

Winter 2009

Fetal Study Newsletter



JOHNS HOPKINS
BLOOMBERG
SCHOOL of PUBLIC HEALTH

Greetings Families!

Since our last fetal Neurobehavioral Study Newsletter was almost five years ago, we thought it was time to bring you up to date on the more interesting findings from the many studies that would not have been possible without the dedication of our wonderful study families. We've heard from many of you over the years, and really appreciate your notes, cards and Christmas letter updates! It's been almost 20 (twenty!) wonderful years and by the time we're done with our current project, over 900 participants will have been through one of our studies. Our oldest "babies" are now driving and our youngest ones have not even been born yet. Over fifty of you, fondly known as our "frequent flyers", have participated two or three times with successive pregnancies. But whether you are a new or long-time participant, getting to know each of you (and assorted husbands, grandmothers, grandfathers, children, and on occasion, pets) has been the most fulfilling part of our jobs.

Are we still at it? You bet! Over the years we've become more interested in the relationship, both physiological and psychological, that develops between a pregnant woman and the fetus. Anyone who has been pregnant knows that this relationship doesn't start at birth and that the link between mother and fetus/baby is more profound than science recognizes, or perhaps even can measure. We are currently concluding one study and starting another to see if we can develop such measures. And to see whether these predict to mother-infant interaction after birth, we're following up the pair six months postpartum. Seeing the 6-month-old babies, who are all so very different, has been great fun! So, if you're pregnant again, or have any friends or relatives that might be interested in learning more, you know where to find us. Best continuing wishes to you and your families.

Kathleen & Janet

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The results we share with you on the next pages include the study cohort. Many of the studies based on Cohorts 1-2 were in earlier newsletters. Here's how to identify which cohort you were in:

Cohort or Study	Baby's Birth Date	Cohort or Study	Baby's Birth Date
1	01/01/92 - 12/31/93	Relaxation	09/04/03 - 05/05/05
2	01/01/94 - 05/25/95	Maturation	05/06/05 - 07/19/07
4	11/01/97 - 01/26/01	StressEraser	10/17/07 - 06/04/08
CPC	10/31/03 - 02/06/06	Interaction 1	06/11/08 - present



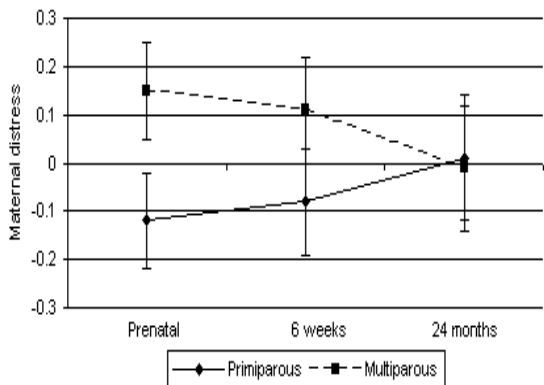
*Unlike us, Kathleen's
Tilly never seems to age!*

For full reprints of any of the articles on the next pages, please contact Janet and we'll send you them by email. We also included full citations because many of these articles are available online through Pubmed (<http://www.ncbi.nlm.nih.gov/sites/entrez>).

Does maternal stress during pregnancy harm the fetus? (Cohort 4 & Maturation)

Most people think “yes” – your data say “no”. In fact, we found that at age two, children of women who reported higher levels of anxiety or stress during pregnancy tested slightly *higher* on standard developmental assessments of mental and motor behavior, even when we controlled for maternal postnatal levels of these characteristics (DiPietro, J., Novak, M., Costigan, K., Atella, L., & Reusing, S. 2006. Maternal psychological distress during pregnancy in relation to child development at age two. *Child Development*, 77, 573-587; Cohort 4). This finding received a great deal of media attention and we received emails from all over the world, including a reader of the *Times of India*. The general nature of these emails was “Whew! I experienced lots of stress during pregnancy and have been waiting for my child, who seems entirely normal, to have problems”. We have also reproduced the direction of this association in a soon to be published study. In it we found that newborns of women who reported greater stress or anxiety during pregnancy had faster conduction in their auditory nerve, which indicates that they matured more quickly in utero. (DiPietro, J., Kivlighan, K., Costigan, K., Rubin, S., Shiffler, D., Henderson, J., & Pillion, J. *in press*, *Child Development*; Maturation). A caution - it's possible that these findings wouldn't apply to women with profound, chronic stress associated with trauma or poverty. But for pregnant women experiencing the types of stresses associated with everyday modern life, women can stop worrying about worrying.

+++++++ Wrong interpretation ALERT ++++++++
We've actually been asked if women should seek out MORE stress to boost fetal development!! Of course not – anyone juggling a job and family has plenty of stress already and the last thing a new mom needs is to head into newborn baby care stressed and exhausted.



What does the fetus tell us about the child? (Cohorts 2 & 4)

Any parent with more than one child knows that children are different at birth. Do these differences begin before birth? So far we've found that fetuses who...

- ❖ show more mature sleep-wake patterns at 36 weeks are less irritable after birth (DiPietro, J., Costigan, K., & Pressman, E. 2002. Fetal state concordance predicts infant state regulation. *Early Human Development*, 68, 1-13; Cohort 2).
- ❖ moved more before birth are also more active toddlers, and this is especially true for boys (DiPietro, J., Bornstein, M., Costigan, K., Pressman, E., Hahn, C., & Painter, K., Smith, B., & Yi, L. 2002. What does fetal movement predict about behavior during the first two years of life? *Developmental Psychobiology*, 40, 358-371; Cohort 2).
- ❖ respond more when their mom is watching a labor & delivery film are more likely to react irritably to a developmental assessment as infants (DiPietro, J., Ghera, M., & Costigan, K. 2008. Prenatal origins of temperamental reactivity in early infancy. *Early Human Development*, 84, 569-575; Cohort 4).

Does the fetus relax when you relax? (Cohort 4 & Relaxation)

Sort of. When we provided pregnant women with an 18-minute guided imagery relaxation audiotape, moms showed all of the expected changes in physiology, such as reduced heart rate, breathing, decreased skin conductance. Fetuses also showed slower heart rate, less movement, and greater linkage between heart rate and movements, a sign of well-being, during the relaxation period compared to before and after (DiPietro, J., Costigan, K., Nelson, P., Gurewitsch, E., & Laudenslager, M. 2008. Fetal response to induced maternal relaxation during pregnancy. *Biological Psychology*, 77, 11-19; Relaxation). Obviously relaxing, right? Nope. We found something similar in the fetus when women either took a mildly stressful cognitive challenge, the Stroop color-word test, or when they watched an emotional documentary in which other women related their birth stories. In each situation, fetuses reacted to what mom was doing by becoming temporarily LESS active, just like during maternal relaxation. So we can't really say that relaxation causes the fetus to “relax”. How can such different maternal experiences affect the fetus in a similar way? We think it's possible that they're reacting to changes in mother's heart rate or other internal sounds that accompany changes in maternal experiences. Paying attention to mom *before* birth? Maybe. (DiPietro, J., Costigan, K., & Gurewitsch, E. 2003. Fetal response to induced maternal stress. *Early Human Development*, 74, 125-138; & DiPietro, J., Ghera, M., & Costigan, K. 2008. Prenatal origins of temperamental activity in early infancy. *Early Human Development*, 84, 569-575; Cohort 4).

What did we learn from all of your “homework”? (Cohort 4)

Well, something you might have expected – that compared to others, women who are more worried, stressed or sad during pregnancy are also more worried, stressed or sad two years after pregnancy. But we also found what we call a “motherhood” effect based on whether you were a first (primiparous) or later (multiparous) time around mother when you were in the study: first time mothers became more psychologically distressed from pregnancy to when their children were two years old; but later time around mothers become less distressed over time (see figure left). The lesson? Your first child gives you the most gray hairs.

"We worry about what a child will become tomorrow, yet we forget that he is someone today." S. Tauscher

QUALITY TIME

GAIL MACHLIS

Let's see, I get three points for getting up and reading to him at 6:30 a.m., but then I was short-tempered when he spilled the milk carton--that's minus two... but then we spent an hour and a half building castles at the park--four points--but I didn't get off the phone to admire his picture--minus two--let him help make lunch--three points...

so that's six, plus two for playing pirates....



Do prenatally-detected choroid plexus cysts harm development? (CPC cohort)

Suppose you go in for an ultrasound at 20 weeks and the doctor says "Your baby looks fine except we see a cyst in their brain, but it's not anything to worry about". If you're like most people, you stopped listening after the shock of hearing "cyst in their brain". Our study compared pregnancies in which there was and was not a prenatally detected choroid plexus cyst (CPC) seen on ultrasound. All women with a CPC finding reported shock, fear, distress, or decreased feelings of attachment despite the fact that most (82%) of their physicians told them that CPCs are harmless (Cristofalo, E., DiPietro, J., Costigan, K., Nelson, P., & Crino, J. 2006. Women's responses to fetal choroid plexus cysts detected by prenatal ultrasound. *Journal of Perinatology*, 26, 215-223). The good news is that we found no differences in anything we measured about fetal neurobehavioral development between the CPC and control groups (DiPietro, J., Costigan, K., Cristofalo, E., Lu, Y., Bird, C., McShane, C., & Crino, J. 2006. Choroid plexus cysts do not affect fetal neurodevelopment, *Journal of Perinatology*, 26, 622-627). Better yet, when we measured children's development at 18 months after birth, the CPC group was developing as normally as the control group (Cristofalo et al, *paper in progress*). So when you hear about other pregnancies (about 3%) in which a CPC was observed on a prenatal ultrasound, you can assure the worried parents that it won't affect their baby's development.

We know the mother influences the fetus, but does the fetus influence the mother? (Cohort 4)

What happens when you look at the relationship between women's heart rate and skin conductance and fetal heart rate and movement on a second by second basis? As we expected, we found that maternal measures changed in synchrony with fetal ones. But not in the way we imagined! When the fetus moved, mothers experienced a slight increase in heart rate and skin conductance a few seconds later. Most of you have learned by now that the baby raises the parents, and now it looks like the baby's influence begins even before birth! The fact that women don't detect the majority of fetal movements makes this finding even more interesting (DiPietro, J., Irizarry, R., Costigan, K., & Gurewitsch, E. (2004). The psychophysiology of the maternal-fetal relationship. *Psychophysiology*, 41, 510-520). We were intrigued by this finding and repeated it in another population of maternal-fetal pairs - this time indigenous women living in Lima, Peru. Exactly the same association was found, despite the many socio-demographic ways in which this group of women differed from your cohorts (DiPietro, J., Caulfield, L., Merialdi, M., Irizarry, R., Chen, P., & Zavaleta, N. 2006. Prenatal development of intra-fetal and maternal-fetal synchrony. *Behavioral Neuroscience*, 120, 687-701). Do mother-fetal pairs with more or less synchrony interact differently after birth? This is the focus of our current longitudinal study so stay tuned!

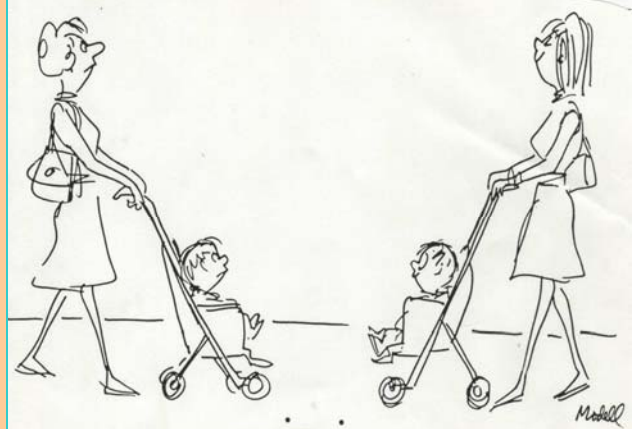


Figure caption multiple choice:

- a) Happy/unhappy moms raise happy/unhappy babies
- b) Happy/unhappy moms share genetics with happy/unhappy babies
- c) Happy/unhappy babies raise happy/unhappy moms.
- d) All of the above

Answer: D

Does heartburn during pregnancy mean the baby will be born with lots of hair? (Relaxation cohort)

Fresh on the heels of the success of the first pregnancy myth we put to the test (Perry, D., Costigan, K., & DiPietro, J. 1999. Are women carrying basketballs really having boys? *Birth*, 26, 172-177: answer - no), we decided to move on to the next burning question that we're often asked. Women rated their heartburn near the end of pregnancy, which most (78%) reported. After the babies were born two outside observers - a professional hair stylist and a young mother - looked at pictures of the newborn and rated their amount of hair. Answer? More severe heartburn - more severe hair! Also, 23 out of 28 women with moderate to severe heartburn had babies with average or above-average hair; 10 out of 12 with no heartburn had babies with little or no hair (Costigan, K., Sipsma, H., & DiPietro, J. 2006. Pregnancy folklore revisited: the case of heartburn and hair. *Birth*, 33, 311-314). Needless to say, this "ground-breaking" finding got lots of media attention!

Pregnancy's top 10 uplifts and hassles (Cohorts 2, 4 & Maturation)

Uplifts	(Yes) %	Hassles	(Yes) %
How much the baby is moving	100	Normal discomforts of pregnancy	88
Visits to the obstetrician/midwife	96	Ability to do tasks/chores	79
Thinking about the baby's appearance	100	Clothes/shoes don't fit	63
Feelings about being pregnant at this time	99	Getting enough sleep	83
Making nursery arrangements	96	Body changes due to pregnancy	69
Discussions with spouse about baby names	84	Your weight	69
Courtesy from others because you're pregnant	97	Thinking about your labor and delivery	77
Comments about your pregnancy/appearance	97	Thoughts about if the baby is normal	67
Discussions with spouse about pregnancy/childbirth issues	95	Physical Intimacy	53
Spiritual feelings about being pregnant	93	Concerns about physical symptoms	47

In general, women are 1.3 times more uplifted than hassled by their pregnancies, although there is a tendency for women who have been pregnant before to become a little less delighted with the pregnancy as it moves along compared to first time mothers who become even more uplifted as gestation progresses. And not surprisingly, women who report being a more anxious or depressive type of person feel more hassled by the pregnancy, while women with a more positive outlook in general find pregnancy more uplifting. Most studies on pregnancy have focused only on the negative aspects of pregnancy. As a result of these studies, short and longer versions of this scale are becoming used throughout the world because they measure both the good and bad. (DiPietro, J., Ghera, M., Costigan, K. A., & Hawkins, M. 2004. Measuring the ups and downs of pregnancy stress *Journal of Psychosomatic Obstetrics and Gynecology*, 25, 189-201; Cohorts 2 & 4; & DiPietro, J., Christensen, A., & Costigan, K. 2008. The Pregnancy Experience Scale – Brief Version. *Journal of Psychosomatic Obstetrics and Gynecology*, 29, 262-267; Maturation cohort).

Is there a fetal test for intelligence? (Cohort 4)

Nope. Recently, we did show that a specific feature of fetal neurobehavior – how much variability there is in heart rate patterns – was associated with higher levels of mental, motor and language development in toddlers (DiPietro, J., Bornstein, M., Costigan, K., Hahn, C., & Achy-Brou, A. 2007, *Child Development*, 78, 1788-1798). All of the children were developing normally, so this is more of a scientific validation of the importance of the prenatal period in telling us something about neurological development than a prenatal measure we can use to predict how individual children will turn out. And of course, just like in Lake Wobegon, all of our study children are “above average”!



The truth about boys (All cohorts)

Boys are more active in utero and have slower heart rates, right? Wrong. Data from our studies in Baltimore and Peru, and one by a Dutch group, all come to the same conclusion that there are no sex differences in either movement or heart rate before birth. However, we did find a tendency for boys to show a bigger rebound in motor activity after a maternal cognitive challenge was over, leading us to wonder whether their motor system is more primed to be reactive (DiPietro, J., Costigan, K., & Gurewitsch, E. 2003, *Fetal response to induced maternal stress. Early Human Development*, 69, 23-38; Cohort 4).

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To all our study families!!

Questions, Comments, Concerns?

We have fielded many questions from participants when problems in a child's development arise, and have been able to put some families in contact with sources of help. Please feel free to contact us if there's something about your child's development that troubles you or if there's something you think we would like to know about your child that could help us understand possible signs to look for before birth.

Cohort 4 – remember this? For those of you who don't – this is the Stroop Color-Word Task which we used to get an increase in mom's heart rate. Try it online with your kids: <http://faculty.washington.edu/chudler/words.html#seffect>