.]

ARE COLOBOMA MICE A GOOD MODEL FOR ADHD?

M. R. Brumley, A. J. Marcano-Reik, & S. R. Robinson
Department of Psychology, University of Iowa, Iowa City, IA, 52242, U.S.A.

Although the mechanisms for locomotion begin developing before birth in the rat, postural constraints typically prohibit the expression of walking behavior in immature animals. However, strong sensory stimulation or pharmacological tools can be used to induce locomotor behavior. For instance, fetal and newborn rats show alternated hindlimb stepping after injection of the 5-HT agonist quipazine. Quipazine is presumed to activate neural circuitry associated with locomotion. To test whether stepping behavior is influenced by experiential events during this period, we examined 5-HT-induced hindlimb stepping at term in rats that differed in their degree of pre- and postnatal experience. On post-conception day 22 (term), subjects were treated with 3.0 mg/kg quipazine by IP injection after a 5-min baseline. Subjects were tested before birth as fetuses (F22), 4-hr after vaginal delivery (V22), 4-hr after cesarean delivery at term (C22), or 24-hr after cesarean delivery on the day before term (C21). During baseline, V22, C22, and C21 subjects were more active than F22 subjects. During the 10-min period after injection, C21 subjects were significantly more active than subjects in all other groups. Also, C21 animals showed the highest incidence of hindlimb stepping (4−10 times as many steps). Kinematic analysis further detailed differences in hindlimb coordination among birth conditions. These data suggest that experience in a postnatal environment potentiates hindlimb coordination. They also suggest that locomotor mechanisms in the newborn rat can be influenced by ecologically relevant sensorimotor experience. [Supported by grant HD 33662 to SRR.]

DIFFERENCES IN CATECHOLAMINE UTILIZATION AT POSTNATAL DAY 10 IN RATS

S. A. Brunelli & P. Kehoe
New York State Psychiatric Institute, Columbia College of Physicians & Surgeons, & University of California Irvine, Biological Sciences Program

Two lines of rats have been selectively bred for high and low rates of infant ultrasonic vocalizations in response to separation and isolation at postnatal day (P)10. In this experiment, P10 pups from the High and Low USV lines and the randomly bred control line (Random) were tested under selection conditions (2 min isolation in a novel cage) and ultrasonic vocalizations were recorded. Immediately after testing each pup was sacrificed and brains were rapidly removed and dissected on ice. At the same time, littermate controls were taken directly from the home cage and sacrificed for brain dissection. Brain areas dissected were: amygdala, bed nucleus of the stria terminalis (BNST), caudate putamen, cingulate cortex, hippocampus, hypothalamus, nucleus accumbens, periaqueductal gray (PAG), and septum. Tissues were assayed using high performance liquid chromatography (HPLC) for levels of catecholamines and their metabolites: dopamine (DA), norepinephrine (NE), and serotonin (5-HT). There were no differences in levels of 5-HT across the two lines of rats, but the high and low USV lines had significantly different levels of DA and NE. The above maternal-, pregnancy-, and situation-related factors accounted for a substantial proportion of the variance in physiological stress responses. Linear regression analyses indicated these variables accounted for 53% (F = 7.5, p < 0.0001) and 35% (F = 3.5, p < 0.001) of the variance in SBP and DBP PSR, respectively. Thus, these results show that selection for an infantile trait has altered the development of systems that are involved in the regulation of affective, motivational and vocal motor responses. [NIHM RO1 MH40430.]

PERINATAL DEVELOPMENT OF HINDLIMB COORDINATION IN THE RAT I. POSTNATAL EXPERIENCE POTENTIATES 5-HT-INDUCED STEPPING AT TERM

A. L. Cammack,1 I. S. Federenko,2 C. Hayakawa,2 S. Ahmed,7 & P. P. D’Aiddy7
1Departments of Psychiatry & Human Behavior, University of California, Irvine
2Psychology & Social Behavior, University of California, Irvine

Maternal psychological stress has been identified as a determinant of adverse fetal, neonatal and infant developmental, and health outcomes. The effects of maternal stress are presumed to be mediated, in part, by physiological processes (i.e., psychophysiological stress reactivity; PSR). Several individual and situational characteristics are known to regulate PSR, however, very little is known about the regulation of PSR in human pregnancy. We conducted a study in a clinic-based convenience sample of 65 pregnant women. Subjects were exposed to a standardized psychosocial laboratory stressor (i.e., the Trier Social Stress Test, TSST) at 16 ± 1.25 (SD) weeks gestation. Multiple measures of systolic (SBP) and diastolic (DBP) blood pressure were obtained from 30 min before until 30 min after the stressor, and area-under-the-curve (AUC) calculations were performed to obtain indicators of PSR. We examined the effects of maternal- (age, parity, BMI), pregnancy- (obstetric risk, fetal sex), and situation-related (sleep, glucose level) factors on PSR. Results indicated that exposure to the TSST produced significant SBP (F = 41.8, p < .001) and DBP (F = 35.5, p < .0001) responses. The above maternal-, pregnancy-, and situation-related factors accounted for a substantial proportion of the variance in physiological stress responses. Linear regression analyses indicated these variables accounted for 53% (F = 7.5, p < 0.0001) and 35% (F = 3.5, p < 0.001) of the variance in SBP and DBP PSR, respectively. Thus, these findings highlight the importance of taking person- and situation-related factors into account in studies of maternal stress and biological responses to stress in human pregnancy and early development. [Supported by NIH grant HD-33506 to PDW.]

REGULATION OF MATERNAL PSYCHOPHYSIOLOGICAL STRESS RESPONSES IN HUMAN PREGNANCY

ISDP 38th Annual Meeting
THE EMERGENCE OF EMOTION REGULATION STRATEGIES DURING INFANCY: CONTRIBUTIONS FROM INFANT TEMPERAMENT AND MATERNAL BEHAVIORS

A. Cardell & M. A. Bell
Virginia Polytechnic Institute and State University, Blacksburg, VA 24061, U.S.A.

Much work in infancy has pointed to temperament as the basis for individual differences in emotion regulation strategies. Work with infants and young children has also included environmental factors. The purpose of this longitudinal study was to examine emerging strategies of emotion regulation by observing infant-mother dyads at 5 months (before self-regulation strategies begin) and again at 10 months (when rudimentary strategies are developing). One hundred infants and their mothers participated in a variety of dyadic interactions and we coded maternal behaviors during two play events and infant regulatory behaviors during two distressing tasks. Mothers completed an infant temperament questionnaire. Infant regulatory strategies were related to maternal sensitivity during play, implying that by 10 months infants had developed patterns of emotion regulation based on a history of maternal interaction. Maternal reports of infant temperament were also correlated with emotion regulation strategies during distressing tasks. Infants whose mothers rated them high on attention were more likely to use attentional strategies to regulate their distress. Furthermore, whereas mother’s behaviors toward their infants were fairly stable over time, infant regulatory behaviors changed dramatically. This is consistent with Rothbart’s conceptualization of temperament, in which we expect to see self-regulation strategies emerging at 10 months. These preliminary results suggest that there are at least two sources from which infants develop emotion regulation strategies: learning from maternal interactions and temperamentally based differences in psychology. [Grant sponsor: HD043057.]

DISRUPTION OF SPATIAL DISCRIMINATION REVERSAL BY MK-801 IN WEANLING RATS IS NOT STATE DEPENDENT

K. K. Chadman, D. J. Watson, & M. E. Stanton
Psychology Department, University of Delaware, Newark, DE 19716, U.S.A.

Recently, we showed that i.p. administration of the NMDA noncompetitive receptor antagonist MK-801, does not impair acquisition of spatial discrimination but impairs reversal learning in weanling rats at doses that do not entail performance effects. Here we ask if these MK-801 effects change during development and they reflect a state dependent action of the drug. Long-Evans rats were trained on postnatal day (PD) 21, 26 or 30 to acquire a T-maze spatial discrimination (cf. Freeman & Stanton, Beh Neurosci, 1991, 105, 386–395). The animals were trained in two 48-trial sessions, acquisition in the morning and reversal in the afternoon. State-dependency was examined by administering 0.10 mg/kg MK-801 before acquisition or reversal, both or neither (saline vehicle). There was no main effect of age or interactions of age × MK-801 in acquisition or reversal. MK-801 given only prior to reversal impaired performance more than MK-801 given prior to both acquisition and reversal (phase × block × acquisition-dose × reversal-dose, p < 0.024), although both of these groups were impaired relative to controls. This negates the state-dependency hypothesis, which predicts greater impairment when MK-801 is administered before both acquisition and reversal than before reversal-only. Sensitivity of spatial reversal learning to this dose of MK-801 does not change between PD 21–30. Spatial reversal is more sensitive to NMDA-receptor antagonism than acquisition. Spatial reversal may be useful for investigating developmental disorders where altered NMDA-receptor function is implicated. [Supported by PO1-HD-35466-01, ROI AA01428-01.]

OLFACTION AND THE AMYGDALA MEDIATE THE FEAR RESPONSE IN YOUNG RATS

S. W. Chen & C. Wiedenmayer
Department of Psychiatry, Department of Biological Sciences, Columbia University, Department of Developmental Psychobiology, New York State Psychiatric Institute, New York, NY 10032, U.S.A.

Young rats are able to detect dangerous situations and to perform defensive, fear-related behaviors such as freezing to counter threats. We hypothesized that the olfactory system and the amygdala mediate freezing in response to a social threat in preweanling rats. We induced anosmia in 14-day-old pups by nasal infusion of zinc sulfate and exposed the pups to a potentially infantilical adult male rat. After male exposure, amygdala activation was assessed by immediate early gene expression. Anosmic pups froze significantly less than saline infused or untreated animals in the presence of the adult male rat. This decrease in freezing was associated with a decrease in neuronal activation in the medial nucleus of the amygdala, determined by c-fos expression. To assess whether the medial amygdala is involved in freezing, we inactivated this nucleus with bilateral infusion of muscimol. The lateral amygdala was inactivated as a control. Inactivation of the medial but not the lateral amygdala reduced freezing to the adult male rat. These findings indicate that in young rats, as in adult rats, the amygdala is involved in the detection of threatening stimuli and the mediation of the unlearned fear response. [National Institute of Health, MH01975.]
MATERNAL SEPARATION AFFECTS SOCIAL BEHAVIOR AND THE NUMBER OF CALCIUM BINDING PROTEIN-CONTAINING NEURONS IN THE BRAIN OF PERIADOLESCENT RATS

F. Ciralli,1 C. Giachino,2 N. Canalia,2 A. Berry,1 M. Riva,3 E. Alleva,1 & P. Peretto3

1ISS, Rome, Italy
2University of Turin, Turin, Italy
3University of Milan, Milan, Italy

Disruptions in the mother-infant relationship can lead to long-term changes in anxiety at adulthood. Aim of this study was to investigate the effects of early handling and maternal deprivation (15 min vs. 3 hr from PND 2–14) on rodents’ social behavior and on the density of calcium binding proteins-containing neurons in brain regions involved in the response to stress and anxiety, i.e., the hippocampus and the amygdala. Calcium binding proteins calretinin, calbindin, and parvalbumin identify various subpopulations of GABAergic interneurons that serve important roles in CNS plasticity by buffering intracellular calcium levels. Social behavior was measured in the social interaction test at perialdolpecia (PND 35–40), a peculiar developmental stage in rodents characterized by high levels of affiliative and play behavior. Results indicate that both handled and separated animals showed more affiliative behavior and were less neophobic when confronted with a novel individual, compared to controls. Quantification of immunohistochemically stained sections revealed increased amounts of calretinin- and calbindin-immunoreactive neurons in the hippocampus and of parvalbumin-positive neurons in the lateral amygdala of both handled and maternally deprived rats, compared to controls. These results indicate that early manipulations can significantly alter the number of the calcium binding proteins-containing neurons in specific brain regions, and suggest that these modifications may underlie changes in anxiety and social behavior. Moreover, they indicate that early handling and maternal deprivation can lead to similar behavioral and morphological effects. [Support contributed by: Grant ISS-NIH Rf. 0F14 to E. A.]
MATERNAL BARKING ELICITS CRYS IN THE NEWBORN SOUTHERN ELEPHANT SEAL (Mirounga leonina): AN ADAPTIVE MECHANISM FOR ELICITING NEONATAL AROUSAL?
L. M. Conatser,1 B. Litz,2,3 L. A. Baer,4 R. M. Ortiz,5 C. L. Ortiz,6 C. Campagna,7 & A. E. Ronca1
1Department of Obstetrics and Gynecology, Wake Forest University School of Medicine, Medical Center Blvd., Winston-Salem, NC 27157, U.S.A.
2School of Fisheries and Ocean Sciences, University of Alaska Fairbanks, PO Box 730, Seward, AK 99664, U.S.A.
3Alaska SeaLife Center, P.O. Box 1329, Seward, Alaska 99664, U.S.A.
4Life Sciences Division, 239-11 NASA Ames Research Center, Moffett Field, CA 94035, U.S.A.
5Division of Natural Sciences, University of California-Santa Cruz, NAT SCI II Annex, Santa Cruz, CA 95064, U.S.A.
6Department of Biology, University of California-Santa Cruz, NAT SCI II Annex, Santa Cruz, CA 95064, U.S.A.
7Centro Nacional Patagonico, CONICET, Boulevard Brown s/n. Código Postal 9120, Puerto Madryn, Chubut, Argentina

During mammalian birth, stimulation by the mother arouses the newborn and facilitates the emergence of important postpartum responses, such as breathing and the expulsion of lung liquid, that are vital for the newborn’s adaptation to the extrauterine world. We previously reported in the rat (Rattus norvegicus) that pups are exposed to hundreds of labor contractions during birth. The parturient dam lacticles and handles each newborn pup as she removes its birth membranes, thereby providing intense tactile stimulation during the immediate postpartum period. In the present study, we analyzed labor contractions and postpartum maternal stimulation in a marine mammal, the Southern elephant seal (Mirounga leonina). We hypothesized that because elephant seal pups have flippers rather than paws, postpartum tactile stimulation to their newborn pups is minimal. However, elephant seal cows may aurally stimulate their newborn pups by vocalizing. Female elephant seal undergo their pregnancies underwater then transition to land prior to giving birth. Gravid female seals, members of a small harem, were videotaped at Peninsula Valdez, Argentina during the months of September and October for two breeding seasons. During review of the videotapes, we encoded key aspects of the mother’s behavior during the parturition process: (1) Labor contractions, (2) Pup births, and (3) Maternally directed activities (visual interest, vocalizations, and physical contact). In the 10 min prior to birth, parturient elephant seals showed an average of 39.3 (± 25.7) contractions characterized by head and body extensions (lordosis contractions) and an average of 114 (± 16) contractions characterized by abdominal lifts (vertical contractions). Following birth, females tended to bark at their pups, with the majority of the pups crying in response to their mother’s vocalizations. Collectively, these observations suggest that Southern elephant seal pups are aurally aroused at birth by their mother’s vocalizations. The pup’s cries may assist in clearing lung fluid following birth. Maternal stimulation at birth appears to be an important adaptive mechanism for facilitating the universal mammalian transition from fetus to newborn. (Supported by NIH Grant MH 46485, NASA Grant NNA04CK83, and the MIRT/Fogarty Program.)

EFFECTS OF MATERNAL SMOKING ON FETAL BEHAVIOR
B. Cowperthwaite, S. M. J. Hains, & B. S. Kisilevsky
Queen’s University & Kingston General Hospital, Kingston, ON, Canada

Fetal heart rate, body, and breathing movement changes within 1 hr of mothers smoking a cigarette have been reported. Because longer term effects are unknown, this study examines behavior in fetuses of smoking mothers who have not smoked for at least 1 hr. All women in the study were experiencing a healthy, low-risk, singleton, pregnancy. Women in the smoking group were asked to refrain from smoking for 1 hr prior to arrival at the lab. 34–40 weeks GA fetuses of 19 non-smoking and 18 smoking women received a 20 min recording of spontaneous heart rate, a 30 min observation of spontaneous body and breathing movements, muscle tone, and an estimate of amniotic fluid. As fetal behavior is said to reflect the development, functioning, and integrity of the central nervous system, fetal response to auditory stimulation was included. Each mother generated a 2 min tape-recorded speech sample by reading a nursery rhyme. Then following the standardized 50 min protocol, the fetuses received a 6 min maternal voice procedure (2 min pre-voice, 2 min mother’s voice, 2 min post-voice period). Results showed no differences in spontaneous fetal behaviors between smoking groups. Term fetuses in both groups and pre-term fetuses of non-smoking mothers showed a heart rate acceleration during the playing of their mother’s voice; pre-term fetuses of smoking mothers showed no response. It was concluded that the effects of maternal smoking on fetal spontaneous behaviors are transitory. However maternal smoking appears to delay fetal maternal voice recognition. This suggests that maternal smoking may have some more subtle effects on fetal development. (Julia Card Medical Research Fund, Queen’s University Health Sciences.)

INFANTS FORM ASSOCIATIONS BETWEEN MEMORY REPRESENTATIONS OF STIMULI THAT ARE ABSENT
K. Cuevas & C. Rovee-Collier
Department of Psychology, Rutgers University, Piscataway, NJ 08854, U.S.A.

Traditional models of associative learning assume that an association can be formed only between cues that are physically present. Using a flavor-preference procedure, Dwyer, Mackintosh, and Boakes (1998) found that rats formed an association between the representations of two stimuli that were simultaneously activated in memory but were not physically present when the association was formed. We performed an analogous study with 6-month-old human infants using a combination of sensory preconditioning (puppet A-puppet B), operant conditioning (mobile training in context 1), and deferred imitation procedures. We found that the representations of the mobile and puppet B, which had never appeared together, were similarly associated when their representations were simultaneously activated in memory by exposing the infants to puppet A in context 1. Neither object was present when the association was formed. The association remained latent for up to 2 weeks, when infants used it to perform a deferred imitation task with puppet B. These findings reveal that what infants merely see can retrieve memories of their past experiences and combine them in new ways. In addition to challenging a fundamental tenet of classic learning models, these findings have major implications for the importance of early enrichment and varied stimulation. In the course of their typical daily interactions with the environment, immature organisms of all mammalian species undoubtedly form numerous associations between the memories of absent stimuli in this same manner. (Supported by NIMH grant #32307 to C. R. C.)
CENTRAL MAO ACTIVITY MEDIATES MATURATIONAL CHANGES IN BEHAVIORAL RESPONSES TO L-DOPA
Carlos A. de la Rosa & Donald J. Stenhower
Department of Psychology, University of Florida, Gainesville, FL 32611, U.S.A.

L-DOPA, a catecholamine precursor, induces stereotyped locomotion in rats up to approximately 20 days of age. After this period, rats do not respond to L-DOPA with locomotion. We propose that this failure to respond is due to a developmental increase in the activity of monoamine oxidase (MAO), an enzyme responsible for destroying catecholamines within axonal boutons. To test this hypothesis, rats at ages 15 and 25 postnatal days (PND) were injected with 25 mg/kg nialamide (a MAO inhibitor) or its vehicle, followed 1.5 hr later with an injection of 100 mg/kg L-DOPA or its vehicle. Rats at age 25 PND injected with nialamide and L-DOPA showed significantly elevated levels of perseverative locomotion compared to other groups. These findings suggest that an ontogenetic increase in MAO activity is responsible for dramatic behavioral changes in response to L-DOPA.

PREGNATAL DEXAMETHASONE EXPOSURE IN A NON-HUMAN PRIMATE: LONG-TERM PHYSICAL, ENDOCRINE, AND BEHAVIORAL OUTCOMES
A. C. Dettling, J. Hauser, S. Pilloud, C. Maier, N. Zürcher, J. Feldon, & C. R. Pyczek

Despite the undoubted benefits of prenatal dexamethasone (DEX) administration for reducing risk of respiratory distress in preterm infants, animal, and human evidence suggest that this therapy can affect growth and neurodevelopment. The present study investigated the outcome of fetal DEX exposure in the common marmoset: physical development, development of the HPA axis, and behavior were monitored. Twelve breeding pairs, each providing twin offspring, were randomly assigned to three treatment groups and 7-day administration of 5 mg/kg dexamethasone or saline was conducted at two stages of embryonic development (ED 42–48/90–96): Early DEX (DEX/SAL), Late DEX (SAL/DEX), Control (SAL/SAL). Infant growth, HPA activity, motor skills, and emotional and social behavior were monitored at specific ages between birth and adulthood. Gestational length was slightly but significantly reduced in LDEX compared to CON with EDEX intermediate. Litter size and offspring sex did not differ between groups. Physical parameters were similar in all groups on PND2. During development, the body weight/knee-heel ratio increased more rapidly in LDEX than LDEX offspring with CON intermediate. Motor skills were impaired in LDEX females. To date, DEX treatment had no significant effect on basal or stress response levels of ACTH or cortisol in urine or plasma. DEX treatment reduced undisturbed social behavior and reduced agitation behavior while emotionally challenged in EDEX. Despite the lack of altered cortisol and ACTH levels at birth and throughout development, physical and behavioral (social and emotional) postnatal development were altered by prenatal DEX exposure. [European Commission, Quality of Life and Management of Health research.]

MATERNAL DEPRESSION AFFECTS FETAL GROWTH RATE
M. D. Diego, T. Field, & M. Hernandez-Reif
Department of Pediatrics, University of Miami School of Medicine. Miami, FL 33101, U.S.A.

Fetal growth restriction is among the leading causes of fetal morbidity and mortality and has been associated with adverse long-term health outcomes. A number of factors have been associated with fetal growth including prenatal depression. Prenatal depression affects from 10% to 25% of all pregnant women and has been shown to negatively affect fetal development. However, even though numerous human studies have examined the effects of prenatal depression on birth weight, none have directly assessed the effects of prenatal depression on fetal growth rate. As such, the present study assessed maternal depression using the SCID and measured symptoms of depression and anxiety using the CES-D and STAI. Maternal urinary cortisol levels were also assayed and fetal growth rate (grams/week) across the second half of pregnancy was estimated. Analyses of variance revealed that fetuses of clinically depressed mothers exhibited significantly slower growth rates than fetuses of non-depressed mothers. Correlation analyses further revealed that symptoms of depression and anxiety were comorbid and were significantly related to maternal cortisol. Measures of maternal depression, anxiety, and cortisol during mid gestation were also significantly related to fetal growth rate. Hierarchical regression analyses revealed that only cortisol was a significant predictor of fetal growth rate, suggesting that the effects of maternal depression (and anxiety) on fetal growth rate may be mediated by cortisol. [Supported by MH00331 and MH46586 to TF.]

CARDIAC MEASURES OF ATTENTION PREDICT COMPLEX RULE LEARNING IN INFANTS
R. L. Donohue, T. S. Wass, & H. Sedges
Department of Child & Family Studies, University of Tennessee, Knoxville, TN 37996, U.S.A.

Patterns of anticipatory saccades provide evidence that infants can learn complex spatial rules in the Visual Expectation Paradigm (VExP). Although prior research documented individual differences in anticipatory responding, the influence of attention regulation and processing efficiency on individual differences has not been examined. Further, studies frequently overlooked sex differences in anticipatory responding. To assess the impact of processing speed and attention regulation on rule learning, 13-week-old infants watched a repeating left-left-right pattern in the VExP and completed a visual fixation task, while heart rate (HR) data were collected. Median splits on respiratory sinus arrhythmia (RSA) extracted from a baseline period and during the VExP defined four groups of infants: high/low baseline RSA and high/low RSA during VExP. A median split on maximum fixation duration during the visual fixation task defined the fast and slow processors. If infants utilized the rule, a quadratic pattern should emerge with many correct shifts prior to the first left and right locations, but few erroneous shifts prior to the second left picture. Separate 2 (high/low baseline RSA) × 2 (high/low RSA during VExP) × 2 (fast/slow processors) × 3 (location) repeated measures ANOVAs examined the male and female data. There was a significant baseline RSA × VExP RSA × quadratic location interaction in the female, but not the male, analysis. Girls with high baseline RSA who suppressed RSA during the VExP, displayed the optimal pattern of anticipatory responding reflective of rule learning. Processing speed did not affect rule-based responding.
A METHOD FOR QUANTIFYING INFANT BODY MOVEMENTS FROM THE ELECTROENCEPHALOGRAM (ECG)
W. P. Fifer, M. M. Myers, M. J. Areizaga, & J. T. Grier
Departments of Psychiatry & Pediatrics, Columbia University and New York State Psychiatric Institute, New York, NY 10032, U.S.A.

Assessments of cardiorespiratory function are affected by factors such as temperature, sleep/wake state, and body movements. In many studies no specific monitor of movement is available. In this report, we compare the characteristics of a highly filtered ECG signal to the movement signal produced by an accelerometer to determine if this provides an acceptable index of movement. Subjects were infants and parent-infant pairs of age that underwent –8 hr polysomnograms as part of a large co-operative study of infant sleep physiology (CHIME). The accelerometer, which indicated movement versus no movement, was placed on the infant’s foot and the dichotomous data were digitized at 2 Hz. The ECG signal, obtained at 100 Hz, was smoothed with a 140 point moving average filter, full-wave rectified, and then down-sampled to 2 Hz. Visual inspection of the ECG and movement time series showed close correspondence. Spectral analysis of these signals was conducted in sequential 5 min blocks (minimum five blocks) and power for each signal was computed in three frequency bands corresponding to low (25–100 s), medium (5–25 s), and short (2–5 s) intervals between movements. Correlations between power obtained from the accelerometer data and power obtained from the filtered ECG confirmed there is very good concordance between the two signals. This was especially true in the band reflecting the most frequent body movements (mean r = 0.93, range 0.76–1.00). These data show that filtered ECG signals can provide a very good marker of body movements in the absence of a specific movement monitor. [HD 045653 and the Sackler Institute of Developmental Psychobiology.]

CONTRIBUTIONS OF THE DORSOLATERAL PONTINE TEGMENTUM TO THE REGULATION OF SLEEP AND WAKEFULNESS IN EARLY INFANCY
A. Gall, A. Poremba, & M. Blumberg
Department of Psychology, University of Iowa, Iowa City, Iowa 52242, U.S.A.

Recently, we described a region within the dorsolateral pontine tegmentum (DLPT) of week-old rats, including the laterodorsal tegmental nucleus (LDT) and parabrachial nucleus (PB), that contributes to the production of high muscle tone. To further explore this region in 8 to 10-day-old rats, we used electrical stimulation to map the locations where high tone in nuchal and extraocular muscles is produced. We found that high tone in both muscle groups was produced by stimulation of the DLPT region, including the LDT, PB, and adjacent regions. Next, to establish that stimulation of cell bodies was responsible for this effect, the cholinergic agonist carbachol was infused in unanesthetized, head-fixed pups. Carbachol infusion (22 nM, 0.1 μl) into the DLPT produced rapid and reliable increases in muscle tone whereas saline infusions did not. Then, to understand more about the circuitry involved in this region, the nucleus pontis oralis was lesioned (using a high concentration of the glutamate agonist quisqualic acid) and the cholinergic antagonist scopolamine (10 nM, 0.1 μl) was infused into the DLPT region. Consistent with previous findings, we found that lesioning the pontis oralis produced chronic levels of high muscle tone; then, infusion of scopolamine produced transient decreases in muscle tone. Finally, chemical lesions of nucleus pontis oralis were performed and pups were injected with 2-deoxy-glucose so as to visualize the metabolic activity. These last data are currently being analyzed. All together, these findings provide additional detail concerning the neural circuit that modulates sleep- and wake-related motor activity in infants. [Supported by grants from the NIMH, MH50701 and MH66424.]
LITTER HUDDLE AND WEIGHT HIERARCHY IN THE NEWBORN RABBIT.
E. Garcia, M. Martinez-Gomez, R. Hudson, & A. Bautista
IIB-UNAM; CTBC-UAT, AP 262, CP 90070, Tlaxcala, Mexico

In litters of newborn altricial mammals, huddling behavior confers benefits to individual participants such as more efficient thermoregulation, and we have found that central positions within the litter huddle are occupied positively with body temperature, growth, and survival. Here we ask if the ability to compete for such advantageous positions is associated with the intralitter hierarchy in body weight, with individual differences in behaviors associated with re-entering the huddle, and with body temperature, growth, and individual survival. On postnatal days 1, 3, 5, and 7, we recorded the frequency of rooting and climbing-over behaviors associated with re-entering the huddle, in the heaviest and lightest pups of seven litters kept at 25°C and filmed at regular intervals from above. Neck and body temperature and body weight were also regularly measured. Mortality was associated with low body temperature and low body weight at birth. Heaviest and lightest pups improved their relative position within the huddle using both rooting and climbing strategies, but lightest pups used rooting more frequently. It remains to be investigated if lightest pups can maintain such gains in position to the same degree as their heavier sibs. [CONACYT 25889-N, PAPIIT-UNAM IN 217100, PIFOP-2002-30-03.]

WALKING AND FALLING: AN EVERYDAY MARATHON
J. S. Garciaiguirre & K. E. Adolph
New York University, New York, NY 10003, U.S.A.

Despite many theoretical claims about the importance of locomotor experience for infants’ psychological development, the nature of infant’s locomotor experience remains largely unexamined. This study is a first step toward a quantitative description of infant’s everyday walking experience. We developed a non-intrusive video-tracking method to count the number and temporal distribution of infants walking steps, infants experience maintaining balance in other postures, and the prevalence of trips, slips, and falls. Experimenters tracked 38 14 months old as they walked with their parents around a city block (where walking was strongly encouraged) and during 16 min of free play (where walking was optional). Our findings indicate that infants accumulate massive amounts of daily practice with balance and locomotion. Infants averaged 1,094 steps in the city block and 572 steps in the free play session. Walking steps were distributed in short bouts (M = 18.4 s), punctuated by rest periods of standing, sitting, and crawling (M = 11.1 s). Some rest periods were induced by falls. Infants averaged 3.9 falls in each condition. Most falls were salient (infants heads touched the floor), but falls rarely resulted in crying (M = 5%) or parent intervention. Moreover, falls were rarely caused by variations in the ground surface. Instead, infants toppled over while standing or walking due to the variability of their own motor system. We discuss results in terms of how immense regimens of variable and distributed practice with balance and locomotion may facilitate improvements across psychological domains. [Research supported by NICHD Grant No. HD33486 to K. E. A.]

REGULATORY RESPONSES TO A ROBOT IN AN OPEN FIELD BY HIGH-RISK TODDLERS
J. M. Gardner, B. Z. Karmel, & R. L. Freedland
Department of Infant Development, NYS Institute for Basic Research in Developmental Disabilities, Staten Island, NY 10314, U.S.A.

The ability to regulate and modulate behavior is fundamental to a broad array of biobehavioral processes and their development. Deficits in autoregulation have far-reaching effects, producing problems in perceptual, cognitive, social/emotional, executive function, language, and motor organization. We measure exploratory behavior of a novel environment in an open field to assess changes in arousal and inhibition to environmental stimuli in high-risk toddlers from 13 to 25 months. Toddlers (13 and 16 months) roam freely and play with toys under three 3-min conditions (stranger present/stranger absent/stranger returns) with the caregiver always present but instructed to not interact as much as possible. The distance from the caregiver across trials is scored. Children stay closer when more aroused due to stranger presence. By 19 months the stranger returning on the 3rd trial no longer has as strong an effect so we add a remote-controlled robot as an arouser, and assess emotionality as well as motor activity. We score behavioral inhibition and emotional regulation in terms of approach/ withdrawal relative to the robot and affect using a five-point scale from very negative to very positive. We find a significant relation between affect and neonatal arousal and attention modulation so long as CNS injury is controlled (n = 133). This procedure produces regulatory variation in motor behavior and affect as a function of arousal and CNS injury. Interestingly, 25 months old show strong memory for the valence of the reaction months earlier, with many children anticipating the robot as indicated by their arousal, verbal, and exploratory behavior. [NIH NICHD grant HD21784, NIDA grant DA06644, and NYS-OMRDD.]

A DOSE-RESPONSE ANALYSIS OF THE EFFECTS OF NEONATAL ALCOHOL EXPOSURE ON SPATIAL WORKING MEMORY PERFORMANCE IN A MORRIS WATER TASK IN ADULT MALE AND FEMALE RATS
D. Garzon & C. R. Goodlett
Department of Psychology, IUPUI, IN 46202, U.S.A.

Heavy, binge-like exposure to alcohol during the early postnatal period in rats (during the 3rd trimester equivalent of human brain development) is known to produce significant deficits in spatial learning and memory. The purpose of this study was to determine the dose-response of alcohol-induced deficits in acquisition of a spatial working memory task using the Morris water maze. Long Evans rat pups were treated on postnatal days (PD) 4 through 9 with 3, 4, or 5 g/kg of alcohol each day. Comparison groups included a sham intubated (SI) control group and separately reared unintubated control (UC) group. On PD 60, rats of all groups were included a sham intubated (SI) control group and separately reared unintubated control (UC) group. On PD 60, rats of all groups were randomly assigned to either place or random training. Animals were tested for 12 days: days 1–7 using four trials a day, days 8–12 using two trials a day, with probe trials on days 10 and 12. The rats given neonatal alcohol exposure were impaired in acquiring efficient performance on trials 2–4, confirmed by a significant trial by group interaction in the path-length over the first 7 days [F(12, 240) = 2.31, p < 0.01]. In addition, males acquired task performance faster than females [F(1,135) = 5.250, p < 0.05]. On days 8–9, significant deficits in finding the platform on the second trial were evident in all three alcohol-treated groups. Results showed a significant group by trial interaction [F(4, 80) = 2.69, p < 0.05]. These data extend previous reports of vulnerability to alcohol-induced deficits in acquiring spatial working memory tasks (Girard et al., 2002), and indicate that the acquisition deficits were apparent even at the lowest dose used. [Supported by AA09838; AA11945.]
EMERGENCE OF FLEXIBILITY: HOW INFANTS LEARN A STEPPING STRATEGY
Simone V. Gill-Alvarez & Karen E. Adolph
New York University, NY, U.S.A.

A hallmark of motor skill is flexibility modifying action to cope with current constraints. In a microgenetic training study, we examined the emergence of a stepping strategy taking smaller, slower steps to cope with changing constraints of increased surface slant. Thirteen 15-month-old infants practiced walking down slopes in 10 sessions over the course of a month; 12 infants in a control group were tested only at sessions 1 and 10. At session 1, we used a psychophysical staircase procedure to estimate the steepest slope infants could walk down their motor threshold. Infants received 20 slopes varying by 2° in a target range of 10 walkable hills, from −14° to +4 relative to their threshold. At sessions 2–9, infants received 30 practice slopes in the target range. At session 10, we estimated a new threshold and tested infants on 20 slopes in a new target range. At session 1, most infants did not exhibit a stepping strategy. By session 10, infants in the practice group consistently used the stepping strategy. They modified step number and time according to the degree of slant ($r = 0.67$ and 0.54 for step number and time, respectively). Footfall measures showed that infants gait modification was prospective: They shortened step length and slowed down before stepping onto steeper slopes. At session 10, infants generalized the stepping strategy to new slopes. Infants in the control group showed improvements, but less so than infants in the practice group. In sum, infants exhibited flexibility by discovering a stepping strategy to walk down slopes. Slope practice helped, but everyday walking experience was sufficient to spur improvements. [NICHD Grant #33486 to Karen E. Adolph.]

PRENATAL CHOLINE AVAILABILITY ALTERS RESPONSES OF ADULT RATS TO NOVEL ENVIRONMENTS AND ENHANCES HIPPOCAMPAL CELL PROLIFERATION AND SURVIVAL
M. J. Glenn, E. M. Gibson, E. D. Kirby, & C. L. Williams
Psychological & Brain Sciences, Duke University, Durham, NC 27708, U.S.A.

Choline supplementation in the maternal diet has lifelong effects on cognitive function of the offspring, leading to improved memory capacity and precision that resists normal, age-induced decline. In the current study, we explored the hypothesis that prenatal choline supplementation may alter rats’ interaction with and response to the environment leading to long-term alterations in hippocampal plasticity and cognitive ability. On embryonic days 12–17, pregnant rats received a control diet containing 1.1 g/kg choline chloride (CON), or a diet supplemented with 5 g/kg choline chloride (SUP). In adulthood, all rats were observed exploring a novel environment with and without objects. Then, half of each diet group received 40 consecutive days of training on a 12-arm radial arm maze; the other half of each group received no training. During the last 10 days of maze training, all rats were injected daily with BrdU and then sacrificed 24 hr or 28 days after the final injection. We found that compared to CON rats, SUP rats showed less anxiety and more exploration in the novel environment; improved spatial memory performance; and increased hippocampal cell proliferation. In particular, the combined effects of training and prenatal choline supplementation appear to have survival-promoting effects on hippocampal cells that exceed the effects of either condition alone. These results reveal that prenatal choline supplementation alters rats’ responses to novel environments and increases hippocampal plasticity suggesting that these brain and behavioral changes may contribute to the life-long improvements in spatial memory. [Supported by AG09525 to C. L. W. and AG025052 to M. J. G.]

RELIEF IN NEWBORNS
N. Goubet, K. D. Strasbaugh, & J. L. Chesney
Department of Psychology, Gettysburg College, Gettysburg, PA 17325, U.S.A.

Previous literature indicates that olfactory familiarity lowers distress in newborns after a painful procedure. The present study examined the determinants of the odor familiarity effect, specifically the role of arousal and condition of familiarization. Forty-four nursing newborns were presented with a vanilla scent or a dry pad during a routine blood draw (heelstick). Half the sample was familiarized with vanilla prior to the procedure (via the crib or the mother) and half was not. During the procedure, infants familiar with vanilla were presented with a vanilla-scented pad, while infants unfamiliar with vanilla were either presented with vanilla or with a dry pad. All infants were swaddled during the procedure keeping arousal levels low. Infants crying, grimacing, and appetitive oral responses (mouthing) were recorded. Infants exposed to the familiar vanilla cried and grimaced significantly less during the heelstick compared to infants in the unfamiliar group. Both groups had significantly lower level of distress by the end of the procedure. Moreover, exposure to the familiar odor led to more mouthing movements overall. Finally, infants exposed to vanilla in the crib cried significantly less during the heelstick than infants in each of the two unfamiliar groups. Infants exposed to vanilla via their mothers cried less during the heelstick compared to infants exposed to unfamiliar vanilla ($p < 0.05$) or a dry pad ($p = 0.07$). The familiar odor was effective in relieving pain during the procedure whether familiarization occurred in the crib or via the mother. These results highlight the mediating role of arousal in the odor familiarity effect. [Financial support provided by a Gettysburg College grant to NG.]
ONTOGENY OF PLACENTOPHAGIA IN MALE AND FEMALE PHODOPUS: DIFFERENCES BETWEEN A BIPARENTAL AND A UNIPARENTAL SPECIES

J. K. Gregg & K. E. Wynne-Edwards
Queen’s University, Kingston, Ontario, Canada K7L 3C7

Placentophagia is virtually universal among parturient female mammals, but generally rare among virgin females of reproductive age. Placentophagia by males during the birth has been observed in some paternal species. However, the ontogeny of placentophagia has not been determined for any species, and data on male placentophagia is very limited.

Here, we have determined the ontogeny of placentophagia in male and female dwarf hamsters (Phodopus) of two species: the biparental Phodopus campbelli and the uniparental Phodopus sungorus. Virgin and reproductive males and females of both species received either placenta or liver, a control tissue, during a 10-min test. Virgin male and female Phodopus sungorus showed low levels of placentophagia at all developmental stages, while reproductive females showed high levels of placentophagia on the day before and the day following the birth.

Placentophagia was also increased in reproductive male Phodopus sungorus on the day following the birth, likely due to familiarity with placenta gained during the birth. By contrast, adult virgin male Phodopus campbelli showed high rates of placentophagia at all developmental stages, while virgin females showed a decline in placentophagia from puberty through peak reproduction. Both male and female Phodopus campbelli showed an increase in placentophagia on the day before and the day following the birth.

Results provide the first evidence for developmental patterns of placentophagia. The increase in placentophagia seen in reproductive male Phodopus campbelli, as well as females, could indicate a relationship between placentophagia and paternal behavior.

[NSERC, CIHR, Queen’s University, OGS.]
MATERNAL BEHAVIOR IN FETAL/NEONATAL IRON DEFICIENT RATS
M. Hall, A. Schmidt, & M. Georgieff
1Department of Psychology, University of Minnesota, MN 55414, U.S.A.
2Department of Pediatrics, University of Minnesota, MN 55414, U.S.A.
3Center for Neurobehavioral Development, University of Minnesota, MN 55414, U.S.A.

Early iron deficiency (ID) is common throughout the developed and developing world. This widespread condition has been associated with changes in brain biochemistry, morphology, metabolism, and behavior (some of which may persist into adulthood despite iron repletion). However, certain evidence (mainly gathered from human studies) suggests that maternal behavior may differ substantially in ID and non-ID mothers. Thus, because maternal behavior has been shown to exert a powerful (and long-term) effect on brain function, it remains unclear how much (if any) of the long-term changes noted in fetal/neonatal ID are contributed to by variations in maternal behavior during the lactational period. The current study endeavored to observe (and quantify) the maternal behavior of ID and control rat mothers within early to mid lactation. Each litter was observed for 30 min a day everyday from postnatal day 4 to 14 and the occurrences of active nursing, passive nursing, pup grooming, self grooming, and time spent in pup contact were recorded. Results indicate no significant differences in the occurrence of these five key maternal behaviors between ID and control litters (>0.05 for all measures). These findings suggest that maternal behavior (as indexed by the behaviors selected) is not likely the major factor leading to the long-term changes in brain structure and function previously observed in ID. [NICHD # HD29421 to M. K. G., NSF Graduate Fellowship to A. T. S.]

STIMULUS CONTINGENCY AND PERINATAL LEARNING IN BOBWHITE QUAIL CHICKS
C. W. Harshaw & R. Lickliter
Department of Psychology, Florida International University, Miami, FL 33199, U.S.A.

Few studies have directly investigated the differential impact of contingent and noncontingent stimulation on early perceptual learning and development in precocial avian species. The few studies that have been done have produced mixed results. Previous research with bobwhite quail chicks has shown that neonates require up to 240 min of passive stimulation with an individual bobwhite maternal call to prefer that familiar call over a novel call. In nature, young organisms are exposed to contingent, active nursing, passive nursing, pup grooming, self grooming, and time spent in pup contact. Chickens that heard an individual bobwhite maternal call to prefer that familiar call over a novel call. The current study endeavored to observe (and quantify) the maternal behavior of ID and control rat mothers within early to mid lactation. Each litter was observed for 30 min a day everyday from postnatal day 4 to 14 and the occurrences of active nursing, passive nursing, pup grooming, self grooming, and time spent in pup contact were recorded. Results indicate no significant differences in the occurrence of these five key maternal behaviors between ID and control litters (>0.05 for all measures). These findings suggest that maternal behavior (as indexed by the behaviors selected) is not likely the major factor leading to the long-term changes in brain structure and function previously observed in ID. [NICHD # HD29421 to M. K. G., NSF Graduate Fellowship to A. T. S.]

REFINING THE BOUNDARY OF INFANTILE AMNESIA
H. Hayne & N. Davis
Psychology Department, University of Otago, Dunedin, New Zealand

When asked to recall their earliest memories, most adults have no recollection of their infancy or early childhood. Freud referred to this phenomenon as infantile amnesia; he argued that our early memories remained in storage, but were repressed due to their unacceptable sexual or aggressive content. Subsequent research has failed to provide support for Freud’s repression model. Recent attempts to explain infantile amnesia have focussed on the psychobiology of memory development during infancy and childhood. An adequate theory of infantile amnesia rests on a clear definition of the boundaries of the phenomenon. Although Freud originally argued that infantile amnesia extended into the 6th to 8th year of life, many researchers have since argued that this boundary is not correct. On the basis of more than 100 years of research, the consensus view is that infantile amnesia ends between a person’s 3rd or 4th birthday. In 1993, however, Usher and Neisser published a landmark study in which they lowered the boundary again, arguing that adults can recall some events that occurred when they were as young as 2. Here, we revisit the procedure used by Usher and Neisser to refine the boundary of infantile amnesia. We asked 50 adults to recall the birth of a sibling who was born when the target adult was 1 to 5 years old. Participants were asked to answer the 17 questions originally posed by Usher and Neisser. When we applied the scoring criterion originally used by Usher and Neisser, we replicated their results. When we controlled for the possibility of guessing, however, the boundary of infantile amnesia was substantially higher. [A Marsden Grant from the Royal Society of New Zealand to H. H.]

ASTROCYTES GOING EMOTIONAL: STRESS-INDUCED CHANGES OF S100\(\beta\) AND GFAP EXPRESSION IN THE RODENT PREFRONTAL CORTEX
C. Helmeke, R. Antemano, W. Ovitscharoff, Jr., & K. Braun
Department of Zoology/Developmental Neurobiology, Otto von Guericke University, Magdeburg, Germany

Astrocytes, once considered as mere supporting cells in the brain, are now acknowledged to play a major role in neuronal plasticity during brain development. However, only very few studies have analyzed the role of glia cells in the experience-driven synaptic development. We applied a paradigm of repeated mild stress (daily 1 hr separation from the family during the first 3 weeks of life) and quantified the densities of GFAP and S100\(\beta\) immunoreactive (IR) astrocytes in the medial prefrontal cortex (mPFC) of trumpet-tailed rats (Octodon degus). Significantly lower densities of GFAP-IR astrocytes were found in layer III of all investigated prefrontal subregions, i.e., the anterior cingulate cortex, precentral medial cortex, prelimbic cortex, and infralimbic cortex in the stressed animals compared to their control counterparts. In contrast, the stressed animals displayed elevated densities of S100\(\beta\)-IR astrocytes in layer I-III of the anterior cingulate cortex and the precentral medial cortex compared to controls. Glia–neuron interactions are critical during synaptic formation, stabilization, and pruning. Thus, it is tempting to postulate a functional link between the experience/stress-induced astrocytic changes and the previously reported increases of dendritic spines in the prefrontal cortical regions after applying the identical stress paradigm. In particular, the observed stress-induced enhanced expression of the astrocytic protein S100\(\beta\), which has been shown to act as trophic factor for synaptogenesis, might be one of the glial factors which are involved in the epigenetic control of neuronal and synaptic development. [Supported by a fellowship from the DAAD (R. A.) and GIF.]
PUTATIVE POTENTIATION IN A PRECOCIAL SPECIES: SOCIALLY MEDIATED FACILITATION OF RESPONSES DURING ISOLATION IN PREWEANING GUINEA PIGS

M. B. Hennessy,1 E. Miller,1 & H. N. Shair2
1Department of Psychology, Wright State University, Dayton, OH, U.S.A.
2New York State Psychiatric Institute and Columbia University College of Physicians and Surgeons, New York, NY, U.S.A.

In rat pups, ultrasonic vocalizations during isolation can be doubled by permitting brief reunion with the mother prior to a subsequent period of isolation. Whether this socially mediated enhancement of vocalizing (termed potentiation) is limited to the rat and other altricial rodent species is not known. We examined possible socially mediated effects during isolation in the precocial guinea pig pup. In Experiment 1, 10 days old were isolated in a novel environment for 10 min, reunited with their mother for 5 min, and then isolated for another 10 min. Littermate controls were not reunited with the mother during the 5-min period. Control, but not mother-exposed, pups showed a decline in whistle vocalizations and line-crossings from the first to the second 10-min isolation. In Experiment 2, pups reunited with a littermate, as well as non-reunited controls, showed declines in both vocalizing and line-crossings from the first to the second isolation. Thus, exposure to the mother had a modest, but significant, facilitative effect on responses during isolation, which based on Experiment 2, cannot be accounted for by her familiarity. The effect in the guinea pig (prevention of a decline) was of much smaller magnitude than seen in the rat pup (approximate doubling of response) and, unlike the case for the rat, involved locomotor activity as well as vocalizing. In sum, socially mediated effects on responses during isolation are not unique to altricial rodents. Yet, the magnitude and nature of the effect vary across species and may depend on such factors as relative independence of the young and the species ecological niche.

HOW MUCH FLEXIBILITY IS THERE IN 12-MONTH-OLD INFANTS REPRESENTATIONAL FLEXIBILITY?

J. S. Herbert & E. J. H. Jones
Department of Psychology, University of Sheffield, Sheffield S10 2TP, U.K.

The ability to abstract common information across situations is an important aspect of learning and memory. Although human infants can learn and retain specific and detailed information from early in life, flexibility in memory retrieval has a protracted development across the infancy period. Unless there is an almost exact match between the conditions present at the time of encoding and at the time of retrieval, then infant memory retrieval is disrupted. Between 18 and 24 months of age additional cues provided at the time of encoding or at the time of retrieval can facilitate flexibility across changes in stimuli. In two experiments, we examined whether it was possible to facilitate memory flexibility in 12-month-old human infants tested in the deferred imitation paradigm. In Experiment 1, increasing the number of demonstrations in a massed or distributed manner, or providing variability training, failed to facilitate representational flexibility. In Experiment 2, we examined whether memory flexibility might be influenced by events occurring during the retention interval. One group of infants remained in the demonstration/test context throughout the 10-min delay interval. An additional group of infants left the demonstration/test context during the delay. The results suggest that at 12 months of age, events occurring during the retention interval can impact on the flexibility of infant memory retrieval.

EFFECT OF MATERNAL AND LITTERMATE DEPRIVATION DURING THE POSTNATAL PERIOD ON THE DEVELOPMENT OF MATERNAL AND OFFENSIVE AGGRESSION IN FEMALE RATS

M. Hernández-Curiel,1,2 M. Pérez-Ledezma,1,2 K. L. Hoffman,1 & A. I. Melo1
1CIBA, CINVESTAV-Lab. Tlaxcala, Universidad Autónoma de Tlaxcala, México
2Maestría en Ciencias Biológicas, UAT, México

Early experiences in the nest are critical for the development of subsequent emotional, social, and behavioral systems. However, there are almost no data related to early experience on the development of aggression. In order to assess the role of maternal care and littermate contact early in life in rats, we removed female pups from the nest on postnatal day 3 and raised them in an artificial system until postnatal day 20 with (AR-SOC) or without (AR) two same-age pups. As adults, all females were tested for offensive aggression (before mating) and for maternal aggression (lactation day 5) using the intruder test. Compared to maternally reared rats (MR), in the offensive aggression task AR rats showed more attack postures, attacks, and bites, and also induced more subordinate postures in the intruder females (p < 0.05, for all behaviors). Furthermore, the latencies to display the first attack and to induce the first subordinate posture in the intruder female were shorter in AR rats compared to MR. Interestingly, the level of aggression of AR-SOC females was similar to MR. In the maternal aggression task, AR dams displayed more attacks toward the intruder than AR-SOC and MR. Additionally, the latencies to the first attack and bite, and to the induction of a subordinate posture by the intruder were shorter in AR than in AR-SOC and MR rats. These findings support the hypothesis that maternal and sibling stimuli during the postnatal period participate in the development of aggression in the rat. [Financed by project CONACyT SEP-2003-C02-43793 to Angel I. Melo.]

DEVELOPMENTAL SELECTION: EVOLUTIONARY CLUES TO THE NATURE OF ONTOGENY

Myron A. Hofer
Department of Psychiatry, Columbia University, New York, NY 10032, U.S.A.

Recent progress in a synthesis of Evolutionary and Developmental Biology, or Evo-Devo, has given development new importance in the generation of evolutionary change. As I continued to follow this new field, it occurred to me that when a prolonged phase of development began to evolve within animal life cycles, novel developmental processes must have been selected to carry on the functions of creating variation and maintaining heritability, functions that in unicellular organisms had been more directly related to the genetic expression of replicated and recombined genes. Looking for developmental as well as genetic mechanisms that promoted heritability in the next generation, led me in some interesting directions and seemed to provide a way to cut through the false dichotomy between nature and nurture. When combined with the more familiar functions of constructing a successful adult organism and promoting survival and adaptation during its immaturity, a concept of developmental selection emerged. Perhaps development can be better understood by thinking of it as having been organized during evolution to embody these four principal functions: construction, adaptation, variation, and inheritance. I plan to give examples of how this concept can provide a coherent way of thinking about development that raises new questions and specific hypotheses about how development evolved and how it works.
66

SOCIALLY STIMULATED PREGNANT DAMS PRODUCE OFFSPRING THAT SHOW ACCELERATED ODOR-BASED HOMING
Hunter G. Honeycutt & Jeffrey R. Alberts
Department of Psychology, Indiana University, Bloomington, IN, U.S.A.

Mice (Mus musculus) born to dams housed in social isolation throughout pregnancy (IsoPreg) begin on Postnatal Day 6 to differentially approach their home bedding versus clean bedding, whereas offspring of dams housed with two other adults during pregnancy (SocPreg) display such odor-based homing behavior on Day 4. Although the accelerated onset of homing by SocPreg could be attributed to a variety of non-sensory factors, our data suggest that SocPreg pups differ from IsoPreg pups in the functional development of their olfactory systems. Social housing during the final week of gestation is necessary and sufficient to accelerate onset of homing. Moreover, exposing pregnant IsoPreg mice to bedding taken from socially housed dams accelerates homing onset in the IsoPreg offspring, though not to the same extent as the full social context. Overall, it appears that the facilitation of homing onset involves a combination of developmental factors and social stimuli. These data underscore the idea that fetal development is situated in the context of the mother, who is herself embedded within a larger social context. This broader social context regulates offspring development. [NIH grant MH-28355 and HD-07475.]

67

TIME WINDOWS FOR OPERANT LEARNING DURING INFANCY
V. C. Hsu & C. Rovee-Collier
Department of Psychology, Rutgers University, Piscataway, NJ 08854, U.S.A.

A time window is a limited period after an event is over when its memory can be retrieved. A succeeding event must occur within the time window of a prior event to be integrated with it. Three months old, for example, remember a single operant session for 3 days. When session 2 occurs after 3 days, infants remember the task for 8 days, confirming that the two sessions were integrated; when session 2 occurs after 4 days, infants treat it as a new first session and remember it for 3 days. Currently, we asked whether a similar time-window phenomenon occurs for older infants, who remember longer. Prior research found that 6, 9, and 12 months old remember two operant sessions separated by 1 day for 2, 6, and 8 weeks, respectively. How long they remember one session is unknown. To determine the time window for a single session, therefore, we operantly trained infants of each age for one session and measured their retention after varying delays. At each age, infants remembered one session approximately half as long as two consecutive sessions. Next, we administered session 2 either just inside or just outside the time window, again assessing retention after varying delays. When session 2 was within the time window, all ages remembered the task longer than after two consecutive sessions; when session 2 was outside the time window, 6 and 9 months old treated it like another first session, remembering accordingly. (The testing of 12 months old is still underway.) We conclude that the timing of information within a time window influences whether knowledge accumulates in the knowledge base throughout infancy. [Supported by NIMH grant #32307 to C. R. C.]

68

DEVELOPMENTAL AND PHARMACOLOGICAL ANALYSIS OF TRACE AND SERIAL COMPOUND FEAR CONDITIONING
Department of Psychology, College of William and Mary, Williamsburg, VA 23187, U.S.A.

Serial compound conditioning is procedurally similar to trace conditioning (CS1 → US), except that the trace interval between offset of CS1 and onset of the US is filled with a second CS (i.e., CS1 → CS2 → US). Trace conditioning exhibits a later ontogenetic emergence than delay conditioning. The late ontogeny of trace conditioning parallels the protracted maturation of the hippocampus and its cholinergic innervation. Three experiments were designed to examine the effects of serial compound conditioning on fear responding to a trace CS in young animals, 18 and 25 days of age. Results can be summarized as follows: (1) greater freezing was observed to the trace CS in animals that were given serial compound conditioning (light → tone → shock) compared with animals that were trained with standard trace conditioning trials, (2) scopolamine produced a dose-dependent decrease in responding to the trace CS at both ages, in animals trained with or without a serial compound, (3) scopolamine had no effect on acquisition of fear to CS2 and scopolamine’s deleterious effects on trace acquisition were mediated by its central actions. Collectively these results show that serial compound conditioning can enhance trace acquisition in young animals, and that the presence of CS2 in the serial compound does not alter the cholinergic dependence of trace conditioning. Indeed, CS2 seems to enhance activity in an otherwise immature hippocampal-cholinergic pathway. These data have implications for the ontogeny of trace conditioning and the neurobiological mechanisms of serial compound conditioning. [NIAAA grant AA02466.]

69

POSTURE-SPECIFIC LEARNING IN 12-MONTH-OLD CRAWLERS AND WALKERS
S. Ishak, S. A. Lobo, & K. E. Adolph
Department of Psychology, New York University, New York, NY 10003, U.S.A.

Previous cross-sectional and longitudinal research with infants on adjustable slopes (0–90 cm) and gaps (0–90 cm) revealed posture-specific learning from crawling to walking: Infants avoided risky slopes and gaps in an experienced crawling posture but attempted impossibly risky increments in a newly acquired walking posture. However, a recent study with 12-month-old crawlers and walkers on the visual cliff paradigm addressed these discrepant findings by testing 12-month-old experienced crawlers (M = 3.5 months) and novice walkers (M = 1.1 months) descending adjustable slopes (0–50°). In contrast to the visual cliff where infants were tested in only one trial on the drop-off, in the slope paradigm, infants were tested on dozens of trials. We used a psychophysical staircase procedure to estimate the steepest slope each infant could crawl or walk down 50% of the time, their motor threshold. Slopes shallower than the threshold were safe; slopes steeper than the threshold were risky. Experienced crawlers accurately gauged possibilities for action by attempting to descend safe slopes and avoiding risky ones. In contrast, novice walkers indiscriminately attempted to walk down both safe and risky slopes. For example, walkers attempted slopes 16 beyond their threshold on 83% of trials, but crawlers attempted increment on only 27% of trials. Results are discussed in terms of differences between the visual cliff and adjustable slope paradigms and in terms of flexibility and specificity of motor learning. [Research supported by NICHD Grant No. HD33486 to K. E. A.]
LEARNING FROM SLIPPING AND FALLING

A. S. Joh, K. E. Adolph, & N. K. DeWind
Department of Psychology, New York University, NY 10003, U.S.A.

Falls are common in infant locomotion. Although most falls do not cause serious injuries, falling presents a prime opportunity for learning. Multiple cues visual cues and physical sensations accompany falls. Therefore, we asked whether infants benefit from such opportunities and learn from falling. Eighteen 15 months old walked down a walkway interrupted by a slippery Teflon insert. The entire walkway was sloped so that infants slipped and fell backwards if they stepped onto the Teflon. An experimenter following alongside rescued infants as they fell. The Teflon was visually distinct from the rest of the walkway: It was white and shiny like ice, while the rest of the walkway was covered with blue carpet. On trial 1, all infants stepped onto the Teflon, slipped, and fell. On subsequent trials, infants averaged 12 trials to learn from falling. Current findings expand our previous work where we tested crawling and walking infants. We assessed whether the sequential presentation of the same information to the auditory and visual modalities would also facilitate the detection of amodal properties during prenatal development. Bobwhite quail embryos were exposed to one of two experimental conditions for 10 min/hr during the 24 hr prior to hatching: (1) A Bimodal Sequential-Redundant group received sequential presentations of a 3 s burst of an individual maternal call followed immediately by a 3 s burst of a pulsed light, which matched the temporal properties of the call. Thus, the amodal properties of rhythm, rate, and duration were presented to both the visual and auditory modalities, (2) An Onset Synchrony Group received exposure to the same maternal call with the pulsed light synchronized to the onset of the first note of each call burst, thus providing bimodal temporal synchrony during each call exposure. Embryos exposed to sequential intersensory redundancy did not prefer the familiar maternal call over a novel maternal call when tested at 24 hr following hatching. In contrast, embryos from the onset synchrony group preferred the familiar call at testing. These results indicate that temporal synchrony is a necessary component of the salience of intersensory redundancy during early development. [This research was supported by NICHD grant RO1 HD048423.]
VOCAL DEVELOPMENT, VOCAL LEARNING, AND BABBLING IN AN AVIAN SPECIES: PARALLELS TO HUMAN DEVELOPMENT?
G. Kaplan
Centre for Neuroscience and Animal Behaviour, University of New England, Armidale, NSW 2351, Australia

Current debates on song production, song development, and song maintenance have received particularly strong impetus from neuroscience. In this context, song has functioned as a model case for the study of memory formation and for the complex interaction between neural activity, auditory feedback, plasticity, attrition and development of song. The avian forebrain (now called the pallium) does not share the layered structure of the mammalian cortex but it has many of the same functions, in particular those known to involve higher cognition, and birds share with humans (but few other orders and species) the ability to learn vocalizations. Understanding the mechanisms of bird vocal development may have substantial implications for research on human speech development. This paper will present the results of 5 years of research into vocal development and vocal learning of the Australian magpie (Gymnorhina tibicen) and my conclusions suggest that the acquisition of learning seems to follow discreet stages of development and of phonetic play (such as babbling) and these roughly correspond to human language development. Further, my results show that brain plasticity for learning new sounds may be life long, as in humans. Given these results, birds may offer a more pertinent model for human language development than do non-human primates.

DETERMINANTS OF ASSOCIATIVE LEARNING FAILURES IN INFANTS OF DEPRESSED MOTHERS
P. S. Kaplan, J. K. Dungan, A. Burgess, & A. J. Moreno
Department of Psychology, University of Colorado at Denver and Health Sciences Center, Denver, CO 80217, U.S.A.

Infant-directed (ID) speech produced by depressed mothers contains less fundamental frequency modulation than that produced by non-depressed mothers, and fails to promote associative learning when it signals a smiling face reinforcer in a conditioned-attention paradigm. The purposes of the current work were: (a) to test whether fundamental frequency modulation is the main proximate cause of learning failures in response to “depressed” ID speech, and (b) to examine whether the quality of current mother-infant interactions predicts the signaling (CS) effectiveness of a mother’s ID speech in this paradigm. In Experiment 1, extent of fundamental frequency modulation in a mother’s ID speech was significantly lower for depressed than non-depressed mothers, but did not predict infant learning. In Experiment 2, after several demographic variables and maternal depression diagnosis were taken into account, a mother’s rated sensitivity in a brief laboratory mother-infant play session predicted a significant increase in proportion of variance accounted for in infant learning. This finding is consistent with the possibility that the salience of a mother’s ID speech CS is affected by an infant’s experience with the mother, and may be explained as an instance of latent inhibition, learned irrelevance, or a conditioned emotional response.

PARENT EMOTIONAL AVAILABILITY MODERATES TEMPERAMENTAL EFFECTS ON CHILD CORTISOL
D. A. Kertes & M. R. Gunnar
Institute of Child Development, University of Minnesota, 51 E River Rd, Minneapolis, MN 55455, U.S.A.

Biological predispositions involving heightened behavioral and adrenergic responses to stressors may be modulated by the quality of early life care. In human infants, temperamental fearfulness, anger proneness, and maternal behavior are linked with variation in infants’ cortisol responses to stressors. The present study assessed the continued impact of parent-child relations on children’s cortisol levels during the preschool years, a period in which effortful control of attention and behavior is developing. One hundred two children aged 3–4 years and their primary caregivers participated. Salivary cortisol was collected five times over a 2-hr lab session designed to challenge children’s coping capacities. Child temperament ratings were provided by parents and experimenters. Dimensions of parent emotional availability were assessed via observation of semi-structured parent-child play. Patterning of children’s cortisol using HLM indicated linear \( t(99) = 2.2, p < 0.05 \) and quadratic \( t(99) = 3.0, p < 0.05 \) change over the session. Parent sensitivity moderated child anger in predicting overall cortisol levels, \( t(99) = 2.6, p < 0.05 \). Linear and non-linear change in cortisol was predicted by child shyness, \( t(96) = 2.2, p < 0.05 \). Parent intrusiveness interacted with shyness in predicting cortisol change following separation from the parent, \( t(96) = 2.7, p < 0.01 \). Parenting effects were not accounted for by variation in children’s ability to effortfully regulate attention/behavior. These findings support the notion that child temperament and parent-child emotional relationships may continue to act in concert to influence child cortisol responses to stressors into the preschool years.
PATTERNS OF EARLY BEHAVIORAL DEVELOPMENT AFTER LOW DOSE PRENATAL ADMINISTRATION OF THE NEUROTOXIN METHYLAZOXYMETHANOL (MAM)
G. A. Kleven & S. R. Robinson
Department of Psychology, University of Iowa, Iowa City, IA 52242, U.S.A.

Recent interest has been generated in a phenomenon known as prenatal programming, where prenatal insults lead to silent damage or vulnerability that does not emerge as functional deficit until later in life. Methods that allow direct fetal observation in rodents now provide the means necessary to develop a mammalian model of early behavioral deficits resulting from prenatal insults, including those that lead to prenatal programming. In this study, fetal rats were exposed to a low dose (10 mg/kg) of the neurotoxin methylazoxymethanol (MAM), by intraperitoneal injection to the pregnant dam on E17 of gestation. At subsequent ages (E18-P10), direct observations of behavior were made using a battery of early behavioral measures including both spontaneous movement and evoked responses. These observations revealed deficits that emerged in waves across early development at the peak expression of each newly emerging behavior. This pattern of variability in the timing and expression of behavioral deficits reveals, for the first time experimentally, the possible pattern of early behavioral development likely to be observed during the emergence of prenatal programming. Because deficits were transient, revealed only at time points early in the peak expression of newly emerging behaviors, traditional outcome measures are unlikely to detect this type of neural insult. Consequently, these results suggest that the best methods for detection and investigation of insults likely to produce effects of prenatal programming are quantitative measures designed to assess the early emergence of behavior. [Supported by APA Dissertation award to G. A. K., and HD33862 grant to S. R. R.]

EXPERIENTIAL PARAMETERS FOR ODOR-GUIDED HUDDLING PREFERENCES IN RAT PUPS
S. Kojima & J. R. Alberts
Department of Psychology, Indiana University, Bloomington, IN 47405, U.S.A.

By Day 15, a rat pup huddles preferentially with either an animal or an object bearing an odor previously associated with its dam. The present study was designed to identify during the first 14 postnatal days a possible sensitive period in the establishment of odor-guided huddling preferences. Beginning on day 1, 5 or 10, pups received five daily 2-hr exposures to a lactating foster dam anointed with a novel scent. Littermate control pups were similarly exposed to the odor but in the absence of a dam (i.e., mere exposure). On day 15, when odor-guided huddling naturally begins, pups exposed to a maternally paired odor from days 5–9 or days 10–14 displayed a reliable preference for the paired odor, but the youngest group did not. Three days of exposure conducted on days 12–14 were not sufficient for establishing a preference on day 15. Additional analysis of the data revealed that female pups more reliably acquired the olfactory huddling preference than did males. This was also seen in an additional group in which odor conditioning performed on days 10–14, but testing was conducted on day 20. In this retention test, only females showed a significant preference for a maternally paired odor. The present study did not reveal a circumscribed sensitive period for the acquisition of odor-guided huddling, but it did identify: (a) two periods sufficient for inducing preference, (b) an apparent lower limit of duration of exposure for such induction, and (c) a sex difference in acquisition or expression of odor-guided huddling preference. [Supported by NIH MH-28355 grant to J. R. A.]
AGE-DEPENDENT CORRELATION OF C-FOS ACTIVATION AND COCAINE PREFERENCE IN RATS
L. Kussmaul, L. Napierata, & S. Andersen
Department of Psychiatry, Harvard Medical School, Laboratory of Developmental Neuropharmacology, McLean Hospital, Belmont, MA 02478, U.S.A.

Adolescence is a time of dramatic change in brain morphology and function during which drug abuse often emerges. The areas of brain activation underpinning the transition between no interest in pre-adolescence to adolescent cocaine preference are not well understood and could provide insight as to why this is such a drug-vulnerable time of development. Our goal in this study was to determine whether an association exists between c-fos activation and behavioral drug preference in animals of different ages. Juvenile (25 days old), adolescent (40 days), and young adult (60 days) rats were placed in environments paired with either saline or 10 mg/kg cocaine for 2 days and tested in a drug-free state. Once preference or aversion to the cocaine-associated side was established, they remained immediately in that chamber for an additional 30 min, were perfused, and prefrontal cortical structures (cingulate (Cg) 1 and 2, infralimbic, and orbital) were assayed for c-fos immunoreactivity. Our results indicate that the pre-adolescent animals (P25) demonstrated a significant behavioral aversion to the cocaine-conditioned chamber that did not correlate with c-fos response in any cortical region ($r < 0.3$). By adolescence, a strong correlation ($r = .84$) was observed between c-fos immunoreactivity in Cg1 and level of drug preference or aversion. These data support our previous neurochemical findings that the prefrontal cortex is becoming more adult-like during this transition and implicated the Cg1 region specifically in vulnerability to drug abuse emergence at this stage of development. [NIDA (DA-015403).]

DEVELOPMENTAL SPREAD OF NEURAL ACTIVATION FOLLOWS PATH OF SEIZURE CIRCUITY DURING EPILEPTOGENESIS IN SEIZURE-PRONE EL MICE
M. P. Leussis, S. M. Korbey, & S. C. Heinrichs
Department of Psychology, Boston College, Chestnut Hill, MA 02467, U.S.A.

The EL mouse, a model of multifactorial epilepsy, develops recurrent seizures, but onset of seizure susceptibility is environmentally dependent. Under standard housing conditions, onset of seizure susceptibility occurs around 80–90 days of age. In susceptible individuals, seizures can be reliably elicited by a repeated tail suspension protocol. In the first part of the study, we examined neural activation elicited by tail suspension at three different ages: juvenile (25 days old), adolescent (40 days), and young adult (60 days). Juvenile and adolescent mice experienced two 30-s-tail suspension or remained naive, and expression of c-fos protein was examined. Tail suspension elicited significant age- and region-dependent increases in c-fos expression in EL but not in DDY mice, even though no seizures were observed. With increasing age, activation occurred at progressive points in the seizure-circuitry, mirroring the generalization of an actual seizure event. In the second part of the study, we assessed whether environmental enrichment, which can delay the onset of seizure susceptibility, could decrease the tail-suspension induced neural activation observed in EL mice. Enrichment attenuated the tail-suspension-induced increase in c-fos expression in several brain regions including the locus ceruleus and CA3 region of the hippocampus. [C.U.R.E. and Boston College (S. C. H.).]
FRICTION UNDERFOOT AFFECTS INFANTS ABILITY TO COPE WITH SLOPES

S. A. Lobo, S. Ishak, L. B. Karasik, K. E. Adolph
Department of Psychology & Department of Applied Psychology, NYU, New York, NY 10003, U.S.A.

Low friction exacerbates changes in surface slant. Previous research showed that 14-month-old walkers accurately gauge safe versus risky slopes based on degree of slant, but not based on surface friction. Previous work also showed that walking experience enables infants to better use perceptual information to guide their actions. The current study asked whether 18 months old might fare better on low friction slopes. By 18 months, infants have more everyday walking experience and more exposure to various friction conditions than 14 months old. We tested infants on an adjustable, sloping carpeted walkway (0°–30°) either walking barefoot (N = 24) or wearing Teflon soled shoes (N = 16). We estimated an individualized motor threshold using a psychophysical staircase procedure and compared infants motor decisions to their own walking skill. As expected, friction affected infants ability to walk down slopes. Infants could walk down much steeper slopes barefoot (M = 24°) than in Teflon shoes (M = 10°). Infants in the barefoot group matched attempts to walk to the probability of success: Attempts decreased with risk; they attempted slopes 4° steeper than their threshold on 37% of trials and slopes 10° steeper than threshold on 34% of trials. In contrast, infants in the Teflon group overestimated their walking ability. They attempted slopes 4° steeper than their threshold on 89% of trials and 10° steeper on 79% of trials. When slopes were noticeably steeper 18°> threshold attempts decreased to 25%. Findings indicate that experienced infant walkers use depth cues, such as slant, to guide their motor decisions but do not take friction into account. [Supported by NICHD 42697 grant to K. E. A. and C. T. L.]

EFFECTS OF NEONATAL HANDLING ON MATERNAL ODOR PREFERENCE IN THE RAT FEMALE PUPS: ROLE OF NORADRENALINE/CREB PATHWAY

Physiology, UFRGS, Porto Alegre, RS, Brazil

The disruption of the mother-pup relationship may induce profound long-lasting behavioral and neuroendocrine changes. Rat pups recognize their mothers through olfactory cues. This early odor learning in rats is associated with increased noradrenaline (NA) and cAMP response element-binding protein (CREB) phosphorylation in the olfactory bulb (OB). Present study aimed to analyze the effects of neonatal handling on maternal odor preference test and the NA/CREB pathway in female rat pups. Pups were daily handled for 1 min during the first 7 days (repeated handling) or just once on day 7 after delivery (single handling). Nonhandled pups were left undisturbed. The behavior in the odor preference test was evaluated in the repeated handled pups on day 7 (15 min after handling) and 8 (24 hr after handling). Levels of CREF, pCREB, NA, and MHPG in the OB were analyzed on day 7. Neonatal repeated handled pups tested on day 7 and 8 showed increased latency to reach the nest bedding compared to nonhandled pups. Reduced maternal odor preference was correlated with reduced sexual preference in adulthood. Single handling induced no significant change on the odor preference test, but increased pCREB levels in the OB compared to nonhandling group. Repeated handling did not change pCREB. Neither repeated nor single handling altered NA content, but MHPG increased in the repeated and single handling compared with nonhandling group. Neonatal repeated handling decreases maternal odor preference and increases activity of NA/CREB system in the OB in rat pups and decreases sexual behavior in adulthood. [FAPESP, CNPq, and CAPES.]

ANIMAL MODELS

Bar-Ilan U, Israel
Felsenstein Med Ctr, Tel-Aviv U, Israel
U North Carolina, U.S.A.

Childhood depression is common, recurrent, and associated with significant morbidity and mortality. There are notable differences in the neurobiological correlates and treatment response of depressed children and adults. Most notably, depressed children and adolescents fail to respond to antidepressant treatments (that target brain monoamines) as well as adults do. To examine a potential new antidepressant approach for childhood depression, we asked whether prepubertal rats of two different “genetic animal models” for depression [Flinders Sensitive Line (FSL) and their controls, Sprague-Dawley (SD) rats; Wistar Kyoto (WKY) and their controls, Wistar rats] exhibit abnormal levels of Dehydroepiandrosterone (DHEA), in four central regions of the limbic system [nucleus accumbens, ventral tegmental area, amygdala and hypothalamus]. We also measured dopamine and serotonin in these regions. The results suggest that prepubertal FSL and WKY rats exhibit separate patterns of abnormal levels of DHEA and monoamines in different regions of the limbic system. These different patterns may reflect two different subgroups of childhood depression. We previously found that prepubertal rats of one strain show co-morbidity of depression and anxiety and severe symptoms of depression (WKY rats), while the other strain does not. Similarly, there are subgroups of human childhood depression showing similar different patterns of symptoms. Our two different genetic animal models can help in the attempts to understand the neurobiological basis of childhood depression and may contribute to successful treatment strategies for different patterns of this pathology. [Supported by the Israel Science Foundation (A. W)].

ADOLESCENT ETHANOL ADMINISTRATION HAS LASTING EFFECTS ON LOCOMOTOR ACTIVITY IN ADULT FEMALE RATS

Antonette M. Maldonado & Cheryl L Kirstein
Cognitive and Neural Sciences, Department of Psychology, University of South Florida, Tampa, FL 33620, U.S.A.

Initiation of alcohol use during adolescence is high and the propensity to continue use into adulthood is greater for individuals who begin use during this developmental period. The present study was conducted to assess the effects of repeated ethanol administration during adolescence on ethanol-induced locomotor activity (LA) to a moderate (0.75 g/kg) or high dose (1.5 g/kg) of ethanol. Female rats were pretreated with 0.75, 1.5 g/kg ethanol, or saline b.i.d. from postnatal days (PND) 35–46. Baseline LA was assessed (PND 34), in response to acute ethanol (PND 35), and after repeated ethanol administration (PND 46). On PND 34 there were no differences in LA among the groups. Animals administered 1.5 g/kg ethanol displayed decreased LA relative to all other groups on PND 35. After repeated ethanol, PND 46 animals pretreated with 0.75 g/kg ethanol displayed elevated LA relative to saline controls. Animals administered 1.5 g/kg ethanol had similar levels of LA as saline controls. Ethanol injections were discontinued for 2 weeks, which brought all animals to adulthood (PND 60), and animals were challenged with ethanol or saline. At the challenge test, animals pretreated and challenged with 0.75 g/kg ethanol displayed elevated LA at all time points relative to animals administered acute ethanol as adults. In contrast, animals pretreated and challenged with 1.5 g/kg ethanol displayed similar levels of LA relative to animals treated with acute ethanol as adults. Results from the present study demonstrate some of the long-term consequences of alcohol exposure during adolescence on behavior in adulthood.
PERINATAL DEVELOPMENT OF HINDLIMB COORDINATION IN THE RAT. II. MOTOR LEARNING MODIFIES 5-HT-INDUCED STEPPING

A. J. Marcano-Reik, M. R. Brumley, & S. R. Robinson
Department of Psychology, University of Iowa, Iowa City, IA 52242, U.S.A.

Interlimb motor training results in changes in movement coordination in the perinatal rat. Hindlimb training with a stiff interlimb yoke produces conjugate (in-phase) movements characterized by both hindlimbs moving together in parallel trajectories. On the day after birth (P1), rat pups show an eightfold increase in conjugate hindlimb movements after a 30-min period of in-phase training. Conjugate hindlimb activity runs counter to the typical pattern of alternated (antiphase) interlimb coordination, which is characteristic of quadrupedal locomotion. Hindlimb training with an interlimb stepper produces an alternated pattern of movement that is similar to air stepping. On P1, training with a stepper results in a 50-fold increase in alternated stepping. To evaluate whether species-typical behavior may be affected by this form of motor training, P1 pups received in-phase or antiphase limb training followed by an IP injection of 3.0 mg/kg quipazine (a 5-HT agonist). Quipazine induces hindlimb stepping in perinatal rats, and thus is presumed to activate neural circuitry associated with locomotion. Video recordings were analyzed to characterize hindlimb coordination for all subjects during a 5-min baseline, a 30-min training period, and a 15-min post-injection period. Quipazine effectively promoted alternated stepping in control (unyoked) subjects. Alternated hindlimb movements were diminished after in-phase training and remained pronounced after antiphase training. The effects of motor learning on 5-HT-induced stepping therefore suggest that early motor experience may shape patterns of interlimb coordination generated by locomotor circuitry. [Supported by grant HD 33862 to S. R. R.]
CAN KNOWLEDGE OF DEVELOPMENTAL PROCESSES ILLUMINATE THE EVOLUTION OF PARENTAL CARE?
George F. Michel
Psychology (P.O. Box 26170), University of North Carolina at Greensboro, Greensboro, NC 27402-6170, U.S.A.

There are two levels of investigation for the evolution of parental care. The macro level focuses on how parental care can evolve as an aspect of reproduction. The micro level focuses on how species variations of parental care evolve. Recently, modern evolutionary biology has turned to developmental biology as a source of information about how trait variability can emerge during development and serve as the substrate upon which natural selection and other evolutionary mechanisms operate. Developmental processes also constrain variation and serve as the basis for the inter-individual similarity of species typical traits. This integration of developmental information into evolution is called “evo-devo.” Applying this approach to parental care means that variations in developmental pathways can provide the phenotypes for the potential evolution of different parental care systems. This paper will describe the variations in the development of mammals that may have contributed to the development of bi-parental care. Perhaps, understanding the developmental mechanisms responsible for species variations in mammalian parental care systems can inform our understanding of those mechanisms that may have been involved in the evolution of parental care.

NONASSOCIATIVE OLFACTORY LEARNING IN THE RAT NEONATE SOON AFTER BIRTH
S. S. Miller, J. Lee, N. E. Spear
Binghamton University

For the blind and deaf neonatal rat, odor cues are essential to its viability. Perinatal experience with amniotic fluid makes this a salient olfactory cue for promotion of the first suckling experience (Hofer, Shair, & Singh, 1976; Teicher & Blass, 1977). The effects of odor exposure immediately after birth may not only have special ecological relevance but also could provide clues about the influence of birth-induced neurochemicals on postnatal learning. In the present experiment, pups were exposed to an arbitrary odor, lemon, for one hour either immediately, 1 hr or 2 hr after cesarean section. The effects of duration of odor exposure immediately following delivery were also explored. Exposure to lemon odor within the first, second or third hours after cesarean section resulted in increased behavioral activation upon re-exposure to lemon odor at testing, 4 hr postpartum. Additionally, only exposure within the first 2 hr of life resulted in a decreased latency to attach to a surrogate nipple in the presence of lemon odor, while only odor exposure within the first hour increased consummatory measures at the nipple (e.g., time attached, mean grasp duration, body weight gain) especially for females. Fifteen minutes of immediate exposure to lemon odor was sufficient to see increased whole body behavioral activation and decreased latency to attach to a lemon-scented nipple at test, but head movements (a specific component of behavioral activation) and consummatory measures at the nipple were affected only after longer odor exposure durations. [National Institute of Mental Health (MH035219) to Norman E. Spear.]

EFFECTS OF MODAFINIL ON DEVELOPING SLEEP PATTERNS IN INFANT RATS
E. J. Mohns, K. E. Karlsson, & M. S. Blumberg
Program in Behavioral and Cognitive Neuroscience, Department of Psychology, University of Iowa, Iowa City, IA 52242, U.S.A.

During the first postnatal week in infant rats, the lengths of sleep bouts increase significantly. Utilizing precollicular decerebrations and electrolytic lesions, we recently showed that this elongation is influenced by hypothalamic structures, including the GABAergic preoptic area (POA), which promotes sleep in adult rats by inhibiting wake-promoting areas of the brain. We found that POA lesions in infants had wake-promoting effects similar to those seen in adults, suggesting that the POA is similarly performing an inhibitory function at this early age. However, during this early postnatal period, GABA has been reported to be excitatory, rather than inhibitory. The drug modafinil is thought to promote wakefulness in part by potentiating noradrenergic inhibition of GABAergic POA neurons. We therefore utilized modafinil administration to determine whether specifically inhibiting these neurons in infants would have effects on sleep and wakefulness that are similar to those seen in adults, and thereby indicate whether or not infant POA neurons do indeed have an inhibitory function at this age. Postnatal day 8–9, Sprague-Dawley Norway rats (Rattus norvegicus) were injected intraperitoneally with modafinil or methylcellulose vehicle, and sleep/wake behaviors were measured using nuchal muscle electromyography and observation of associated motor behaviors. Modafinil caused an increase in mean wake bout durations and a decrease in mean sleep bout durations, in addition to an overall decrease in the percentage of time spent asleep. This effect was similar to that of POA lesions in rats of the same age, which we have described previously. The present findings suggest that in infant rats, as has been suggested in adults, modafinil promotes wakefulness by interfering with functionally inhibitory descending POA neurotransmission. The possibility of a differential effect at younger ages is currently being examined. [Supported by NIMH grants MH50701 and MH66424 to M. S. B.]

RECOGNITION AND POSITIVE RATINGS OF MOTHER’S VOICE BY COLLEGE STUDENTS
Christine Moon, Allison Gable, Stacie Wyman, Liem Phan, & Kristopher Johnson
Department of Psychology, Pacific Lutheran University, Tacoma, WA, U.S.A.

Newborn infants are capable of recognizing mother’s voice using one-word utterance voice samples (the word baby) that are less than 1 s in duration (Black et al., 2004; deRegnier et al., 2000, 2002). They also demonstrate a behavioral preference for maternal one-word utterances despite a paucity of acoustic cues (Moon et al., 2004). It has not been known whether this sensitivity and positive valence for mother’s voice are maintained beyond the newborn period. In the current newborn analog experiment, 40 college students heard one token each of the word baby spoken by their own mother versus the previous participant’s mother. Participants were unaware of the existence of the recordings. They activated the stimulus tokens ad libitum while rating the two voices for several characteristics. Participants also provided free written and comments regarding the voices throughout the experiment. Nine participants commented on the familiarity of one of the voices during the ratings task. After completing the ratings, students were informed about the sources of the stimuli and were asked to indicate which of the two had been the maternal voice. Thirty three participants correctly identified the maternal voice (binomial test, p < 0.001). Average ratings were more positive for mother’s versus stranger s voice (n = 40, paired sample t-test, p < 0.05). Results are interpreted as showing that, at least among college students, the sensitivity and positive valence for the maternal voice that are present in newborn infants are present in adulthood. [Severtson/Forest Undergrad. Research Prog., U Washington Inst. for Learning and Brain Sci.]
CORTICOSTERONE CONTROLS TERMINATION OF INFANT RAT’S ATTACHMENT SENSITIVE PERIOD
S. Moriceau & R. M. Sullivan
Zoology Department, University of Oklahoma, Norman, OK 73019, U.S.A.

During a sensitive period, neonatal rats learn to prefer odors paired with pain presumably to ensure pups learn to prefer the mother’s odor required for survival. At postnatal day (PN) 10, fear conditioning and amygdala activation emerge. Here we show that low corticosterone (CORT) levels during this sensitive period prevents pups from learning fear (odor avoidance) from odor-shock (0.5 mA) pairings. We paired an odor with shock in either sensitive period (PN8) or post sensitive period (PN12) pups while manipulating CORT levels. We then assessed preference/aversion learning and olfactory neural circuitry (2-DG). While saline Paired odor-shock PN8 pups continued to learn an odor preference, Paired odor-shock CORT (3 mg/kg, ip) PN8 pups showed a precocious odor aversion and neural activity within the odor learning circuit similar to that expressed by post sensitive period PN12 pups (post piriform CTX and amygdala activity increased but ant piriform CTX decreased). At PN12, Sham Paired odor-shock pups showed an odor aversion, although CORT depleted adrenalectomy pups showed odor preference learning and an odor learning circuit characteristic of the sensitive period (nonparticipation of amygdala and post piriform CTX but increased ant piriform CTX activity). These results suggest the importance of CORT in the developmental emergence of olfactory fear conditioning. Since pups stimulation by the mother modulates endogenous CORT levels, these data suggest that the quality of maternal care may temporally alter the sensitive period. [Funding by NSF IBN0117234, NICHDHD33402, OCAST to R. M. S.]

MATERNAL CORTISOL IN BREAST MILK INFLUENCES INFANT DEVELOPMENT AND TEMPERAMENT
K. S. Mount, E. P. Davis, A. Chicz-DeMet, C. Dunkel Schetter, C. J. Hobel, C. A. Sandman, & L. M. Glynn
Department of Psychiatry & Human Behavior, University of California, Irvine, CA, U.S.A.

In the past, many benefits of breastfeeding have been shown, including positive effects on infant development and temperament. It is possible that one or more of the biologically active components of breast milk play a role in this relation. With two studies, we assessed whether cortisol levels in breast milk affect infant temperament and development. In Study 1, the relation between cortisol in breast milk and maternal report of infant mood, as measured by the Infant Behavior Questionnaire (IBQ), were assessed in both breastfed and formula-fed infants at 2 months of age. Plasma cortisol levels were used as a proxy for levels in breast milk the correlation between plasma and breast milk cortisol is in the 0.6-0.7 range. Among the 188 breastfed infants, there was a relation between fear and maternal cortisol (r = 0.19, p < 0.05). This relation was not found in the 74 formula-fed infants (r = -0.08, p = 0.5). Although cortisol levels in breast milk were not assessed directly, these data suggest that cortisol in breast milk influences infant temperament. Study 2 directly investigated the relation between cortisol levels in breast milk and infant development and temperament. Breast milk was collected from 35 women at 3 months postpartum and will be assayed for cortisol levels. Infants were assessed with the Bayley Scales of Infant Development and the IBQ. The mean Bayley scores for this cohort were 91.2 for the MDI (SD = 6.21) and 98.3 for the PDI (SD = 7.04). [NIH grants R01 HD-40967 to L. M. G. and R01 HD-28413 to C. A. S.]

POSITION IN THE LITTER HUDDLE AND INDIVIDUAL GROWTH AND SURVIVAL IN RABBIT PUPS
E. Muciño, A. Bautista, M. Martínez-Gómez, & R. Hudson
FCB-UNAM, IB-UNAM; CTBC-UAT, Ap. 262, C.P. 90070 Tlaxcala, Mexico

An initial form of interaction between siblings in newborn altricial mammals is huddling behavior. At low temperatures a central position within the litter huddle should help an individual conserve energy and enhance growth. Here we ask if central positions within the litter huddle formed by newborn rabbits are positively associated with body temperature, growth, and individual survival. We used seven litters of domestic rabbits kept at 25°C. From postnatal days 1 to 7, litters were photographed at regular intervals from above, and individual position relative to littermates estimated using a huddle index. Body weight and neck and groin temperature were also regularly measured. Pups showed individual intralitter differences in the ability to maintain insulated positions within the litter huddle and these were positively associated with body weight, body temperature, conversion of milk to body mass, growth, and survival. We conclude that rabbit pups compete for thermally advantageous positions within the litter huddle and that heaviest pups are the most successful. [CONACyT 25889-N and 124936. PAPIIT-UNAM IN 217100, PROMEP UATlax 149, PIFOP 2002-30-03.]

DOPAMINE D1 CLASS RECEPTORS INTERACTING WITH D2 RECEPTORS MEDIATE RAT PUPS’ VOCAL RESPONSE TO BRIEF ISOLATION FOLLOWING MATERNAL CONTACT
J. Muller, T. Mahabir, M. Myers, H. Moore, & H. Shair
Developmental Psychobiology, New York State Psychiatric Institute, Department of Psychiatry, Columbia University, New York, NY, U.S.A.

Preweaning rat pups placed in isolation emit ultrasonic vocalization (USV) among other behaviors. Maternal contact, but not contact with familiar bedding or littermates, just before isolation increases the rate of vocalization in isolation (maternal potentiation). Thus, potentiation is a selective response to particular social cues. Dopamine has been implicated in the regulation of social and motivated behaviors. The D2-family agonist, quinpirole, disrupts maternal potentiation. Systemic administration of the D1-family agonist, SKF 81297, is now shown to have a similar effect, disrupts potentiation. The D1-family antagonist, SCH23390 has no effect on potentiation, as was true for antagonists of the D2 receptor. The D1 agonist results are not due to nonspecific activation of D2 receptors because the D1 antagonist blocks the D1 agonist effects. Furthermore, the D2 agonist disrupts potentiation in the presence of a D1 antagonist and similarly, the D1 agonist disrupts potentiation in the presence of the D2 antagonist. Still, dopamine regulation of potentiated USV is complex because an antagonist of both D1 and D2 families (alpha-flupenthixol) does disrupt potentiation. This last result demonstrates that some level of dopamine receptor activity is necessary for potentiation to occur, but a high level of activation of either receptor system disrupts this socially mediated vocalization. Whether the critical factor is dopamine receptor activation at a low level or transient changes of activation within that level is yet unknown. We anticipate that dopamine receptor activity in the prefrontal cortex, ventral striatum, and/or amygdala, structures implicated in affect and motivation, may be essential to the phenomenon of maternal potentiation. [Supported in part by NIMH training grant MH018264 and funds from NYS Office of Mental Hygiene.]
BODY LENGTH AND PLACENTAL IGF1 GENE EXPRESSION PREDICT CARDIAC REACTIVITY IN INFANCY

M. M. Myers, P. A. Graham, E. Sibille, S. George, & M. Cohen
Dept. Psychiatry, U. Pittsburgh

Epidemiological studies indicate that babies born in the lower extreme of birth weight (BW) are at risk for physical and mental diseases in adulthood. We are asking whether we can detect signs or markers of this vulnerability very early in life. We measured heart rate (HR) and blood pressure (BP) responses to feeding within the first days of life. Preliminary studies indicate that term babies with low BWs had the greatest increases in HR during feeding. Here we further examined this relationship and asked if placenta gene expression markers associated with fetal growth might also be related to these physiological responses. Thirty-three term infants, enrolled to include a broad range of BWs, were bottle-fed a sweetened solution of 5% dextrose for 5 min. HR and BP changes were measured as values during feeding minus values during baseline just before feeding. Placenta samples were taken shortly after delivery and expression of Insulin-like Growth Factor I was measured using quantitative real-time PCR. Multiple regression analyses that included IGF1 expression, gestational age, BW, length, and head, abdomen and chest circumferences showed that length and IGF1 expression were the best predictors of HR responses to feeding. Each measure showed a negative correlation with HR reactivity and together had a multiple R of 0.623, p < 0.002. Using these two variables, we could identify 10 of the 11 infants with HR responses that were greater than 20 BPM. These results suggest that physical and gene expression markers of fetal growth provide good predictors of infant physiology and, perhaps markers of later cardiovascular disease vulnerability. [Grant Support: ES11096.]

LEARNED HELPLESSNESS IS NOT ALTERED BY FLUOXETINE IN IMMATURE RATS

Lee Napiereta & Susan L. Andersen
Department of Psychiatry, Harvard Medical School, Laboratory of Developmental Neuropharmacology, McLean Hospital, Belmont, MA 02478, U.S.A.

Depression affects all age groups, including juveniles, adolescents, and adults, though at different rates (3%, 8%, and 17%, respectively). Pharmacological treatment with fluoxetine (Prozac) is effective in all groups, however depressed children are less responsive to fluoxetine than adults. We know little about how fluoxetine affects children compared to adults, and an animal model for depressive symptoms and antidepressant efficacy is needed. Assessment of drug efficacy in juveniles poses the unique problem of limited drug treatment periods without leaving the developmental stage of interest. The induction of learned helplessness (LH), determined by latency to escape a mild footshock (1.0 mA) in the presence of a conditioned light cue, is used to test antidepressant efficacy in adult animals. To determine its applicability to younger animals, we tested LH responses in juvenile (25 days old), adolescent (35 days), and young adult (60 days) rats following sub-chronic treatment with 5 mg/kg fluoxetine administered twice daily for 5 days. Latency to escape and escape counts were measured 2–5 days after the presentation of escapable shock preceded by a light cue. Fluoxetine reduced the escape latency at 60 days (p < 0.05). Fluoxetine impaired adolescent behavior (t12 = 2.82, p < 0.05), whereas the juvenile animals were seemingly unaffected by fluoxetine (p > 0.5). These data suggest that fluoxetine reduces LH in adults, but has different behavioral effects in immature animals. Tests that demonstrate antidepressant efficacy in young animals are needed to better understand developmental differences in psychotropic agents in clinical populations. [NARSAD.]

CONTEXT INFLUENCES OFFSET OF INFANTILE AMNESIA

Kim Nguyen, Amy Sussman, & Rachel Barr
Georgetown University

Retrospective studies yield reports of first memories around 3.5 years. Prior studies have examined single factors influencing offset of infantile amnesia including major transitions and cultural background. The current study integrated and extended these studies to examine the combined effect of transitions and cultural background on age and detail of first reported memory. One hundred seventy nine undergraduate students reported details of their earliest memory, and answered questions about major transitions (e.g., birth, death, divorce, moves, childcare, and school), cultural background, and strength of ethnic identity. The average age of first memory was 45 months (range 8–107 months) and the average amount of detail was 12.9 pieces of information (SD = 6.4). Transitions and cultural background factors were entered into a linear regression which revealed that earlier school entry was associated with an earlier age of first memory, suggesting that a major context shift may serve as an anchor point. At the same time, more school transitions were associated with a later first memory. In contrast, the strength of ethnic identity, affected the number of details reported but not the age of first memory suggesting that cultural context impacts the developmental of autobiographical memory. Infantile amnesia has been attributed to the delay in maturation of declarative memory. The present findings provide further evidence against this view and a mechanism dependent on learning history. [HD043047-01 from the National Institute Child Health and Development to Rachel Barr.]

DEVELOPMENT OF PREFERENCE FOR A VARIETY OF VEGETABLES IN INFANCY

Sophie Nicklaus1 & Julie A. Mennella2
1UMR Flavic, INRA, Dijon, France
2Monell Chemical Senses Center, Philadelphia, U.S.A.

Because food experiences during infancy can imprint long lasting preferences, developing strategies to enhance acceptance of a variety of foods early in life is important for long-term health. Although the mechanism through which infants learn to like eating a variety of foods within a meal is largely unknown, adult studies revealed that eating a variety of foods within a meal contributes to enhanced intakes. The goals of the present study were twofold. First, we asked whether infants would eat more when two foods are offered within a meal when compared to when only one food is offered. Second, we determined how repeated exposures to the same food or a variety of foods impact on subsequent intake of novel vegetables. To this end, we evaluated the acceptance of a novel vegetable (green bean) or a pair of novel vegetables (carrot and spinach) before and after an 8-day home exposure in three groups of infants. The groups differed in their background, and strength of ethnic identity. The average age of first memory was 45 months (range 8–107 months) and the average amount of detail was 12.9 pieces of information (SD = 6.4). Transitions and cultural background factors were entered into a linear regression which revealed that earlier school entry was associated with an earlier age of first memory, suggesting that a major context shift may serve as an anchor point. At the same time, more school transitions were associated with a later first memory. In contrast, the strength of ethnic identity, affected the number of details reported but not the age of first memory suggesting that cultural context impacts the developmental of autobiographical memory. Infantile amnesia has been attributed to the delay in maturation of declarative memory. The present findings provide further evidence against this view and a mechanism dependent on learning history. [HD043047-01 from the National Institute Child Health and Development to Rachel Barr.]
SIBLING PRESENCE IN RABBITS: EFFECTS ON MOTOR DEVELOPMENT AND COMPETITIVENESS

L. Nicolas, A. Bautista, M. Martínez-Gómez, & R. Hudson
Instituto Investigaciones Biomédicas-UNAM; Centro Tláhuac de Biología Conducta-UAT, Ap. 262, C.P. 90070 Tláhuac, Mexico

Little is known about the influence of siblings on individual development in mammals. In this study, we examined in domestic rabbits the influence of early sibling presence on motor development, pre-weaning growth, and pre- and post-weaning competitive behavior. On postnatal day 1 a randomly selected pup from each 6-pup litter was raised alone except for the brief once daily nursing. On days 2–7 in 11 litters, pups were placed individually for 2 min on a ramp inclined 15° and the rate of full body rolls (complete overbalancing) was measured. Pups raised with siblings showed more rapid motor development. In another 13 litters, on days 2–20 we measured milk intake and weight gain. Isolated pups obtained significantly less milk and gained weight more slowly. At weaning, we tested pups raised alone from 13 litters, in paired competition tests for food (day 27) and for water (day 29) with a randomly chosen group-raised sibling. In these tests also the isolation-raised pups were less successful. Taken together, the results suggest that growing up with siblings is advantageous in terms of motor development and performance during the competitive suckling episodes of the first postnatal week, and that pups raised with littersmates are more successful in competing for crucial resources postweaning. [CONACyT 25889-N. PAPIIT-UNAM IN 217100; PROMEP UATlax 156, PIFOP 2002-30-03.]

FACILITATE SPONTANEOUS MATERNAL BEHAVIOR IN JUVENILE AND ADULT FEMALE PRAIRIE VOLES

D. E. Olazábal & L. J. Young
Department of Psychology, Boston College, Chestnut Hill, MA 02467, U.S.A.

Jay Rosenblatt and others have presented approach-avoidance models of maternal behavior, which propose that maternal behavior occurs when the tendency to approach and interact with infant stimuli is greater than the tendency to avoid such stimuli. Our research program has uncovered neural circuits, which influence maternal behavior in a manner that conforms with such approach-avoidance models. We present evidence that the medial preoptic area (MPOA; located in the rostral hypothalamus) regulates maternal responsiveness by depressing antagonistic neural systems which promote withdrawal responses while also activating appetitive neural systems which increase the attractiveness of infant-related stimuli. These medial preoptic area circuits are activated by the hormonal events of late pregnancy. Preoptic efferents may suppress a central aversion system, which includes an amygdala to anterior hypothalamic circuit. In addition, preoptic efferents are shown to interact with components of the mesolimbic dopamine system to regulate proactive voluntary maternal responses. We make a distinction between specific (MPOA neurons) and nonspecific motivational systems (mesolimbic dopamine system) in the regulation of maternal responsiveness. [Supported by NSF IOB 0312380 grant.]

OXOTOCIN RECEPTORS IN THE NUCLEUS ACCUMBENS FACILITATE SPONTANEOUS MATERNAL BEHAVIOR IN JUVENILE AND ADULT FEMALE PRAIRIE VOLES

D. E. Olazábal & L. J. Young
Department of Psychiatry & Behavioral Sciences, Ctr Behav Neurosci, Yerkes Research Center, Emory University, Atlanta GA 30322, U.S.A.

Prairie voles are a highly affiliative and biparental species. Oxytocin and the nucleus accumbens (NA) have been implicated in maternal behavior, and the processing of pup-related stimuli relevant for this behavior. Oxytocin receptor (OTR) density in the NA is highly variable in female prairie voles as is their behavioral response to pups ranging from infanticidal to full maternal behavior. We hypothesized that OTR in the NA facilitates the expression of spontaneous maternal behavior in prairie voles. Twenty-six juvenile (~20 days of age) and 42 virgin adult females (60–90 days old) were exposed to pups for the first time and tested for maternal behavior. OTR density in the NA was lower determined using autoradiography. Time spent adopting crouching postures, most distinctive component of alloparental behavior in juveniles, was positively correlated to OTR density in the NA (r = 0.53). Adult females that showed maternal behavior crouching over the pups at least 30 s (n = 24) had higher OTR density in the NA (p < 0.05) than females that did not show maternal behavior or attacked the pups (n = 16). In a second experiment, we tested whether OTR antagonist (t(6CH2)51, Tyr(Me)2,Orn8)-A VT (OTA) in the NA blocks spontaneous maternal behavior. Ten females were infused in the NA either with 2 ng/0.5 μl of OTA or CSF (vehicle). While 5 of 10 CSF-infused females showed maternal behavior, none of the OTA-infused females showed any maternal response (0/10; p < 0.01). These results suggest that in virgin female prairie voles, OTR in the NA is positively associated with alloparental behavior and may increase the attractive value of pups. [This study was supported by MH56538 and MH064692 to L. J. Y., RR00165 to Yerkes Natl Primates Res Ctr.]
THE PRINCIPLE OF ONTOGENETIC ADAPTATIONS IN DEVELOPMENTAL PSYCHOBIOLOGY
Ronald W. Oppenheim
Department of Neurobiology and Anatomy and the Neuroscience Program, Wake Forest University School of Medicine, Winston-Salem, NC, U.S.A.

Because immature animals often inhabit environments (e.g., in utero, in ovo, postnatally), and have needs, that are markedly different from those of the adult, each developmental stage has evolved specific neurobehavioral characteristics that are (a) adaptive for a specific environment or need, (b) often transient in nature, and (c) not merely an immature form of, or a precursor to, adult behavior. I refer to such phenomena as ontogenetic adaptations as opposed to viewing developmental events, solely as ontogenetic antecedents. Although these two principles are not mutually exclusive, for much of the 20th century, the development of behavior was studied primarily from the perspective of ontogenetic antecedents. By contrast, following Darwin and up until the early 1900's, ontogenetic adaptations were a common feature of both behavioral and embryological studies. Ontogenetic adaptations begin at the time of fertilization and occur through all subsequent stages of pre- and postnatal development. I will provide examples of ontogenetic adaptations in neural and behavioral development and briefly describe the experimental analysis of one specific adaptation, embryonic, and fetal motility. My goal is not to propose a general theory of developmental psychobiology, but rather to argue that the principle of ontogenetic adaptations adds a biologically relevant perspective to the more common perspective of ontogenetic antecedents.
THE IMPACT OF RESPIRATORY SUPPORT ON LEARNING CAPABILITIES IN THE PREMATURE INFANT
Amanda Povlock, Deanna Guido, Dana Buccinna, & Charlene Krueger
University of Florida, FL, U.S.A.

The purpose of this study was to determine the impact of respiratory support on the learning capabilities of the 26–34 week premature infant. Study subjects were participants in a larger study entitled, heart rate variability, and learning in the premature. Twenty-eight low risk premature infants, 27–28 weeks post-conceptional age, were recruited and randomly assigned to one of two groups. Group 1 began exposure to a recording of a nursery rhyme recited by their mother at 28 weeks and Group 2 at 32 weeks. Weekly test sessions recorded the premature infants cardiac response (or learning as measured by detection of a cardiac orienting response) to a recording of a nursery rhyme. This analysis addresses the impact of respiratory support on learning during the final test session at 34 weeks post-conceptional age for 11/28 subjects. Respiratory support was divided into two categories: (1) nasal cannula, (2) nasal CPAP. The primary modes of respiratory support for all infants that participated in the study were nasal cannula and nasal CPAP. Nasal CPAP is much louder and obtrusive and we therefore hypothesized nasal CPAP would have a negative impact on learning (or detection of the cardiac orienting response). Our hypothesis was not supported, in that, those infants primarily supported by nasal cannula had no more cardiac orienting responses than those supported by nasal CPAP. Replication is needed due to the small sample size (n = 11), however, follow-up with more subjects is currently under way. This study has implications future questions related to the impact of respiratory support on the development premature newborn. [NIH/NINR P20 07791, NIH/NCRR M01 RR00082.]

 IDENTIFYING CRITICAL PERIODS FOR REVERSING THE EFFECTS OF ISOLATION DURING DEVELOPMENT IN C. ELEGANS
S. Rai & C. H. Rankin
Department of Psychology & Brain Research Centre, Vancouver (BC), V6T1Z4, Canada

Experience at specific stages during development, in which certain events must occur for normal development, can alter the structure and function of the nervous system. In these studies, we use the nematode C. elegans as a model organism to demonstrate the effects of early experience on behavior and development, and to identify critical periods for mechanosensory stimulation on aspects of nervous system development. Earlier studies found that worms raised in isolation, without the mechanosensory stimulation from conspecifics, respond significantly less to a mechanical tap stimulus and are significantly shorter in body length than worms raised in colonies. A study of the synapse between the mechanosensory neurons and the command interneurons showed that in isolate-raised worms this synapse was weaker (fewer postsynaptic glutamate receptors and fewer presynaptic vesicles) than the synapses of worms raised in a colony condition. In the current study, brief mechanical stimulation at any time during development reversed the effects of isolation on the behavioral response to tap and glutamate receptor expression suggesting there is no critical period for these two measures. Preliminary data suggests that stimulation early in development (but not later) rescues vesicle expression and body growth suggesting there may be a critical period for these measures earlier in development. These results suggest that development of different systems follow different rules/time courses. With this simple model system, we have the possibility of determining the cellular bases of such differences. [Funded by operating grant from BCMCFH-HELP to C. H. R.]

MATERNAL SEPARATION: EFFECTS ON MATERNAL BEHAVIOR AND HPA HORMONES IN THE JUVENILE RAT
Stephanie L. Rees & Alison S. Fleming
Department of Psychology, University of Toronto at Mississauga, Mississauga ON, Canada L5L 1C6

Juvenile rats show maternal behavior when presented with pups. Although similar to adult behavior, disparities exist that may be due to ongoing development in, for example, the HPA axis. Since maternal separation affects adult maternal behavior and HPA measures, the purpose of the following was to determine its effects on juvenile maternal behavior and basal HPA measures. Maternal behavior received upon reunion from separation was also assessed. Rat pups were separated for 5 hr daily (PND 2–14) from both mother and littermates (separated alone: SA), separated from mother, but not littermates (separated as a litter: SL), or left with mother and littermates (undisturbed: UND). Also during separation, mother rats were either left with no litter (NL) or with half a litter (female pups only; HL). SA rats showed more initial juvenile maternal behavior than SL and UND rats, despite showing no difference in maternal latency. There were no effects of separation on corticosterone, but SA and UND rats had higher ACTH levels than SL rats. There were also no effects of litter removal (NL or HL) on juvenile maternal behavior or corticosterone or ACTH levels. In terms of maternal behavior received, HL received more licking and hovering and less retrieving than did NL. In terms of correlations, juvenile corticosterone levels were negatively correlated with some juvenile maternal behaviors, while having no correlation with maternal behavior received. In conclusion, being separated from the mother and littermates (SA) increases initial juvenile maternal behavior despite having no effects on basal corticosterone levels or maternal behavior received. [This work was supported by NSERC to A. S. Fleming.]

INFANT VISUAL PREFERENCES AND EVENT-RELATED POTENTIALS
G. D. Reynolds & J. E. Richards
Department of Psychology, University of South Carolina, Columbia, SC 29208, U.S.A.

The modified-oddball paradigm has been used to measure ERP components associated with attention and memory in infancy. A negative component over central leads labeled Negative Central (Nc) is assumed to reflect a general orienting response associated with attention. The goal of the present study was to examine the consistency between ERP and behavioral correlates of attention and recognition memory by embedding visual paired-comparison choice trials within the modified-oddball paradigm. Infants 20, 26, and 32 weeks of age served as participants. Infants were familiarized with two stimuli that were used during testing. Participants were then exposed to a modified-oddball paradigm with brief presentations of three types of memory stimuli: frequent familiar, infrequent familiar, and infrequent novel. Following blocks of brief stimulus presentations, infants were presented with a paired-comparison trial with competing memory stimuli. Look durations during the paired-comparison trials were scored to obtain novelty preference scores. Electroencephalographic recordings were made with a 126-channel system and ERP averages were made from –50 to 2,000 ms around stimulus onset. There was a significant effect of age on visual preference; older infants demonstrated novelty preferences while younger infants did not. In contrast, differences in Nc amplitude based on memory stimulus type were demonstrated by all age groups. These findings indicate that behavioral measures can be successfully integrated into ERP studies of infant cognitive development.
EFFECTS OF NEONATAL 192 IgG SAPORIN CHOLINERGIC LESIONS ON ULTRASONIC VOCALIZATIONS AND FEAR CONDITIONING RESPONSES IN PREWEANING RATS

L. Ricceri, M. L. Scattoni, D. Cutuli, A. Venerosi, G. Calamandrei
Section of Behavioural Neurosciences, department of Cell Biology and Neurosciences, Istituto Superiore di Sanità

We have previously shown that neonatal intracerebroventricular (icv) injections of the selective cholinergic immunotoxin 192 IgG-Saporin on postnatal day (pnd) 7 induce selective cholinergic depletions in the target regions of basal forebrain cholinergic neurons as well as significant behavioral alterations in spatial and nonspatial learning and memory paradigms detectable starting from the third postnatal week. In the present study, we injected 192 IgG-Saporin icv on pnd 7 and we then analyzed fear conditioning on pnd 18 and 19 by recording a variety of behavioral responses as well as ultrasound vocalizations (USVs). In terms of freezing response no effects of the cholinergic lesion was evident on fear conditioned response to environmental or auditory cues. USVs however, increase in 192 IgG-saporin lesioned animals in the retest phases, maximally during re-exposure to the experimental context where. As a whole these results suggest that, in agreement with adult lesion studies, removal of the cholinergic input to cortical and hippocampal region selectively affect USV’s during the fear conditioning and not the conditioning per se. [ISS N.1105/RI, ISS ALZ6.]

EPISODIC SHORT-TERM MEMORY CAPABILITIES IN THE SPONTANEOUSLY HYPERTENSIVE RAT DIFFER ACCORDING TO TASK

B. Robertson & P. E. Wainwright
Department of Psychology, Department of Health Studies and Gerontology, University of Waterloo, Waterloo Ontario, Canada N2L 3G1

The objective of this study was to characterize the episodic short-term memory capabilities in the spontaneously hypertensive rat (SHR), which is a frequently used animal model of attention deficit hyperactivity disorder (ADHD). Six-week-old male SHR, Wistar Kyoto (WKY), and Sprague–Dawley (SD) rats were tested on two behavioral tasks in the water maze, each measuring episodic short-term memory. Each task comprised two trials; the first being an information trial with respect to the location of a submerged escape platform and the second a recall trial, with the delay intervals between the first and second trial varying between 20 s and 1 hr. In the forced alternation task (FA), the rats had to choose the arm in a T-maze opposite to that on trial 1 to locate the platform. In the cued-delayed matching-to-place task (cDMP), the platform position was indicated by a beacon on the first, but not the second, trial. Strains did not differ on FA, and all were impaired at 1 hr, but not at shorter delays. However, when tested on a series of massed trials, both SHR and WKY were impaired relative to SD. On cDMP, both SHR and WKY showed impairments at the 60 s delay compared with SD; WKY were also impaired at 120 s. All strains were impaired at the 1 hr delay. These findings suggest that SHR may be using an egocentric response strategy in order to perform the FA task successfully, but are unable to use the allocentric spatial strategy required by the cDMP task. [This research was funding by a NSERC grant to Dr. Patricia Wainwright.]

MOVING, ATTENDING, AND LOOKING: STEADY STATE VISUAL EvOKED POTENTIALS REVEAL THE SEQUENCE IN YOUNG INFANTS

S. S. Robertson, S. E. Watamura, J. S. Muenke, M. R. Gooch, & L. G. Kleiman
Department of Human Development, Cornell University, Ithaca, NY 14853, U.S.A.

The dynamic integration of body movement, gaze, and attention is necessary for successful interaction with the environment, but the nature of this integration early in development is unknown. We studied 12 wk old human infants (N=12) while they looked freely at two interesting objects that flickered at different rates (8 and 12 Hz). Electrodes over temporal-occipital regions detected the steady state visual evoked potentials (SSVEPs) elicited by the flickering stimuli, which are modulated by attention in adults. Body movement (detected by piezoelectric sensors in the infant carrier) and SSVEPs at 8 and 12 Hz were analyzed in the 4 s preceding shifts of gaze (determined from videotaped corneal reflections of the stimuli). Body movement showed the characteristic surge above baseline beginning 2 s before gaze shifted. At this point, the amplitude of the SSVEP elicited by the fixated stimulus (SSVEP-F) was high, and that elicited by the nonfixated stimulus (SSVEP-NF) was low. One second later (1 s before gaze shifted), SSVEP-F decreased and SSVEP-NF increased. The timing of the SSVEP changes indicates that re-orienting of spatial attention in free-looking 3-month-olds starts before the eyes begin to move, consistent with findings for adults, and demonstrates that SSVEPs can provide a continuous measure of attention independent of gaze even in very young infants. The timing of the surge of body movement, before the changes in SSVEP amplitude, suggests that bursts of motor activity may interrupt attention and unlock gaze early in development. [Supported by NIH grant HD23814 to S. S. R.]

PERINATAL DEVELOPMENT OF HINDLIMB COORDINATION IN THE RAT. III. DO CONDITIONS IN UTERO REINFORCE ANTI PHASE MOVEMENT?

Department of Psychology, University of Iowa, Iowa City, IA 52242, U.S.A.

Developmental neuroscience, comparative ethology, and developmental psychology have produced convergent evidence for alternated patterns of limb, muscle, and neural activity characteristic of postnatal locomotion expressed around the time of birth. Prenatal motor experience may help structure such innate patterns of motor coordination. Spontaneous motor activity of fetal rats varies with the physical conditions in which the fetus moves. Features of the prenatal environment, such as embryonic membranes, scaffold the expression of coordinated action patterns. Fetuses and newborn rats alter patterns of interlimb coordination in response to an external weight added to one limb or the contingent linkage created by an interlimb yoke. Thus, the perinatal rat can acquire, modify, and retain new coordinative patterns through motor learning. But how might such learning occur before birth? The fetus develops within nested physical envelopes created by the embryonic membranes, uterus, and maternal abdomen. The myometrium in particular constitutes an elastic barrier that may provide conditional feedback to the fetus. More than twice the force is required to simultaneously deform an elastic membrane at two points than if the membrane is deformed at just one point. Myometrial tissue can exhibit similar elastic properties. This biomechanical perspective suggests fetuses could expend less energy by extending one limb at a time (alternation) rather than synchronously (conjugate) when pushing against the uterus. If so, the physics of moving within an elastic envelope may provide an intrinsic form of reinforcement for learning antiphase limb movement. [Supported by grant HD 33862 to S. R. R.]
SENSITIVE PERIODS, ENVIRONMENTAL TRIGGERS, AND DEVELOPMENT OF A LATERALIZED BRAIN

L. J. Rogers
Centre for neuroscience and Animal Behaviour, University of New England, Armidale, NSW 2351, Australia

Lateralization is widespread among vertebrates and the domestic chicken provides an excellent model to investigate the processes involved in its development. Exposure to light just prior to hatching triggers developmental processes that lead to lateralization of the visual pathways and to a range of visual behaviors after hatching. This outcome depends on the orientation of the embryo in the egg (occclusion of the left, and not the right, eye). Chicks hatched from eggs incubated in the dark do not develop visual lateralization. Steroid hormone levels pre-hatching interact with the effect of light (e.g., elevated levels of corticosterone prevent lateralization from developing). These pre-hatching events, during a brief sensitive period, channel development of phenotypes that are likely to enhance survival in different environments. Visually lateralized chicks are able to perform more than one task simultaneously (forage and monitor for predators) with ease, whereas non-lateralized chicks have difficulty in dividing their attention effectively. In a natural context, development of lateralization would be triggered by a series of events beginning with the amount of stress hormone that the hen deposits in her eggs, this itself depending on her social position and other stressors in the environment. Then, just prior to hatching, the embryo’s endogenous levels of corticosterone, triggered by stress (e.g., becoming cold), would take effect as too would light exposure, determined by the hen vacating the nest (2 hr is sufficient). Hence, a series of events channel brain development toward lateralization (low stress plus light) or non-lateralization (stress and no light). [Australian Research Council.]

LABOR INSIDE AND OUT: TEMPORAL RELATIONSHIPS BETWEEN INTRAUTERINE PRESSURE AND BEHAVIORAL EXPRESSIONS OF LABOR IN PARTURIENT RATS

A. Ronca,1 L. Baer,2 L. Conatser,1 R. Mccue,3 & K. Saldanha4
1Department of Obstetrics and Gynecology, Wake Forest University School of Medicine, Winston-Salem, NC, U.S.A.
2Life Sciences Division, NASA Ames Research Center, Moffett Field, CA, U.S.A.
3University of Pennsylvania, Philadelphia, PA, U.S.A.
4University of California, Berkeley, CA, U.S.A.

By initiating adaptive responses in the neonate prior to birth, forces associated with labor contractions help lay the foundation for postnatal life. Several studies have analyzed behavioral expressions of labor in the parturient rat, however little is known about changes in intrauterine pressure (IUP) experienced by the fetus or temporal relationships between IUP and overt behavioral signs of contractions. We previously established a technique for making precise, reliable measures of intrauterine forces before and during birth. In the present study, we coupled this technology with behavioral analysis to relate physiological and behavioral concomitants of labor contractions in the rat. A small telemetric blood pressure sensor was modified and fitted within a fluid-filled balloon, then implanted into the uterus on gestational day (G) 19 of the rats’ 22/23 day pregnancy. IUP signals were sampled at a rate of 500 Hz. Simultaneous real-time videorecordings were made of the dams’ ongoing behavior. During review of the videotapes, comparisons were made between sensor-implanted and non-implanted sham control dams. Eating, drinking, locomotion, rearing, and nest-building by the dams during the hour prior to birth did not differ across sensor implant and control conditions. Contraction frequency, duration, pup-to-pup birth intervals and pup-oriented activities of the dams measured from 1 hr prior to the first pup birth until the birth of the third pup were also unaffected by the sensor implant. Different magnitudes of IUP change were correlated with different contraction types (i.e., lordosis vs. vertical contractions). The average change in IUP was significantly larger during periods in which behavioral expressions of contractions were observed. In contrast, IUP change was minimal during intervals in which behavioral expressions of contractions were not observed. IUP signals were subjected to wavelet analysis, a signal transform method that, unlike spectral analysis, provides a time-frequency representation of the data. Application of the Daubachie Wavelet (Matlab Wavelet Toolbox by Mathworks) revealed that IUP signal frequency increased significantly over the course of labor, peaking within the final 10 min prior to birth. Wavelet analysis revealed a close temporal correspondence between behavioral expressions of labor and changes in intrauterine pressure. Collectively, these results provide further evidence that rat fetuses are exposed to intense, patterned sensory stimulation during labor. [Supported by NIH Grant MH46485 and NASA Grant NNA04CK83.]
LIMITED ACCESS ETHANOL CONSUMPTION IN ADOLESCENT AND ADULT RATS
R. C. Ristuccia, S. C. Brunell, & L. P. Spear
Center for Developmental Psychobiology and Psychology Department, Binghamton University, Binghamton, New York, NY, U.S.A.

During adolescence most humans initiate ethanol use, with high consumption reached by some adolescents. Elevated adolescent intake is also often apparent in rodent models, with adolescent rats consuming more than adults in operant-response contingent and 24 hr two bottle choice administration paradigms. The present study explored the use of a limited access procedure to index ethanol consumption across age and to explore its utility as a means of ethanol exposure for assessment of age differences in ethanol effects. Isolate-housed adolescent (postnatal day [P]) and adult (P70) Sprague–Dawley rats were water-deprived and given access to water and either a sweetened 6% ethanol solution or a saccharin solution for 2 hr daily in their homecages for 7 days. The results revealed greater average daily ethanol consumption among adolescents (1.57 g/kg) than adults (0.98 g/kg) across the 7-day period, although animals of both ages drank more of the experimental solution when it contained saccharin alone. Surprisingly, analyses of tail blood samples taken post-access revealed no differences in blood alcohol content (BAC) between adolescents (33.99 mg/dl) and adults (35.57 mg/dl). This finding may be related to more rapid ethanol metabolism by adolescents or to differences in the timing of ethanol consumption within the session (e.g., consumption earlier in the session by adolescents relative to adults). These results support the potential utility of the 2-hr access paradigm for the study of ontogenetic differences in ethanol consumption and its effects, including ethanol-induced social facilitation, HPA axis activation, and tachycardia. [Supported by NIAAA R37-AA12525 and RO1-DA019071 to L. P. Spear.]

ENHANCED ETHANOL CONSUMPTION FOLLOWING REPEATED ETHANOL EXPERIENCES IN VARYING SOCIAL CONDITIONS DURING INFANTILE DEVELOPMENT
S. K. Sanders, K. A. Bordner, E. M. Truxell, N. E. Spear, & J. C. Molina
Department of Psychology, Binghamton University, Binghamton NY 13902, U.S.A.

Prior research has indicated that repeated early ethanol (EtOH) intoxication results in heightened EtOH consumption later in life. This effect has been observed under experimental conditions where social and/or other environmental stressors, known to affect EtOH consumption, have been present. This study analyzed possible interactions between repeated EtOH exposure and the social context in which these experiences occurred. Rat pups were administered 0, 1 or 2 g/kg EtOH (i.g.) on postnatal days (PD) 3, 5, 7, 9, 11, and 13. During the first 20 min of intoxication pups were placed on a salient texture (sandpaper) while isolated, grouped with littermates or grouped with littermates and the dam. Pups were assessed for both EtOH consumption and sandpaper preferences on either PD8 or PD14. No significant main effects or interactions were detected in terms of EtOH intake or sandpaper preference on PD8. By the end of the treatment phase (PD14) significant effects emerged as a function of EtOH treatment (pups treated with 2 g/kg EtOH ingested significantly greater amounts than appropriate controls). This effect failed to interact with social context. The data also suggested that isolated animals with prior EtOH experience were prone to avoid sandpaper. These results confirm observations of the effects of heightened EtOH acceptance patterns as a function of prior experiences with the drug; effects that seem independent from the social context in which EtOH intoxication had been experienced. It also appears that the social context might determine responsiveness to environmental stimuli that are associated with EtOH s postabsorptive effects. [Funded by NIAAA-O1AA11960 to N Spear and FONCYT:PICT05-14024 to J Molina.]

RELATIONSHIP AMONG PRENATAL AND BIRTH FACTORS AND TEMPERAMENT AS MEASURED BY THE ECBQ
J. Salley, A. D. Clements, W. E. Dixon, Jr., B. R. Stanley
Department of Psychology, East Tennessee State University, Johnson City, TN 37614, U.S.A.

Studies have consistently shown relationships between prenatal events and characteristics of children. Attention deficit hyperactivity disorder (ADHD) has been related to prenatal stress specifically. It was the aim of this study to retrospectively explore the pregnancy and birth events of 46 21-month-old toddlers who visited our lab to determine whether prenatal stress, pregnancy complications, birth weight, or gestational age at birth were predictive of temperament as measured by the Early Childhood Behavior Questionnaire (ECBQ), a 201-item parent report temperament measure identifying children’s recent behaviors. It was found that extreme stress during pregnancy was significantly negatively related to attentional focus (r = −0.393, p = 0.007), which would be expected in light of ADHD findings, but chronic stress was unrelated to any temperament variables. Gestational age at birth was significantly negatively related to both motor activity (r = −0.312, p = 0.035) and sadness (r = −0.317, p = 0.032). Birth weight was positively related to positive anticipation (r = −0.332, p = 0.024). Presence of birth complications was positively related to motor activity (r = −0.322, p = 0.029) and negatively related to soothability (r = −0.322, p = 0.029). Each of these findings is in the expected direction if, indeed, stress and birth complications lead to less favorable outcomes and longer gestation and higher birth weight are indicative of more favorable outcomes in children. [Supported by NIH/NICHD Grant HD043865 to Wallace E. Dixon, Jr.]

INFANTS’ SLEEP AND DAYTIME EXPLORATORY BEHAVIOR
A Scher & E Schneider
University of Haifa, Haifa, Israel

In the neonatal and postnatal periods, sleep-wake state organization serves as a measure of neurological integrity (e.g., Beckwith & Parmelee, 1986), and predicts subsequent cognitive development (e.g., Gorter et al., 2002; Whitney & Thoman, 1993). To what extent the characteristics of infants sleep, beyond the early months, correlate with developmental attainments and behavioral regulation? The present study examined whether, in low-risk infants, variations in sleep characteristics towards the end of the first year are associated with task persistence and focused attention when exploring the environment. In a longitudinal study from 8 to 14 months, the sleep of 50 infants was monitored, at home, with a computerized motor detector (actigraph), yielding measures of sleep duration, fragmentation, and efficiency. Infants’ engagement in exploratory play was measured at 10, 12, and 14 months, with the Play Behaviors with Objects during Structured Tasks (POST), a 5-min procedure that enables infants to explore novel objects. The main result was that consolidated-uninterrupted sleep was associated with more advanced exploratory play (e.g., r = 0.43, p < 0.01, at 12 m). The finding that at the end of the infancy period, sleep characteristics significantly accounted for task persistence and exploratory play supports a model that links quality of sleep and daytime functioning. The results are in line with the premise that sleep in infancy provides a relevant window for illuminating behavioral regulation during arousal.
WHAT SO SPECIAL ABOUT MOTHER’S CALL? PITCH AND REINFORCER VALUE IN NORTHERN BOBWHITE NEONATES
S. M. Schneider & R. Lickliter
Department of Psychology, Florida International University, Miami, FL 33199, U.S.A.

The species-typical Northern bobwhite maternal assembly call is highly attractive and serves as an effective filial attachment stimulus for young hatchlings in the period following hatching. Such maternal calls can also act as operant reinforcers, and response-contingent operant relations have been shown to play a role in early social attachments in species such as the domestic chicken. In the present study, we demonstrated the reinforcing efficacy of the bobwhite maternal call and found no decline in reinforcer value over the first five days following hatching. Based on prior research suggesting pitch as a critical element in precocial chicks auditory preferences, we also investigated the reinforcing value of two artificially generated sounds: the first containing several frequencies in the same range as the maternal call, and the second a pure tone of a pitch at the low end of the species audibility range. The complex higher-pitched sound was nearly as effective as a primary reinforcer as the maternal call; in contrast, the low-pitched tone was ineffective. These results suggest that pitch is a critical component of the unlearned auditory preference for the maternal call in this precocial avian species. [Supported by NIMH grant RO1-62225 to R. L.]

THE ONTOGENY OF SLEEP-RELATED PHASIC ACTIVITY IN THE INFANT RAT
Adele M. H. Seelke,1 Karl Karlsson,2 Andrew Gatl1, & Mark Blumberg1
1The University of Iowa
2UCLA

Rapid eye movements (REMs), traditionally measured using the electrooculogram (EOG), help to characterize active sleep in adults. In early infancy, however, they are not clearly expressed. Here we measure extraocular muscle activity in infant rats at 3 days of age (P3), P8, and P14-15 in order to assess the ontogeny of REMs and their relationship with other forms of sleep-related phasic activity. Surprisingly, the tone of the extraocular muscles fluctuates in synchrony with the tone of other muscle groups; focal electrical stimulation within the dorsolateral pontine tegmentum, an area known to contain wake-on neurons in P8 rats, results in the simultaneous activation of both nuchal and extraocular muscles. Furthermore, the causal relationship between extraocular muscle twitches and REMs strengthens during the first 2 postnatal weeks, reflecting increased control of the extraocular muscles over eye movements. As early as P3, however, phasic bursts of extraocular muscle twitching occur in synchrony with twitching in other muscle groups, producing waves of phasic activity interspersed with brief periods of quiescence. Finally, when state-dependent neocortical electroencephalographic activity was observed at P14, it had already integrated fully with sleep and wakefulness as defined using electromyographic criteria alone; this finding is not consistent with the notion that active sleep in infants at this age is half-activated. All together, these results indicate exquisite temporal organization of sleep soon after birth and highlight the possible functional implications of homologous activation states in striated muscle and neocortex. [Supported by grants from the National Institute of Mental Health (MH50701, MH66424).]

THE ONTOGENY OF SLEEP-RELATED PHASIC ACTIVITY IN THE INFANT RAT
Adele M. H. Seelke,1 Karl Karlsson,2 Andrew Gatl1, & Mark Blumberg1
1The University of Iowa
2UCLA

Rapid eye movements (REMs), traditionally measured using the electrooculogram (EOG), help to characterize active sleep in adults. In early infancy, however, they are not clearly expressed. Here we measure extraocular muscle activity in infant rats at 3 days of age (P3), P8, and P14-15 in order to assess the ontogeny of REMs and their relationship with other forms of sleep-related phasic activity. Surprisingly, the tone of the extraocular muscles fluctuates in synchrony with the tone of other muscle groups; focal electrical stimulation within the dorsolateral pontine tegmentum, an area known to contain wake-on neurons in P8 rats, results in the simultaneous activation of both nuchal and extraocular muscles. Furthermore, the causal relationship between extraocular muscle twitches and REMs strengthens during the first 2 postnatal weeks, reflecting increased control of the extraocular muscles over eye movements. As early as P3, however, phasic bursts of extraocular muscle twitching occur in synchrony with twitching in other muscle groups, producing waves of phasic activity interspersed with brief periods of quiescence. Finally, when state-dependent neocortical electroencephalographic activity was observed at P14, it had already integrated fully with sleep and wakefulness as defined using electromyographic criteria alone; this finding is not consistent with the notion that active sleep in infants at this age is half-activated. All together, these results indicate exquisite temporal organization of sleep soon after birth and highlight the possible functional implications of homologous activation states in striated muscle and neocortex. [Supported by grants from the National Institute of Mental Health (MH50701, MH66424).]

NEONATAL FEAR CONDITIONING ATTENUATES ADULT FEAR CONDITIONING AND AMYGDALA INVOLVEMENT
Y. Sevelinges,1 S. Moriceau,2 K. Muzny,3 R. Gervais,1 A. M. Mouly,1 R. M. Sullivan2
1Institut des Sciences Cognitives, CNRS-Univ. Lyon, France
2Zoology, University of Oklahoma, Norman, OK, 73019, U.S.A.

Infant fear (odor, 0.5 mA shock) conditioning paradoxically causes odor preferences until PN10, with emergence of amygdala participation in fear conditioning. We assessed the long-term effects of this paradoxical learning on adult olfactory fear conditioning. Infant rats were trained daily from 8 to 12 days old; Paired (pepp odor, 0.5 mA), Unpaired, Odor only and No (infant conditioning). In adulthood, animals from each of the four infant conditioning groups were trained: Paired (pepp odor, 0.5 mA), Unpaired or Odor-only. Adult animals were tested for freezing to odor-alone, while amygdala 2-DG activity during acquisition was assessed in selected groups. Results showed animals that received both infant and adult odor-shock Paired conditioning, learned to freeze to the odor but at significantly lower levels of freezing compared to Infant Infants or Adult Paired animals. Furthermore, Paired Infant/Paired Adult animals had no detectable amygdala participation in the adult fear conditioning paradigm. This suggests the existence of a fear conditioning alternate pathway with experience dependent activation. Control groups showed that Infant Naive/Adult Paired animals readily learned to freeze to the odor paired with shock in adulthood. Furthermore, the amygdala was incorporated into the fear circuit of this group. Infant Unpaired/Adult Paired and Infant Odor-only/Adult Paired groups performed similarly to Infant Naive/Adult Paired animals. These data suggest that infant pre-exposure to unpaired presentations, did not alter the adult conditioning (freezing). No learning was detected in any adult control group, regardless of infant training. [NSF IBN0117234, NICHD HD33402, OCAST to R. M. S. and Eurodoc grant to Y. S.]

THE PERSISTENCE OF EXTINCTION IN THE 3-MONTH-OLD HUMAN INFANT
C. Shafer & C. Rovee-Collier
Department of Psychology, Rutgers University, Piscataway, NJ 08854, U.S.A.

The phenomenon of extinction is manifested as a reduction in conditioned responding as the result of withholding reinforcement. Pavlov (1927) held that learned associations are permanent, and recent research has suggested that extinction procedures induce new learning that is superimposed on what was learned before rather than unlearning of the original conditioned response. If so, then that new learning must be relatively permanent as well. Although most conditioning studies with human infants have included an extinction manipulation, the persistence of extinction performance has not been examined with human infants. In the present study, we charted its persistence with 3 months old. For 9 min/day on 2 days, infants were reinforced for kicking to move a mobile—a task they remember for 5 days. Immediately afterward, infants received a 6-min nonreinforcement period when kicks did not move the mobile. Independent groups were tested for renewed responding (spontaneous recovery) during a 3-min nonreinforcement period after increasing delays. We predicted that infants would renew conditioned responding with the increasing time passage, but they did not. They failed to respond after all test delays. We attributed nonresponding to extinction after 1–5 days and to forgetting after 7 days. Subsequently decreasing the absolute duration of acquisition and increasing the delay between acquisition and extinction again extinguished conditioned responding and did not lead to renewed responding on the long-term test. For young organisms whose inhibitory mechanisms have not yet matured, extinction may be the primary means by which conditioned responding is culled and shaped. [Supported by NIMH grant #32307 to C. R. C.]
PREWEANLING MATERNAL DEPRIVATION AND ADOLESCENT FOOD INTAKE
K. Shionoya, T. Kimura, M. Ito G. Matsumoto
RIKEN Brain Science Institute, Wako, Saitama, Japan

Clinically, there is a link between childhood abuse/neglect and later obesity, although a causal relationship has not been established. Here, we present an animal model of child abuse/neglect and later adolescent feeding enhancement that suggests a causal relationship. We used a maternal deprivation paradigm where pups were separated from the mother for 2–3 hr/day during the preweanling period with three conditions: separation with peers, separation in isolation and non-separated controls. Food and water intake was assessed over four phases, each more demanding. In phase 1, food and water intake were ad lib. Phase 2 required rats to alternate between food and water delivery. Phase 3 made the additional requirement of visiting the arena center between food and water visits. Phase 4 made the additional requirement of discriminating two different frequency tones to signal food and water availability. Results show that maternally deprived rats ate and drank more than controls in ad lib conditions, but ate and drank less with increasing performance demands. Divergence between the two maternal deprivation groups was found in Phase 4, where maternal deprivation with peers food consumption was intermediate to maternal separation in isolation and the normally reared pups. These results suggest that preweanling maternal separation modification of later consumption is context specific. [Funded by RIKEN.]

MATERNAL BEHAVIORS AND GLUCOCORTICOID RECEPTOR mRNA IN RAT MODELS OF EARLY LIFE STRESS
W. Shoemaker, M. Hornberger, A. Armstrong, & J. Covault
Department of Psychiatry, University of Connecticut Health Center, Farmington, CT 06032, U.S.A.

Our study examined two known early life stress paradigms, neonatal isolation (ISO), and maternal separation (MS). MS separates dam from a litter of pups for a 3-hr duration, where as ISO removes pups individually for 1 hr. All animals were derived from outbred Sprague–Dawley matings and were born in our facilities. Animal facility reared (AFR) controls were born at the same time and only handed during routine husbandry. Duration of ISO treatment continued from postnatal day 2–9, whereas MS is longer in duration, from PN 2–16. Maternal behavior observations were made from PN 2–16, three times daily, AM (post treatment), PM and during the night cycle. Maternal behavior measures were time spent (a) in nest, (b) nursing, and licking pups, either (c) body or (d) ano-genital licking. MS and ISO mothers differed greatly from AFR in the intensity and time course of body licking and ano-genital licking (ANOVA F = 42, p < 0.005 for BL; F = 11.7, p < 0.04 for AGL). ISO mothers had high (mean 101 s per 10 min observation period) levels of licking when their pups were being isolated (PN2–9), after which (PN10–16) ISO mothers licked less (33 s). MS mothers had a much more variable pattern with a mean of 75 s of AGL during the same period (PN2–9), but MS litters were still undergoing treatment and their AGL increased to 111 s on PN10–16. AFR mothers had consistent levels of AGL, 20 s. At adult age, brain and liver tissue were harvested for determination of mRNA for the glucocorticoid receptor isoforms. Initial results indicate that both stress treatments alter GR in hippocampus, but not liver, compared to AFR controls.

EGG-OPENING AND VISUAL STIMULATION MODIFY HEART RATE IN BOBBLITE QUAIL EMBRYOS
M. Sleigh
Department of Psychology, Winthrop University, Rock Hill, SC 29733, U.S.A.

The current study examined heart rate patterns in bobwhite quail embryos under different visual stimulation regimes. Two groups of naive embryos were exposed to 2 cps of visual stimulation, while heart rate was measured with wire electrodes inserted through the intact eggshell. Thirteen embryos were tested on day 17 or 18, and 13 embryos were tested on day 19 or 20. Embryos responded to stimulation onset with an immediate heart rate deceleration. Twenty-nine additional embryos were tested at day 19 (n = 9), day 20 (n = 10), or day 21 (n = 10). These 29 embryos underwent an established egg-opening procedure (EP) prior to visual stimulation exposure. Another 20 embryos underwent a modified, less invasive, egg-opening procedure (MP) and were tested at day 20 (n = 10) or day 21 (n = 10). Both egg-opening procedures resulted in heart rate decelerations, with a greater deceleration occurring in the MP group. The EP embryos exhibited further heart rate deceleration, while the MP embryos maintained a steady heart rate, following the onset of visual stimulation. Throughout testing, both the EP and MP embryos exhibited lower heart rates than embryos in intact eggshells. These patterns demonstrate that an organism s arousal is influenced by multiple elements of its developmental context. The link between prenatal arousal and behavioral outcomes has yet to be clearly understood. [Supported by Jefferson Foundation Grant J-606.]
THE NMDA ANTAGONIST MK-801 IMPAIRS TRACE EYEBLINK CONDITIONING IN WEANLING RATS

J. R. Sullivan, D. J. Watson, & M. E. Stanton
Department of Psychology, University of Delaware, Newark, DE 19716, U.S.A.

Trace eyelink conditioning is more severely disrupted by NMDA antagonism than simple delay conditioning in the adult rabbit (Thompson & Disterhoft 1997, J Pharm Exp Therap, 281, 928–940) and mouse (Takatsuki et al., 2001, Neuropharm 41, 618–628). Trace eyelink conditioning is a hippocampally dependent form of learning, and the hippocampus is rich in NMDA receptors, which may account for the stronger effects of NMDA antagonism on trace conditioning. The role NMDA receptors play in trace conditioning in the developing rat is currently unknown. We tested postnatal day (PND) 26 rats in trace eyelink conditioning with doses of 0.06 mg/kg and 0.10 mg/kg of MK-801, a noncompetitive antagonist of the NMDA receptor. The parameters used in the trace conditioning sessions were the same as those described in Ivkovich & Stanton (2001, Neurobiol Learn Mem, 76, 426–446) except that headstages were surgically implanted on PND 24 and the rats were run 1 session a day for 4 consecutive days beginning at PND 26. Rats were injected IP 30 min before each training session with doses of saline vehicle, 0.06 and 0.10 mg/kg of MK-801. These doses created a clear dose response effect in CR percentage with saline rats performing the best, followed by 0.06 and 0.10 mg/kg of MK-801 treated rats. These results are similar to preliminary data from adult rats in our lab (in progress). These data suggest functional maturity of the NMDA receptors and hippocampus for trace conditioning in the weanling rat at PND 26. [Supported by PO1-HD-35466-01, ROI AA014288-01.]

CHILDHOOD ABUSE AND REGIONAL BRAIN DEVELOPMENT: EVIDENCE FOR SENSITIVE PERIODS

M. H. Teicher, S. L. Andersen, A. Tomoda, E. Vincow, E. Valente, A. Polcari
Developmental Biopsychiatry Research Program, McLean Hospital & Department of Psychiatry, Harvard Medical School

The brain is molded by experiences that occur throughout the lifespan. However, there are particular stages of development when experience exerts either a maximal (sensitive period) or essential (critical period) effect. For example, Hubel and Wiesel found that binocular deprivation maximally affected development of the visual cortex in cats if it occurred early in postnatal life, but had no impact after puberty. Little direct evidence exists for sensitive or critical periods in human brain development. Based on differential rates of maturation specific brain regions should have their own unique periods of sensitivity to the effects of early experiences such as stress. To ascertain if this is true in humans, the size of a priori selected target regions were measured from high-resolution volumetric MRI scans (1.5 T GE Echospeed) from 26 unmedicated collegiate females (18–22 years old) with a history of repeated childhood sexual abuse and 19 healthy subjects. A voxel-based, group-wise age-related analysis revealed that the mid sagittal area of the rostral body of the corpus callosum was affected by abuse that occurred at age 9 (p < 0.001), and in contrast, the midsagittal area of the prefrontal cortex was affected by abuse at age 14 (p < 0.02). These findings provide the first evidence in humans that brain regions with different rates of maturation have unique windows of vulnerability to the effects of early traumatic stress. [NIMH (MH-53636, MH-66222) and NIDA (DA-016934, DA -017846) to M. H. T.]

REINSTATEMENT OF THE NEONATAL SENSITIVE PERIOD IN OLDER PUPS THROUGH ATTENUATION OF AMYGDALA FUNCTION

R. M. Sullivan, S. Moriceau, T. L. Roth, A. Crabbe, & C. Jensen
Zoology Department, Univ Oklahoma, Norman, OK 73019, U.S.A.

The young of many altricial species learn to prefer stimuli paired with pain, presumably due to the critical importance of learning to prefer the caregiver that is required for attachment and survival. With maturity, a learning system emerges that includes the amygdala, and enables the young to easily learn to avoid or fear stimuli paired with pain. Here, we show the simultaneous existence of attachment learning and the more adult like fear learning and suggest that inclusion of the amygdala into the learning circuit determines what the infant will learn. Specifically, we used a fear conditioning paradigm (odor 0.5 mA shock) that produces an odor preference in older post-sensitive period pups when amygdala function has emerged. Here, a shock-induced odor preference was found in older post-sensitive period pups under two conditions: (1) an anesthetized mother is present during odor-shock conditioning and (2) pups had previously experienced odor-shock conditioning during the sensitive period. Moreover, when the odor-shock fear conditioning produced an odor aversion in older pups, there was attenuated amygdala function compared to same aged naïve animals that have normal fear conditioning and enhanced amygdala activity. These results suggest that two learning systems co-exist during the pups preweanling period and may represents pups continued dependence on the mother for survival, while preparing for life outside the nest that will require learning to avoid situations with negative contingencies. [RMS Funding NSF IBN0117234, NICHD HD33402, OCAST.]

APPETITIVE RESPONSIVENESS TO CHEMOSENSORY CUES ASSOCIATED WITH ACUTE ETHANOL INTOXICATION IN INFANT RATS

E. M. Truax, L. Ponce, N. E. Spear, & J. C. Molina
Department of Psychology, Binghamton University, Binghamton, NY 13902, U.S.A.

While neonatal rats are sensitive to the appetitive effects of relatively low doses of ethanol, evidence of ethanol-mediated appetitive conditioning has been elusive in older infants. The present study assessed motivational properties of ethanol in 14-day-old rats by pairing a chemosensory cue with the induction of ethanol intoxication resulting from intragastric administrations (i.g.) of low or relatively high ethanol doses. Due to failed attempts to demonstrate ethanol’s reinforcing effects through first-order conditioning procedures we developed an experimental strategy analogous to second-order conditioning. In Experiment 1, 5 min after pups received i.g. ethanol (0, 0.25 or 0.5 g/kg) they were intraorally stimulated with a 10% v/v sucrose solution (15 pulses, 1 s each; interpulse duration: 60 s). During postnatal day 15 pups experienced four pulses of sucrose paired with sandpaper. Results revealed heightened sandpaper preferences in pups originally exposed to sucrose-ethanol pairings relative to those treated with vehicle alone. Experiment 2 indicated similar sandpaper preferences when using intraoral infusions of water as a CS and when employing a relatively high ethanol dose (2.6 g/kg) as an unconditioned stimulus. Experiment 3 failed to reveal reinforcing effects of 0.5 or 2.0 g/kg i.g. ethanol through assessment of consumption of the CSs originally paired with ethanol intoxication. The present study shows that infant rats are sensitive to ethanol s positive reinforcing properties. It also indicates that higher-order conditioning procedures are more sensitive for revealing such properties than first-order assessments. [N. E.Spear (NIAAA, AA011960-06). J. C.Molina (FON-CyT:PICT05-14024).]
The striate cortex (V1) is characterized by long-range lateral connections. Post-mortem studies of young human infants have shown that these lateral connections are sparse in the immature V1. These connections have been implicated in the perception of contour paths defined by the alignment of small oriented edge elements. The present study tested the prediction that contour detection performance should be poor in 3-month-old infants and improve thereafter. Infants 3–5 months of age were shown images displaying a contour embedded in a background of randomly oriented edge elements. The contour was positioned in one of four quadrant locations. Infants should spend significantly more time fixated (>25%) on the contour-containing quadrant provided that they are capable of perceiving the edge elements. This assertion was tested in Experiment 1, where the spacing between contour elements was set to one-half of the average spacing between noise elements, such that element density served as a contour detection cue. Preliminary analysis indicated that infants tended to fixate on the quadrant with the contour. In Experiment 2, the contour element separation and the noise element separation were equalized such that element density could not be used to detect the contour. Infants in this condition must integrate orientation alignment information to perceive the contour. All infants appear to perform similarly in Experiment 1, but only the older infants appear to reliably perceive the contour in Experiment 2. These psychophysical results support previous anatomical findings pertaining to the immaturity of V1.

[NIH R01-38315 to P. G.]

142

MATERNAL STRESS COMPOUNDS ADVERSE EFFECTS OF NEONATAL PAIN ON THE DEVELOPMENT OF HPA AXIS AND COGNITION IN PRETERM INFANTS

Mai Thanh Tu,1,2 Julie Petrie-Thomass,3 Joanne Weinberg,1,4 Michael F. Whitfield,2 & Ruth E. Grunau.1,2
1Centre for Community Child Health Research, British Columbia Research Institute, University of British Columbia, Canada
2Department of Pediatrics, University of British Columbia, Canada
3Department of Interdisciplinary Graduate Studies, University of British Columbia, Canada
4Department of Cellular & Physiological Sciences, University of British Columbia, Canada

Preterm infants born at very low gestational age (VLGA, <33 weeks) undergo repeated painful procedures in the neonatal intensive care unit. This appears to reset the hypothalamic-pituitary-adrenal (HPA) axis, a key part of the stress system, and adversely affect cognitive development. In rats, repeated neonatal pain increases maternal behavior, which in turn, buffers HPA responses to stress in pups. To our knowledge, this has not been addressed in human infants. We assessed the impact of maternal stress and maternal behavior on the effects of cumulative neonatal pain on cortisol and cognition in 83 VLGA and 42 full-term infants at 8 months (CCA). Neonatal pain, calculated as number of skin breaking procedures from birth to term (adjusted for illness severity and morphine exposure), and maternal stress (Parenting Stress Index) were measured. Infant cognition (focused attention) was assessed during a 6-min toy exploration task and maternal behavior, (Parenting Stress Index) were measured. Compared to sham group, the CI rats showed: decreased weight gain, increased circling behavior, spent more time in the center zone of the open field, and decreased frequency and duration of scanning behaviors with an anesthetized dam. Following a 24-hr deprivation period beginning at postpartum day 7, CI rats showed decreased nipple treading behavior with an anesthetized dam. The pattern of behavioral deficits for the AT group was different from the CI group. Findings indicate that a neonatal brain CI in this rat model is associated with feeding-related behavioral deficits that yield decreased weight gain during food deprived and non-deprived states. [JF-Center for Premature Infant Health and Development, CRA-NIH NS35902.]

DO BRIEF EARLY DISTURBANCES OF PARENTS AFFECT PARENTAL CARE IN THE BI-PARENTAL PRAIRIE VOLE (Microtus ochrogaster)?

A. N. Tyler,1 G. F. Michel,1 K. L. Bales,2 C. S. Carter3
1Department of Psychology, Univ of North Carolina at Greensboro, Greensboro, NC 27402, U.S.A.
2University of California at Davis, U.S.A.
3University of Illinois, Chicago, U.S.A.

Rats and mice that experience repeated brief separations from their mother as pups tend to have a more attenuated behavioral and physiological response to the presentation of a stressor they appear to cope with the stress. Although the literature is mixed, some argue that more prolonged separations from the mother can lead to decreased coping abilities in the offspring in response to a stressor. Maternal care may mediate the relationship between the early separations and adult outcomes because the separations influence the maternal care displayed upon reunion. Unlike rats and most mice, the prairie vole is a bi-parental species in which both the male and female care for the young. In the current study, prairie vole parents were briefly disrupted either on postnatal day 1 or on postnatal days 1 through 7 and compared to an undisturbed group. All were observed for 1 hr on postnatal days 1, 8, and 15 to record their parental care behaviors. Disturbing the parents by handling them briefly on PND 1, led to a higher frequency of pup-directed behaviors and lower frequency of lateral nursing compared to parents that were left undisturbed. Irrespective of group, dams displayed higher frequencies of crouching, grooming, and pup-directed behaviors than sires. The mother decreased her time spent in the nest from week 1 to week 3, while the father increased his time in the nest over the same time period. These results suggest that the disruption for this study had slight but significant effects on parental care. [This project was funded by NIH Grant Number: PO1 HD38490, HD08702.]
MATERNAL BEHAVIOR DIFFERS IN TWO SUBLINES OF RATS: THE HIGH (HY) AND LOW YAWNING (LY) SPRAGUE–DAWLEY RATS AND CHANGE OF STRESS RESPONSES OF THEIR OFFSPRING

A. Ugarte,1 A. I. Melo,2 J. Garcia,1 & J. R. Eguibar1
1Instituto de Fisiología, B. U. A. P. Apdo. Postal 5-66, Puebla, Pue
2CIRA Universidad Autónoma de Tlaxcala, CINVESTAV. Tlaxcala, México

At the Institute of Physiology, BUAP we developed two Sprague–Dawley sublines of isogenic rats selectively bred for high (HY, mean 20 y/h) and low–LY, mean 2 y/h) spontaneous yawning frequency. It has been observed that HY subline shows increased mortality prior to weaning, but the underlying causes of this increased mortality are unknown. In the present study, we compared maternal behavior of lactating female rats of both sublines to their own or cross-fostered pups. Additionally, we compared the stress reactivity of the adult offspring raised by HY or LY dams. Maternal behaviors (latency to retrieve the first pup, crouching over pups, body and anogenital licking) were recorded for 15 min on days 1, 3, 5, 7, and 9 days postpartum. Open field test was conducted between 75 and 80 days postpartum, in both male and female offspring. Our results showed that HY rats displayed lower levels of maternal behaviors compared to LY and Sprague–Dawley control rats. Furthermore, adult rats raised by HY females appear to be more emotionally reactive compared to those raised by LY and Sprague–Dawley mothers. [Partially supported by CONACYT 43674-A and VIEP-BUAP 1/G/SAL/05 to J. R. E.]

MATERNAL-FETAL AND INFANT SYNCHRONY DIFFERENCES REFLECT DIFFERENCES IN LATER EXPLORATION OF NOVEL ENVIRONMENTS IN RHESUS MACAQUES (M. mulatta)

M. K. Unkefer, C. I. Kenney, M. Snyder, S. J. Suomi, & M. F. S. X. Novak
Lab of Comparative Ethology, NICHD, NIH, Poolesville, MD 20837, Northern Virginia Community College, Sterling, VA 20164, U.S.A.

Mechanisms of individual differences among infants willingness to explore the environment may reflect situational differences at the time of exploration; or, may reflect differences in mother-infant relationships, and even maternal-fetal relationships. We hypothesized that differences in acute fetal responsivity to maternal psychological challenges would be reflected in neonatal mother-infant synchrony, and subsequent environmental exploration. Acute changes in maternal and fetal cardiovascular functioning were measured in a pregnant rhesus macaques (Macaca mulatta), instrumented with chronic maternal and fetal catheters on gestational day 120 (parturition –168 days). Two different prenatal, neonatal, and 3-month postnatal patterns are described. In the first, maternal and fetal physiological responding to maternal psychological capture challenges were synchronous however maternal-infant behavior did not approach dependence or synchrony until month 2 ($\chi^2(1) = 18.7, p < 0.05$ and Kappa ($K$) = 0.29, Asymp. SE (ASE) = 0.067, $p < 0.05$, respectively). A similar pattern was observed looking at only maternal-infant disagreement and disturbance behavior. In the second, prenatal responses were not synchronous. However, mother and infant behavior was synchronous during the first postnatal week and unrelated by the end of month 1. For disturbance behavior this pattern was significant for both dependence and synchrony (week 1: $\chi^2(1) = 15.6, p < 0.05; K = 0.13, ASE = 0.071, p < 0.05$, respectively). The first pattern resulted in much higher rates and durations of exploratory behavior at 3 months, demonstrating idiosyncratic patterns of infant behavior may originate before birth. [Intramural Research Program, NICHD, NIH.]

FETAL BEHAVIORAL STATE ORGANIZATION IS ASSOCIATED WITH ADHD IN ADOLESCENCE

B. R. H. Van den Bergh, M. Debruyne, M. Hubert, & L. Lagae
Department of Psychology, University of Leuven, Leuven, B-3000, Belgium

Fetal behavioral states can be regarded as precursors of the adult sleep-wake states. Disturbed sleep-wake organization is a characteristic of psychopathological diseases such as ADHD. In a prospective follow-up study, (n = 63), it was examined whether measures of behavioral state organization at 36–38 weeks of gestation are predictive of ADHD at 14–15 years of age. In the study group, (n = 24) measures of maintenance and building up of particular states were obtained by making combined recordings (120) of fetal heart rate, general movements and eye movements, using cardiotocography and real-time ultrasound. A research diagnosis of ADHD was based on seven mother and teacher report clinical scales, including CBCL and DSM-IV scales. Multiple regression analysis indicated that the duration of transitions between state 1F (quiet sleep) and state 2F (active sleep) explained up to 23% of the variance in ADHD at 14–15 years, after controlling for covariates such as smoking during pregnancy, birth weight and postnatal maternal anxiety. An ANOVA indicated that synchronicity of change of the state variables (i.e. within 3 minutes) during transition was associated with a lower incidence of ADHD then in the prospectively followed reference group (n = 49). Underlying mechanisms (e.g., monoaminergic neurotransmitter system, hormones) and the integration of sleep regulatory mechanisms will be discussed from a developmental psychopathological point of view. [Grant No. G.0211.3, Fund for Scientific Research (FWO), Flanders, Belgium.]
SCHEDULE-INDUCED POLYDIPSIA IN ADOLESCENT RATS RESPONDING FOR WATER AND ETHANOL
C. Vetter, C. Wilmouth, & L. Spear
Center for Developmental Psychobiology, Department of Psychology, Binghamton University, Binghamton, NY, U.S.A.

Previous research has shown that food deprived animals when exposed to a fixed schedule of food delivery will consume excessive amounts of fluids, known as schedule-induced polydipsia. The phenomenon of schedule-induced polydipsia has been extensively described in adult animals, but little research has examined polydipsic behavior in adolescent animals. The purpose of the present study was to examine the acquisition and maintenance of schedule-induced polydipsia using water and a 5% unsweetened ethanol solution in adolescent animals. Adolescent (postnatal day [P] 26–28) male Sprague–Dawley rats were double-housed and food restricted to 85% of their projected free-feeding body weight, using intake data obtained in a pilot study. Animals were maintained at their restricted weight for 3 days before testing and throughout the course of experimentation. Animals were given 12 daily 1-hr sessions in standard operant chambers with a recessed food trough in which food pellets were dispensed every 60 s (Fixed Time 60-s schedule) and free access to a ball-bearing drinking tube containing either water or a 5% ethanol solution. Adolescent animals drank similar amounts (ml/kg) of water and the ethanol solution with a mean fluid intake of 49.52 ml/kg/session, fluid intake increased significantly over the 12 days of experimentation, an increase that tended to be more pronounced with water. Ethanol intake averaged 1.6 g/kg over the 1-hr session. The relationship of these results to adult intakes and the possible potential utility of this model as a binge-like model of ethanol consumption will be discussed. [Supported by grants R37 AA12525, RO1 DA 107091 and RO1 AA12150.]

CONDITONED PLACE PREFERENCE FOR METHAMPHETAMINE IN ADOLESCENT AND ADULT RATS AFTER CHRONIC EXPOSURE TO METHYLPHENIDATE
J. L. Wagner, B. M. Beck, & B. S. Neal-Beliveau
Department of Psychology, IUPUI, Indianapolis, Indiana, 46202, U.S.A.

Methylphenidate (MPD; Ritalin) is a common treatment for attention deficit hyperactivity disorder. One concern is that adolescents exposed to MPD will have an increased propensity to abuse similar drugs as they grow older. As a psychostimulant, MPD activates the same dopamine reward pathway as cocaine and methamphetamine (METH). Chronic activation could alter dopamine receptors in this pathway, affecting subsequent sensitivity to the rewarding properties of psychostimulant drugs. To test this hypothesis, we chronically exposed rats to MPD (0 or 2 mg/kg, sc, twice daily) in adolescence (P20–P15) or early adulthood (P50–P65). The rewarding properties of METH were examined 25 days later in a conditioned place preference paradigm. Rats were conditioned by pairing METH (0, 0.1, 0.3, or 1.0 mg/kg) with one environment, and, on alternating days, saline with a different environment. After 8 days of conditioning, time spent in the two environments was recorded during a drug-free session when rats could freely visit both environments. Increased time in the METH-paired environment would suggest that the rats found the drug rewarding. Differences in preference for control versus MPD rats were compared, as well as adolescent vs. adult MPD exposure. METH appeared to be more rewarding to younger (P69) versus older (P99) control rats. However, the rewarding properties of METH were reduced in adolescent-exposed MPD rats, but enhanced in adult-exposed rats, compared to controls. Thus, rather than increasing susceptibility, adolescent MPD exposure may actually offer protection against future psychostimulant abuse; this appears not to be the case with adult exposure. [Supported by the IUPUI Undergraduate Research Opportunities Program.]

SERIAL REVERSAL LEARNING IN DEVELOPING RATS: MK-801 EFFECTS DEPEND ON STAGE OF REVERSAL TRAINING
D. J. Watson, J. R. Sullivan, K. K. Chadman, & M. E. Stanton
Department of Psychology, University of Delaware, Newark, DE 19716, U.S.A.

We have reported that MK-801, a non-competitive NMDA receptor antagonist, selectively impairs a single reversal (but not acquisition) of a T-maze position discrimination in weanling rats. Here we asked how MK-801 would affect performance after a series of reversals in developing rats. Of particular interest was whether MK-801 injections given during targeted reversals (i.e., either early or late in the series) would impair reversal learning. Long-Evans rats were trained on postnatal day (PND) 26 on serial reversal of a position discrimination in a T-maze (cf. general procedures of Watson et al., Dev Psychobiol, 2005, accepted). The acquired position habit was then reversed six times across a set of 4 days, with two sessions a day separated by 6 hr. Groups were administered 0.10 mg/kg MK-801 either on Reversal 1 or 6 or no reversals (saline vehicle). The group that was given MK-801 on Reversal 6 was much less impaired than the group that was given MK-801 on Reversal 1. That pups are more susceptible to the effects of MK-801 early but not later in the reversal series suggests that formation of learning sets reduces the role of NMDA receptors in reversal learning. Impaired serial reversal learning may be relevant to development disorders dependent upon NMDA receptor function. [Supported by NIH PO1-HD-35466-01, and RO1 AA014268-01.]

A ROLE FOR THE ENDOGENOUS OPIOID SYSTEM IN INFANTILE AMNESIA
Marianne Weber, Gavan P. McNally, & Rick Richardson
University of New South Wales, NSW, Australia

Recent research has shown that the endogenous opioid system may inhibit the storage of associative memories in adult rats (McNally & Westbrook, 2003). In this study, we examined whether the opioid system might play a role in infantile amnesia after contextual fear conditioning. We showed that when 18-day-old rats receive an aversive footshock in a novel context they display conditioned freezing in that context 1 min after training, but not 24 hr after training. A systemic injection of the opioid receptor antagonist naloxone (5 mg/kg) alleviated forgetting when injected prior to testing but not when injected immediately after training. That is, blocking the release of endogenous opioids during the consolidation phase of the context-shock association did not affect performance 24 hr later, whereas blocking opioid receptors during test did. Further, this effect was observed when rats were injected and tested 7 days after training, albeit to a lesser extent. These results converge with previous studies suggesting that infantile amnesia is due to retrieval failure. [Australian Research Council.]
WEIGHT GAIN IN SUCKLING RAT PUPS LACKING CCK-A RECEPTORS: “COMPETITION” AND CROSS-FOSTERING STUDIES
A. Weller, M. Schroeder, O. Zagoory-Sharon, & Y. Lavi-Avnon
Department of Psychology and Gonda Brain Research Center, Bar-Ilan Univ, Israel

Otsuka Long Evans Tokushima Fatty (OLETF) rats lack expression of functional CCK-A receptors, resulting, in adults, in obesity, and diabetes. We are using this model to study the ontogenetic pattern and neurobiology of obesity. We followed-up the patterns of body-weight gain and fat-pad distribution of OLETF and LETO (control) male and female rats, from postnatal day 1 to 65. OLEFT pups were significantly heavier since birth and gained weight more dramatically from the third postnatal week. OLEFT pups significantly accumulated more white fat from the post-weaning period and on, compared to controls. Next, we compared the ability of pups from both lines to gain weight from the same nursing episode. In this competition experiment, OLEFT and LETO pups were fed together by a dam (OLETF or LETO). OLEFT pups gained weight significantly more than LETO. In order to assess how the maternal environment affects the developmental trajectory of OLETF pups towards obesity, similar-sized litters were cross-fostered and diurnal nursing behavior was examined. Preliminary results showed more nursing in OLETF litters in the third, but not in the first and second postpartum weeks. OLEFT pups raised by LETO dams remained obese. LETO pups raised by OLETF dams were overweight until weaning, and (in females) returned to normal average weight afterwards. The results suggest a maternal influence on weight gain during lactation, and a strong obesity-prone phenotype in OLETF pups. [Supported by the US-Israel Binational Science Foundation.]

CRITICAL TIMING FOR NEONATAL ETHANOL’S EFFECTS ON BALANCE AND THE ROLE OF AGMATINE AS A NEUROPROTECTIVE AGENT IN JUVENILE RATS
K. A. Wellmann, D. J. Morrell, B. O. Overgaauw, J. L. Alexander III, & S. Barron
Psychology Department, University of Kentucky, Lexington, KY, U.S.A.

Fetal Alcohol Syndrome (FAS) is characterized by a variety of developmental and learning disabilities. Balance and coordination appear particularly sensitive to prenatal ethanol exposure (ETOH) in both humans and animal studies. A recent focus in our laboratory has looked at the timing of ETOH exposure and ways to reduce some of ETOH’s effects. Balance was examined in rats that received ETOH on either PND 1–7 or 8–15. This paradigm has been used to study the effects of ETOH during a period of CNS development that overlaps the 3rd trimester of human pregnancy. Polyamines appear to play an important role in ETOH withdrawal induced neurotoxicity, which appears to be important in ETOH-related teratogenicity. Agmatine, which blocks the polyamine site on the glutamate receptor, provides further support for the sensitivity of the CNS to ETOH during the first postnatal week. [NIAAA # 014032 to S. B.]

HABITUATION OF ISOLATION INDUCED ULTRASONIC VOCALIZATIONS IN THE INFANT RAT
Keith W. Whitaker & Donald J. Stehouwer
University of Florida, FL, U.S.A.

Infant rats emit ultrasonic vocalizations (USVs) when isolated from the nest. However, it is not clear whether USVs represent an emotional response to isolation per se, or whether they are part of a physiological response to the thermal challenge associated with isolation. In this study, we recorded the USVs of 5-day-old rat pups that were repeatedly isolated in either a novel environment or home nest shavings at 23°C or 35°C. Isolation at 23°C in a novel environment elicited a greater number of USVs than did exposure to the cool temperature or novel environment alone. The effects of temperature and novelty appeared to be additive. Furthermore, USVs habituated with repeated exposure to the novel environment, but not to the thermal challenge. Thus, we conclude that there are two independent and simultaneous mechanisms controlling isolation-induced ultrasound production: a novelty-related process that is subject to habituation and may have an emotional component, and a thermally-related process that is not subject to habituation and may be part of a physiological response.

BEHAVIORAL EXPRESSION OF LEARNED FEAR: FACILITATORY EFFECTS OF PRIOR EXPERIENCE
C. S. L. Yap & R. Richardson
School of Psychology, The University of New South Wales, Sydney 2052, Australia

Developmental studies have shown that the expression of learned fear emerges in a response-specific manner (Hunt & Campbell, 1997). For example, freezing emerges before fear potentiated startle (FPS) to an odor CS (∼PN16 vs. ∼PN23). Moreover, learned fear is expressed in a manner appropriate to the animals age at training and not their age at test. That is, rats given odor-shock pairings at PN16 exhibit freezing to the odor when tested at PN23, but FPS. We recently demonstrated that the expression of early learning could be updated by training a second stimulus at an older age. Specifically, rats given Odor1-shock pairings at PN16 and Odor2-shock pairings at PN23 showed both freezing and FPS to Odor1 (Yap, Stapisinski, & Richardson, submitted). The present study shows that rats given Odor1-shock pairings at PN16 and Odor2-shock pairings at PN20, an age when FPS is not usually expressed, exhibited FPS to both odors when tested at PN23 (Experiment 1). The atypical occurrence of FPS to an odor CS trained at 20 days of age may have been observed in this experiment because of: (1) the 3-day interval between conditioning and test (Experiment 2), or (2) the effects of prior training to another stimulus at PN16 (Experiment 3). It appears that the latter accounts for the facilitated development of FPS at PN20. Moreover, the facilitation effect appears to be modality-specific (Experiment 4a), and does not occur following unpaired presentations of Odor1 and shock at PN16 (Experiment 4b). [Grants from Australian Research Council and Faculty of Science, UNSW.]
EFFECTS OF A PARTIAL D2 RECEPTOR AGONIST ON STRIATAL DA AUTORECEPTOR FUNCTIONING IN PREWEANLING RATS
S. T. Yoshida, S. A. Baella, N. M. Stuebner, C. A. Crawford, & S. A. McDougall
Department of Psychology, California State University, San Bernardino, CA 92407, U.S.A.

There is evidence that partial D2 agonists (e.g., terguride) may not affect D2 postsynaptic receptors in an adult-typical manner during the preweanling period. To determine whether synthesis modulating DA autoreceptors are also affected in an adult atypical manner by partial D2 agonists, preweanling rats were treated either acutely or repeatedly with reserpine (low dopaminergic tone) or vehicle (high dopaminergic tone). Rats in the acute treatment group were injected with saline on PD 16 PD 19 and reserpine (1 mg/kg) on PD 20. Rats in the repeated treatment group were given a daily injection of reserpine on PD 16 PD 20. The ability of terguride (0.1–1.6 mg/kg), quinpirole (a full D2 agonist), or haloperidol (a D2 antagonist) to alter striatal DOPA accumulation was assessed after NSD-1015 treatment on PD 21. In addition, terguride’s ability to modulate DA syntheses was assessed in rats treated with the nerve impulse inhibitor gamma-butyrolactone (GBL). Results showed that both terguride and quinpirole reduced striatal DOPA accumulation during a state of low dopaminergic tone (i.e., after reserpine treatment). During a state of high dopaminergic tone (i.e., after vehicle treatment), terguride had similar effects as haloperidol and increased DOPA accumulation. Terguride, like quinpirole, partially inhibited the GBL-induced increase in striatal DOPA accumulation. Consistent with past studies, these results show that synthesis modulating D2 autoreceptors are functional during the preweanling period. Of more interest, terguride is capable of producing agonist- or antagonist-like effects at these receptors depending on the state of dopaminergic tone.

METHYLPHENIDATE TREATMENT ALTERS BRAIN ACTIVITY AND PARTLY REVERSES EARLY STRESS INDUCED CHANGES OF BEHAVIOR AND DENDRITIC SPINE MORPHOLOGY
S. Zehle, J. Bock, & K. Braun
Department of Zoology/Developmental Neurobiology, Otto von Guericke University, Germany

We have previously shown that early stressful experience can induce behavioral changes such as increased locomotor activity and reduced responses to familiar conspecific vocalizations. These behavioral changes are paralleled by reduced dopaminergic innervation and increased densities of presumptive excitatory spine synapses in prefrontal cortex. Since these changes might resemble hyperactivity and attention deficit syndrome, we studied the effects of methylphenidate (MP) on behavior, brain activity, and brain morphology. Juvenile degus (Octodon degus) were stressed by one hour daily parental separation from postnatal day (PND) 1–21. Open field tests on PND 22 confirmed the development of increased locomotor activity and decreased response to tone stimulation, which in turn could be altered by treatment with distinct MP-doses. Application of 14C-2-fluoro-2-deoxyglucose (2-FDG) revealed a dose dependent increase of metabolic activity in distinct cortical and subcortical brain areas, such as thalamus, striatum, prefrontal cortex, and substantia nigra after 1 and 5 mg/kg MP treatment. Additionally, analyses of neuronal morphology in the anterior cingulate cortex (layer II/III pyramidal neurons) of animals, chronically treated with saline and MP, were performed. Treatment with 1 and 5 mg/kg MP prevented the typically occurring increase of dendritic spine density in separated animals. The presented data demonstrate that disturbances of synaptic connectivity and behavior induced by early stressful events can be partly reversed by MP-treatment. [Supported by DFG/SFB426 & doctoral fellowship from the OvG Uni. to S. Z.]