

**The Development of Temperament During the First Three Years of Human Life**  
**January 19, 2008**  
**2:30 PM**  
**The Philoctetes Center**

**Bruschweiler-Stern: Nadia Bruschweiler-Stern**  
**Carter: Sue Carter**  
**Champagne: Frances Champagne**  
**Coates: Susan Coates**  
**Pfaff: Donald Pfaff**  
**Nersessian: Edward Nersessian**  
**Schechter: Daniel Schechter**  
**A: Speaker from audience**

Nersessian: I'm Ed Nersessian. I'm Co-Director of the center. Francis Levy, the other Co-Director, and Hallie Cohen are in Italy, I hope currently watching the events here. The art on the wall was curated by Hallie Cohen, who, as I said, is in Italy with Francis.

Okay, so the panel is The Development of Temperament During the First Three Years of Human Life. It was suggested to us by Professor Donald Pfaff, who is head of the Laboratory of Neurobiology and Behavior at the Rockefeller University. He is a brain scientist who uses neuroanatomical, neurochemical and neurophysiological methods to study the cellular mechanisms by which the brain controls behavior.

Now I may not pronounce this correctly. Nadia Bruschweiler-Stern is a pediatrician and child psychiatrist. She is the director of the Brazelton Centre of Switzerland, and her work concerns the beginning of the parent-infant relationship.

Next to me is Sue Carter, who is currently Professor of Psychiatry and Co-Director of the Brain Body Center at the University of Illinois in Chicago. Her research program has focused on socially monogamous mammals, and she has described new roles for neuropeptide hormones, including oxytocin and vasopressin, in social bonding, aggression and emotional regulation.

Frances Champagne is Assistant Professor in the Department of Psychology at Columbia University, where she has developed a research group to investigate maternal regulation of epigenetic modifications.

Susan Coates is a Clinical Professor of Psychology in the Psychiatry Department at the College of Physicians and Surgeons of Columbia University, and a member of the teaching faculty at the Columbia Center for Psychoanalytic Training and Research.

Daniel Schechter, who was here at the same time that Donald Pfaff was here not so long ago, is Assistant Professor of Clinical Psychiatry in Pediatrics at Columbia University Medical Center, and he specializes in early childhood and parenting issues, and he serves on the faculty of the Parent-Infant Program of the Columbia Psychoanalytic Center.

Pfaff: It's nice to see so many people here. Many of us have read at one point or another in our lives about Freud's psychosexual stages, with an emphasis on the first three years. But many of you may not be aware of a tremendous thrust in neuroscience during the past maybe ten or twenty years, in which it's seen not only that certain events early in the life of an experimental animal can determine major facets of the animal's behavior for the rest of that animal's life, but also in some cases we know exactly how it works. My own experience with this is with a somewhat unsubtle approach, namely castrating male rats on the day of their birth, under a microscope, of course, and sewing them back up and letting them grow up, or giving injections of testosterone to female rats on the day of their birth and letting them grow up, and finding out that the male rats who previously couldn't do any female behavior can now do female behavior perfectly, but they're not so willing to do male behavior. And correspondingly, the female rats who've been injected with testosterone cannot act like females anymore, and also they can't ovulate, but they will run around and mount male rats.

So that's a rather heavy-handed maneuver, but it was a way to get started. Carol, Sue and Frances have somewhat more sophisticated approaches, and I'm wondering if you could tell us a little bit about things that you can do early in the life of an animal that will influence the animal's social behaviors later on?

Carter: Why don't we start with Frances?

Champagne: Sure. Well, I did take a bit more subtle approach. We took animals that differed in their characteristics, particularly in how individuals respond to stress, and then we worked backwards, so like what's different about this animal's environment. These animals are in a laboratory. Everything is controlled: how much food they get, how much lighting. Then we started looking at the mother-infant interactions, and what we found in fact is that if infants received a lot of stimulation from their mothers during the first week of life, particularly licking and grooming, which is something rodents do quite a lot to their pups, those offspring had a reduced stress response that lasted well into adulthood and affected their reproductive behavior as well. So really not manipulating the environment at all, but just characterizing that environment and selecting groups that differed in the kind of rearing experiences they had was a very good predictor of perhaps what you could say in rodents was a temperament. That's really the overall approach.

Pfaff: So you started out by taking the extremes of the distributions, the animals who had the biggest stress responses compared to the animals who were most mild?

Champagne: Exactly. So looking at how they respond to novelty in a lot of different situations.

Pfaff: These days all of us read in the newspapers about genetic influences on mental activities and behavior, and we talk about single nucleotide polymorphisms in the DNA, in which an individual DNA base has been changed, and probably most of us are familiar with that kind of thinking now. But you've used an approach which examines the epigenetic influences on behavior. Could you really bring us right back to kindergarten and tell us, one, what epigenetic means—because it's certainly important for humans as well as for experimental animals—and two, a little bit of the chemistry in so far as you can explain that?

Champagne: Okay. Well, most people are familiar with genetics, so within the cell nucleus we have this string of nucleic acids that we think of as this double helix and this wonderful structure. But as it happens, DNA has a lot more structure to it, so it has proteins bound to it, and within the cell nucleus it's wrapped very tightly around a core of proteins. So DNA exists, it has this string of nucleic acids, but there's also structure around those acids, and you can modify the structure of DNA. Now, that modification to the structure, what shape DNA is in, has a profound effect on how genes are expressed. DNA doesn't just express itself; there are a lot of proteins that have to bind to the DNA, and the shape of that DNA has to be modified quite significantly. What can happen very, very early on in development are chemical modifications to the structure of DNA, but not the sequence of DNA, which can have long lasting effects on gene expression. What happens in all cells, really, is that one of the base pairs within DNA, cytosine, can be modified in such a way that a methyl group, another compound, is bound to it.

Pfaff: One carbon and three hydrogens.

Champagne: That's right. This is the process that we call 'methylation,' and it's one of the very hot topics in epigenetics right now. So it's a modification to the structure but not the sequence of DNA. Now, this methyl group can be passed on to daughter cells, so when the cell divides that methyl group will still be located in the same position of the DNA in the daughter cells. This is a very stable way for alterations in gene expression to occur. The DNA is altered, not the *sequence* of DNA but the *structure* of DNA, and that is transmitted or inherited by daughter cells.

Now, as it happens there are a lot of influences on this chemical process of methylation, and one of those influences, and the one that I've been involved in researching, is maternal influence. This licking-grooming behavior that I mentioned earlier that the mothers engage in has an effect on how frequently these methyl groups will become bound to the DNA, particularly of genes involved in reproductive behavior and stress response. The more licking a female provides to her infants, the less methylation of the DNA will be found in the cell. As a consequence, there'll be an increase in the genes expressed in that individual, and those genes will effect a cascade of different behaviors that'll be maintained into adulthood.

Pfaff: So your work adds extremely credible and extremely welcome complexities to the relationships between genes and behavior. And just a little bit of scientific history: for a long time before the discovery that DNA was a genetic substance, nobody believed that DNA *could* be the genetic substance because it has only four bases—C, A, G and T—and it was called a 'stupid molecule.' How could a stupid molecule that has only four letters in its alphabet, so to speak, code our entire complexity of brain and behavior? And now we're hearing that, if I may misquote you, "There's no such thing as naked DNA," right?

Champagne: No, there isn't.

Pfaff: And that the access to DNA provides lots of ways—methyl is one way, and there's lots of others ways that I won't bore anybody with—in which the expressions of genes can be altered. This kind of mechanism, although it's studied in experimental animals, is certainly, I'd bet my bottom dollar, true in humans, and so we probably have some methyl groups scattered around the room.

Champagne: Definitely.

Carter: Well, I could either go the direction that Frances has and tell you that working in other animals, other species, we find very similar things. But what I'd rather do, probably, because I think the audience will remember it better, is explain how I got into this kind of work. It wasn't logical like Frances. It was research/me-search. So twenty-seven years ago—

Pfaff: Would you say that again? Research what?

Carter: Research/me-search.

Pfaff: Research/me-search, okay.

Carter: Or me-search/research. Whatever. Twenty-seven years ago my oldest son was born, and I was brought into a hospital setting, which I'd agreed to, you know. I'd given consent to go to the hospital to have the child. I didn't have the baby as fast as they wanted, because you need to have a baby in twenty-four hours, and nobody told me that, otherwise you'll get these horrible bacteria that are in hospitals. Worse things will happen. So I was given Pitocin, which is a compound also known as oxytocin. And I have probably evermore studied oxytocin. I really didn't know what it was when I was given it. I knew just the textbook kinds of basic things. But I kept asking, what happened? What did I do to my child by letting someone give me an intravenous injection of this compound? I had told them from the start I wanted no drugs, and I wasn't happy, but I had to choose between that and a cesarean section, which I also didn't want.

So after that, and really to this day, my brain is constantly processing how can we understand what went on? I waited for about fifteen or twenty years for someone to start doing research on this, and no one did. No one still has in humans. I work with a little animal called a prairie vole. Prairie voles, as you mentioned a little bit, are socially monogamous, extremely interesting animals, but they're not a standard laboratory model, and I thought, well, I'm wasting my time doing these experiments in voles, but we're going to do them anyway because that's what I have and what I understand. Let me say you cannot do to animals what we do to humans. It would be unethical. Don and I, and Frances, could never get it through an IRB—I mean an ACUC. It's simply not accepted. Too many different manipulations set off bells in these kind of review groups that tell us whether we can or can't do our studies. So I thought, well, I'll just do the simplest thing. I'll take the animals on the first day of life and give them a little oxytocin. Or I'll give them an oxytocin antagonist, something that blocks the oxytocin.

Pfaff: It's probably worth it at this point to say exactly what oxytocin is.

Carter: In Chicago, 93% of the women born last year in Northwestern Hospital got some extra oxytocin to help them either hasten the labor or augment the labor they were having. That's not out of line with what's going on in the country, let me tell you. It's wild. The pediatrician over there is shaking her head and saying, "Oh, you've got to be kidding." No, I'm not kidding.

It's a tiny little molecule. It has nine amino acids, a very small series of amino acids called a peptide, and it's made mostly in the brain. This makes it very different than almost all other hormones that we might talk about here today. So it's called a neuropeptide. It's in your body right now, and males and females have approximately the same amount, contrary to what you

may hear in the press. When you measure it in blood at least it's usually almost identical in males. The averages I've done are almost identical. But there are some regulators—

Pfaff: Unless they recently had orgasms.

Carter: He said that. Yeah.

Pfaff: In which case it's raised.

Carter: Men always remember that. Yes, it is released by orgasm. It's released at the time of birth, and by the actual act of the baby being born. No one knows exactly how oxytocin is regulated, but it is regulated, and by things going on in the brain and the rest of the body. There are actually neurons from the cervix—and in the male from whatever is the equivalent of the cervix—back to the hypothalamus without a stop along the way—monosynaptic, meaning no way stations—and it does release oxytocin at, as I said, birth, lactation, sex, and I used to think maybe the other main regulator was sort of safe contact, and it probably is but there are many ways to release this hormone. I don't have time here today, I won't tell you all the problems, but we can talk later. It's not turning out—nothing ever comes out the way I expect. That's another of my rules; I'm always wrong. And I think that's okay, I guess. It's sort of disappointing at times.

But anyway, oxytocin is a great chemical because it allows us to be human. It's necessary to get this huge human head from the inside to the outside world. Remember, it's going through a closed opening—a cervix is really closed. When they talk about full dilation the nurses will put their fingers in—doctors are too busy to do this anymore—they'll put in four fingers and say, “Oh, you're fully dilated.” Well, any baby's head that's as small as four fingers is not a normal baby. It's necessary to push the baby to the outside world, so I consider it the most powerful molecule on the planet, and also the one that has allowed us to have our big heads, and thus cognitive function, and everything that brings you here.

Pfaff: That's fascinating. I've never heard anybody say that before.

Carter: Well, you have to make stuff up. Aren't we in an imagination—

Pfaff: Before you get back to oxytocin antagonist, just another little bit of scientific history. Fish had a precursor of oxytocin. It was a nine amino acid, and if you think of it as a horseshoe, because two of the amino acids are joined by sulfur groups, a sulfur group making a little horseshoe. Then in evolutionary history of vertebrates that primitive hormone got split into two, and one is called oxytocin, which Carol Sue is talking about, and the other is called vasopressin. The most simple-minded way of thinking about it in mammalian behavior is that oxytocin tends to promote friendly behaviors and vasopressin is more famous for promoting aggressive behavior, especially under the influence of testosterone. But it's not nearly as simple as that, and I'll give you just one thing that shows the complexity: vasopressin can bind to an oxytocin receptor just as well as oxytocin can.

Another thing is that they have jobs elsewhere in the body, which allows for indirect routes of action. It's a fascinating bit of protein chemical history that actually started at Cornell Medical School and is now manifest in Carol Sue's research.

Carter: Well, thank you. Okay, so we gave some extra oxytocin to animals, and good news here for the kid, the older brother of my son who is in the audience. The good news is a little bit of oxytocin actually didn't seem to be too bad. The bottom line was a little bit of oxytocin made the animals more friendly, more social. They did all the things that Don predicted.

A lot, not so good. In fact, these animals that normally form pair bonds when given very high doses are actually not social at all, or—well, no, they're still social. Excuse me. They're not pair bonding; they don't do the social bonding.

Pfaff: What's a pair bond?

Carter: A pair bond is—every human who's sort of normal has some kind of attachment to others. In voles the male and female bond is sort of like a marriage. They meet each other when they're young, they live happily ever after until one dies, and they usually don't form new bonds. Only 20% will actually form a new social bond. But anyway, the bottom line here: giving a little oxytocin wasn't so bad, but giving a lot wasn't good, and that tends to be what we always find in biology. There's always too much of a good thing.

The second thing is when we blocked oxytocin it actually was the males who were most affected. They were affected because we had messed up—Don set me up nicely—this other molecule, vasopressin. We had interfered with its production, and we had also down-regulated the vasopressin receptor, the part of the receptor that plays a role in—

Pfaff: Could you bring us step by step—down-regulated the what?

Carter: By blocking oxytocin receptors with a molecule that was supposed to be selective—let me give you a clinical context here. Humans are often born too early. This creates a lot of business for the people in clinical work, and the pediatricians, and everybody. In fact, it's a constantly increasing problem, prematurity. So there are invented molecules that block oxytocin, which is part of the birth process, for the purpose of preventing prematurity. Those molecules are available to scientists to use as research tools, and what they do is they go to the receptor and they occupy that receptor, sometimes stimulating it but generally just blocking it so that oxytocin which is trying to get to it can't work anymore.

Now, if this weren't a clinical tool my experiments wouldn't be very interesting, actually, but they kind of are because all over the world, except in the US and Canada, mothers who are in labor are being given oxytocin antagonists—not often, because it's expensive, but it's still used—to try to buy a little time for the baby to stay inside and complete its development.

The good news is that you get about eight days, maybe. The bad news is that this stuff that I'm talking about can pass through the placental barrier and reach the baby. It's not a true peptide; it's a linearized compound that's made to go places. I don't know if it passes the blood-brain barrier, but don't worry about that. It gets to the baby, and what it did to the baby animals was it created anxiety, to put it simple. They were anxious. They didn't have access to the oxytocin that they needed during development, and we only do one dose on the very first day of life, one treatment. We don't keep giving them this stuff. And these animals are full term. The humans

that are getting it are getting it as early—human gestation is usually about forty days—forty weeks. Forty days. Well, whatever. That would be good. Yeah, we'd be born little.

But forty weeks, and around twenty-eight weeks they can start to use these things and will start to use them to prevent premature labor, especially in a woman who's very, very anxious to have a baby, wants whatever heroic things that can happen to save that fetus, they want to prolong that pregnancy. Of course the infant's lungs are not developed. There are a lot of reasons you don't want a premature baby. But giving an oxytocin antagonist, at least the one that's out there right now, is probably not a very good idea, although I have never seen a single clinical study, nothing following the children in any form. No one wants to know. If you're a drug company making a molecule that might have some bad effects, the last thing you want anyone to do is to tell you what those bad effects are of the stuff already on the market, and anybody who reads a newspaper knows this is a big problem for pharmaceutical companies.

Pfaff: A few sentences ago you said, in the most provocative way, that all normal humans have these pair bonds of some sort.

Carter: Right. I think that's true.

Pfaff: But you're in a city where more than half of the adults in Manhattan live alone.

Carter: I'm not talking about marriages. I'm talking about social bonds, someone they care about, okay? I don't care if they're married or if they're living in the same apartment.

Pfaff: So sleeping over is okay?

Carter: It has nothing to do with sex, Don. I'm so sorry to tell you this. This is really going to crush you, because he's studied reproduction all along. It's not personal. It has to do with social bonds, some kind of feeling about another individual, and that might even be somebody you don't know. People bond in the strangest ways. They can bond to Brad Pitt, okay? They can bond to someone they've never met. They can bond to a deity that they might or might not be able to see.

Pfaff: So it can be imagined?

Carter: Yeah, well imagination, yeah. I'm talking too much.

Pfaff: Would you agree that telephones or email bonds or fantasy bonds count?

Schechter: There's a spectrum of human relationships, and one thing that I know Susan and Nadia and I are all kind of interested in is the attachment, and if you have a good enough early attachment that affects all other relationships, so that it affects relationships to God, to community, to teachers. It at least permits those relationships to occur, and if you have an early relationship that doesn't allow flexibility and adaptability then that's when people get stuck, and they can't form these bonds and they end up with various social problems and in prisons and on drugs and whatnot. So in efforts to regulate—because a lot of what we've learned about from Frances's and Myron Hofer's work, and your work as well, is that relationships often have to do with regulation.

Nersessian: But what makes for the attachment? Is it connected to what you were saying?

Schechter: Yes, but maybe I'll let other people respond.

Coates: For an attachment to go well, a mother needs to be very sensitively attuned to her child's desires, needs, I think very powerfully to the child's temperament. If the mother can respond sensitively to the child, particularly when the child has very negative affect, very negative emotion, the child will become securely attached. If the mother cannot tolerate the child's negative affect—you know, crying when there's separation, for example—when the child is very upset some mothers will totally reject a child's bids for comfort. Or they will react to the child sometimes and not other times. When parents are really inconsistent or when they're very negative around negative affect, the child becomes insecurely attached.

Now, I think a very interesting problem that Dan and I have been interested in for some time is that we're both interested in how trauma that has been unresolved in one generation gets visited upon the next generation, and this is a place where temperament becomes very important, because children who have irritable temperaments, who are really difficult to soothe, are really lightning rods. They become the nexus when there's unresolved trauma, and they're at great, great risk for this carriage from one generation to the next. This is where our field is doing a lot of thinking at this point in time. How do you really stop this transfer from one generation to the next?

Bruschweiler-Stern: What's your understanding of that process of transmission?

Coates: Yeah, one of the ways—

Pfaff: So the question was about the mechanism or the understanding of cross-generational transmission.

Coates: Yeah. If you've had an experience as a child with a violent parent and you've never been able to resolve that in the sense of becoming able to contextualize that in any way, and to get some distance from it, a crying baby can really easily activate either your own emotional memory of that experience or it can reactivate a memory of the abusing person. So in the moment the parent can experience this child as abusing *them* and can really go after the child in a highly destructive way.

Schechter: Or avoid the child.

Coates: Yes, or avoid. They can do one or the other. Either of those have very, very negative effects on the child's development, and on their ability to develop the capacity to regulate affect.

Pfaff: Humans are thought of as bi-parental, men taking care of children quite as well as women. In this rage against the child, is there a sex difference? Is the father more likely to be upset than the mother?

Coates: Not that I know of. Dan, do you—

Schechter: This is actually what we study empirically, what Susan is talking about. Our model, which has grown out of the developmental and neuroscience that we're hearing about at Columbia, involves looking at mothers who have violence exposure and how that experiential component can get in the way of their assisting their children, because we find that the child might be behaviorally inhibited or might be irritable regardless of the temperament, so it distorts the mother's perceptions and mental representations of that child so that her behavior with the child is more defensive than affiliative, and she has trouble assisting in the mutual regulation process that's necessary during the early years of life.

That being said, there's a lot of complexity, and we're hearing about how some temperaments may be more vulnerable, or some individuals may be more vulnerable to environmental effects than others. There's a lot of controversy now in that field. As Justin Thomas said, there could be a poor goodness of fit, and you can have a bad match between a mom who really has trouble with that irritable baby, and Nadia has seen this too. I've seen videos of hers where it can be a perceived irritable twin and a perceived inhibited twin and the mom or the dad will glom onto the inhibited twin, and the irritable twin becomes bad and potentially violent.

Pfaff: So you've said the magic word. The name of this discussion was supposed to be "The Development of Temperament." And among those four words I know what 'the' means and I know what 'of' means, and I'm pretty sure I know what 'development' means. But we animal-brained people might not be quite as good at talking about exactly what temperament means. How would you define it and talk about it?

Schechter: Okay, I'll get stuck with this one. Traditionally, temperament implies what is brought into the world biologically by the child. The old idea was that the child has what Freud and others referred to as "constitutional factors," and now we know from the work that we're hearing about that there's genetic,—DNA genetic, in the chain of DNA—there's epigenetic, there's intrauterine environment, there's post-uterine environment. There are all kinds of factors which I think go against the idea that there's this constitution. There's also the parental perception and the interactions during pregnancy and immediately after that impact, right from the moment of birth and before even, this baby and who that baby will become, so that I think it's more of a chaos theory. It's almost like the weather. You never know what's going to happen, and there's a particular light that can't be captured. There's so many factors involved in creating that particular child as a moment in time, and it's always changing with development, that what temperament is—I've answered the question by opening it up to more questions.

Pfaff: From the point of view of animal behavior and animal brain, just sitting here a few minutes ago I thought of the phrase "enduring patterns of emotional disposition and expression." What do you think?

Bruschweiler-Stern: I think you laid out the problem very well. It's very hard to have one idea, one definition about the temperament. There is the traits that the baby gets born with, and then there is the development and all the interaction with the surroundings, which is so shaping for the person.

Pfaff: But you wouldn't want to be throwing up your hands, would you, and saying, "Oh, it's all so complex. Let's go get a drink," or something like that.

Bruschweiler-Stern: Almost. No, I think we have to get into much more detail. Having been working with infants now for many years, I cannot reduce the babies I see in temperamental descriptions. There are so many different descriptions in each of them, but each of these babies has very particular traits that are his or hers and you cannot generalize. You see, there are parts that will remain. For example, the threshold for stimulation is one of them: when they get interested and when they get upset. The range, also the width of the range of where they are interested and comfortable, is different from one child to the other, but also in development.

Pfaff: So thresholds for response such that a very calm baby might have a very high threshold.

Bruschweiler-Stern: He might, but he might not, too.

Pfaff: Really. But are there some patterns of traits that are more frequently co-existing with each other than other patterns of traits?

Bruschweiler-Stern: I'm not sure. This is so complex. You can have a baby with a low threshold that is very active and a baby with a low threshold who is not very active. You can have so many combinations that, for me, actually it's much more fun to look at each of the babies. But I think the developmental part is also important, because the baby you see at—if it's a pre-term, for example, or a full term baby, or a two month old baby and at five years and later, they can be very, very different.

A: So are you saying there's no such thing as temperament then?

Bruschweiler-Stern: Yeah, well, no, I think there are traits that are more or less stable in the child, even though they will be shaped by the surroundings. There have been a lot of studies on irritability, for example. But we didn't diagnose the acid reflux—maybe the results we have are biased with an organic problem, but there was pain, and these babies were irritable. It became a temperamental trait, but it's not for these babies. I think we like to reduce things in general groups, but I actually think I like to see the specificity of each child, but the combination with the family as well, because the parents' temperaments, each of theirs will influence the baby's development, and their whole past and expectations will as well.

Pfaff: So would you agree that—

Coates: Well, I think of it a little bit differently. One aspect of temperament that's been studied very extensively by Kagan is children who are shy in novel situations, so they become inhibited in the face of novelty. They might be hams at home, so you wouldn't think of them as shy, but in a new situation they are slow warmer-uppers, they're shy. Children out on the extreme of this continuum really have significant stability in their temperament, and they are prone to develop social anxiety, so you see a great many of these children in psychotherapy. And their experience with their parent can influence it very much, so that a child may be born with this temperament or not, but a mother who has serious maternal depression—even at sub-clinical levels maternal depression will skew things in the direction of behavioral inhibition.

Then you have all kinds of complexes in terms of match and mismatch. If a very behaviorally inhibited child is born to a mother who is really sort of bold and intense and out there, the behaviorally inhibited kid can drive her crazy. She'll be pushing the child prematurely to do all

kinds of things they're not ready to do, making it much, much worse, skewing it further out. And if a mother is both sensitively attuned but nudges a little bit—if you're overly attuned to this kind of inhibition you can cause problems for your kid. So you need to both be attuned and push a little. Those children will, over time, become less inhibited.

Pfaff: In Jerome Kagan's work or in yours have you ever noticed sex differences?

Coates: Yeah, girls are more behaviorally inhibited than boys.

Pfaff: As you talked about the intense, active mother in a sense putting pressure on the child and the child being so inhibited, I began to think about Chronic Fatigue Syndrome, and probably many of you know—what was the name of that person who wrote a book about a horse, who was a famous sufferer of Chronic Fatigue Syndrome? Nobody remembers, including me. She's a famous sufferer of Chronic Fatigue Syndrome, with symptoms very severe. Most people think of it as a mixture of an autoimmune syndrome, to which women are predisposed more than men, and a burn-out syndrome, and that there's a variety of fatigue syndromes that have varying mixtures of these two things, where the body, especially in a young woman—typically a young middleclass woman in her 20s or 30s—the body says to the brain, time out. We're going to give ourselves a break. And that might go on for years and years. Is that the kind of thing you were talking about, a possible precursor of Chronic Fatigue Syndrome?

Coates: I've never thought about that. That's a very interesting question. I could imagine, just sort of playing with it in fantasy, that kids that are pushed—well, first of all, let me back up. If you think about American parenting, American parenting is, more than in many other cultures, in-your-face pushing and more aggressive. If you have children who really need this down-regulating time, you could imagine they're pushing themselves beyond what's really a normal pace for them. You could imagine them exhausting themselves in ways. You really need to teach mothers, particularly New York mothers, if you have this kind of kid that he should not be scheduled for dancing lessons on Monday and other lessons every day of the week. These are kids that come home and they need to down-regulate. Helping a parent to really understand, I think, both the positive and negative aspects of temperament—one of the things that I often tell parents who are very irritated about this temperament, and dads get very irritated about this temperament, is that many years ago Steve Suomi did a study with his monkeys—

Pfaff: This is Steven Suomi of NIH?

Coates: Yes, and what he did was he bred extremes of the shy and bold monkeys, and then he cross-fostered, reared them with mothers I call 'therapy mothers.' There were some mothers that allowed the infants to both separate more gradually and to be weaned more gradually. He then put them out on an island to see what happened in terms of hierarchy. So you have these extremes—bold, shy—and reared in these two different ways. Anyone want to guess at what might have happened?

Well, the interesting thing that happened, and it really shocked Steve at the time, because he's not a clinician, was that the shy monkeys who have the additional therapy input all ended up at the top of the hierarchy. It was a totally unexpected finding. There may be empathic advantages that the shy kids have, and one of the real challenges in therapy, I think, is helping people to

really begin to understand their strengths and their vulnerabilities in terms of temperament. I think there's not been enough attention to it, and since we are in the hallowed house of psychoanalysis, there's an old adage that psychoanalysts do not believe in temperament until they have their second kid. We are only beginning to really think about how critical it is to understand temperament in the context of therapy. I think it plays a very, very large hand.

Pfaff: So this is the same Steven Suomi who found out that monkeys with what I'll call 'lousy serotonin systems'—that is, certain mutations in the serotonin receptor—who might have been predisposed toward, as I recall, violent behavior, if they were given excellent early care that they could be just as civilized as the other monkeys?

Coates: No.

Pfaff: No?

Coates: No, it's not what's been found. I think that what has been found is that the impact of the nurturant parenting had little effect on the bold—

Pfaff: Oh.

Coates: But it has a very great effect on the high arousal inhibited. There's an emerging literature that the environment may shape certain kinds of temperament much more powerfully than others.

Schechter: I think it's a different study. There's a study of peer-reared versus maternal-reared monkeys, and those with the short allele of the serotonin transporter were more aggressive in the peer-reared—

Pfaff: That's what I was referring to.

Schechter: Yeah, that's a different study.

Bruschweiler-Stern: I tend to agree more with you, but I also think that it should start very early to learn about the baby's temperament.

Coates: Oh, absolutely.

Bruschweiler-Stern: Because when you start treatment when the child is three, or five, or later, things are already so well trained and inscribed that it's much harder to reopen the system for good relationships.

Coates: Absolutely. My introduction to temperament—I had the extraordinary fortune in my first job to test three-day old neonates, nearly 100. I was twenty-one. It was my first job, and I thought these are wonderful, adorable babies. One of the very shattering moments for me was to realize there are these babies that I would take home in a minute, but there were babies that I utterly hated. There were babies who could not be soothed. There were babies that were as rigid as a board. I felt that the only thing I could do was to pray for their mothers. It was really frightening.

Bruschweiler-Stern: But did you have many of these?

Coates: We had numbers of them, yeah.

Bruschweiler-Stern: Because I've seen hundreds of babies, and I haven't seen that many that were so difficult.

Nersessian: That's Switzerland.

Coates: That's right.

Schechter: I think it might be helpful, because I think it's possible to talk about temperament on so many different levels, and Susan is talking about a macro level. I think Nadia, having seen her tapes—it might be good to hear an example of the baby who has a particular sensitivity, which is very circumscribed, like a hidden regulator, as Myron Hofer would say. There's a particular feature of this baby's trait that may or may not be picked up on by a parent, and that causes a larger problem. Maybe if you gave an example it might be helpful.

Bruschweiler-Stern: Well, for example, I'll tell you about a baby I've seen—actually, I have to tell you about the consultation. I see the parents right after birth, a few days after, and they tell me about the pregnancy, the delivery, how they met with the baby, what the baby looked like when he just came out of the womb, and what's their memories or their fantasies of the child during the pregnancy, but also how they see the baby now at the time of the consultation. Then we turn to the baby to do the Brazelton Scale, which helps display the baby's different behaviors, so we have a chance to see how well regulated he is, how he goes from one state to the other, if it's very quickly or very unstable, or if it's very stable and with nice transitions. For example, how he moves: if it's jerky movements or well matured and harmonious, kind of a nice dance. And also the orientation interaction, how he would follow the red ball—which is what everybody knows about the Brazelton Scale, usually—and answers to a noise and to the voice, and to the human face and voice, the two of them together.

So we have a wide range. We look at the process, how the baby evolves through the scale, and how, for example, when he gets irritable or when he gets tired, how the baby shows it, and also the self-soothing maneuvers, like a lot of us right now are touching ourselves in many different ways and all of these are self-soothing maneuvers. We look at that in the baby and how active the baby is to try to regulate himself, or is just helpless. Some babies just don't know what to do and they just cry. When they get tired and overwhelmed they have several ways of escaping the situation, and one of them is by crying, which we all know about, and one of them is in falling asleep and just getting away, shutting off of all the stimulation. We all know about it, and it's actually very helpful to understand adult behavior to know about all this.

To give you an example, I saw a three-day old newborn: full term, perfect pregnancy and delivery, everything was fine. He was a very sensitive baby, a very sensitive infant. He would very quickly get fussy and start crying. Everything had to be very smooth and at a low pace so he could handle whatever I was trying to do with him. I turned to the parents and asked them if that was familiar to them and if they knew how they were themselves as infants, and the father right away recognized himself in this little boy and he said, I'm exactly that way, and I was as a baby,

from what he was told. So they leave, and that was it for that consultation, but two months later the mother calls me and she wants to see me because a toy fell on the baby's face and the baby got surprised and cried, and since then she sees him startle very often and have kind of surprised expressions and fear expressions.

So she comes back, and we talk and play, and the baby is between us and she plays with him, and this mother has a very intense way of relating with the baby. She just dives into the baby's face and has loud expressions and she's fun, she's great, she has a wonderful energy. Except the baby gets overwhelmed, and at two months I could see these kind of mixed expressions of pleasure and fear at the same time of the baby wanting to relate to his mother but being overwhelmed and being really on the edge all the time of falling apart. My guess then was that the startles and the surprised behavior were there before that event, but she became more aware of it because she felt guilty that the toy fell on the boy.

It's this kind of thing—we worked around understanding how the baby was feeling and in which style of relationship he would feel comfortable, and which level of stimulation and interaction. So that's an example.

Pfaff: Reacting to something you said before, first I'll defensively say that I celebrate human individuality as much as the next guy, and I've raised three children, and in fact Brazelton was their pediatrician. But before you said, oh, there are so many different combinations and no particular trends, and so many indirect and direct routes of causation. To a scientist it sounded, I must say, somewhat obscurantist. I'd like to jump from that extreme to the other extreme in order to ask a question—that we in basic neuroscience are witnessing the merging of our biological and behavioral science with mathematics and with physics and with chemistry. In fact, the National Science Foundation has a major initiative to figure out how physicists and engineers and mathematicians can help us figure out the brain and behavior. So when you do that you tend to think in terms of equations and dimensions, like graphs. I know you're going to hate this.

So my question is, if you clinicians were to think of dimensions of temperament, like X, Y, Z, Z-prime, the number of dimensions you could imagine would be greater than what? And what might they be? What would you call them? If we picture ourselves meeting fifty years from now, when we have a real science of temperament, what are the names of the axis going to be?

Bruschweiler-Stern: I can give you a very partial answer to this, and I keep coming back to some of Winnie Dunn's work on the sensory motor behaviors and system. She has a simple way of putting together big groups, and I think they make a lot of sense. It really leaves out a lot of other dimensions—

Pfaff: High responsive, low responsive—

Bruschweiler-Stern: Exactly.

Pfaff: This would be Winifred Dunn, I think, at University of Kansas? Or Kentucky?

Bruschweiler-Stern: Oregon—is that possible?

Pfaff: No.

Bruschweiler-Stern: I'm not sure.

Pfaff: It's some place where they read the bible.

Bruschweiler-Stern: It's Winnie Dunn. That I'm sure of. She has these four groups with low threshold and high threshold, and active and passive, so it gives you four groups. What she says is if you are a high threshold and you're active you get yourself into trouble all the time. You want stimulation, you look for it, so you provoke tension all around. You like to put yourself in danger and you like challenges all the time. If you are a high threshold and a passive, you tolerate everything, because it doesn't bother you, so you're the universal companion. That's what she describes.

Coates: That's great.

Schechter: A Swedish group, I don't remember the name of the researchers, but they're considering that psychopathology may be extremes of the continuum, for example, of novelty seeking, so that Attention Deficit Hyperactivity Disorder would be extreme novelty seeking and Autistic Spectrum Disorders would be very little novelty seeking and need for sort of rigid stability. Kagan has talked about that, and arousability, and sort of where the person's affective center is, whether it's more on the peppy side or on the melancholic side. We can go back to the humours, if you want to get into that. It's been around since Aristotle.

Pfaff: What dimensions would you add, or what concepts?

Coates: I think sensory sensitivity very early on is very important. When Brazelton was teaching me to use his scale there were two babies in the room. There was a lot of light in the room, there was some noise, and this one baby was sort of alert and enacted very, very readily. Then he said to me, "Watch this," and he turned the light down. There was a baby that was apparently sleeping next to this baby, and he turned the light down very, very considerably, and that baby then woke up and become very present. And I thought, whoa! Just imagine the combinations with different kinds of parenting. If this baby that really needs to be down-regulated in every way possible is matched up with one of these high-intensity mothers you can be in tremendous trouble. On the other hand, if the mother is well matched and understands that about the baby things can go very well. It's really a match and mismatch of all kinds of things.

Bruschweiler-Stern: And more than that, it's understanding it at the level it's expressed. I don't want to take too much time, but I had another clinical situation exactly with this kind of problem. It's a newborn, six days old, full term, very strong, heavy—I mean 4.2 kilos, so that's about more than eight pounds. The baby was very sensitive, would keep her eyes shut all along. It was very hard to wake her up and capture her attention. We had to turn the light almost off to have her with her big eyes open, ready to just interact and be there. The mother thought she would describe her as 'introverted.' She explained that by saying, "Well, you know, my first child at the same age was all open, curious, into everything, looking and searching. But for the first pregnancy I was free, so I was excited for each step along the pregnancy. But for this one I was working and I had no time to think about it, so maybe she felt it." The mother was saying, I didn't invest her enough or the right way, and maybe she felt it and now she's introverted. She doesn't want to relate with me. She was understanding that phenomenon at a psychological level,

and setting the stage for a relationship where her baby was finishing her as soon as she was born, when it was a totally different problem, you see? So that's just what I would add. Beside the match of the temperament there is also the psychological understanding, and the way people make sense of the baby's behavior.

Coates: The negative attribution.

Nersessian: One of the things I'm finding puzzling as we are talking about it is you said is temperament enduring patterns? But as we discussed it seems like it's not enduring, that it is only enduring if you don't do the right thing. But if you do the right thing, whether it's therapeutically changing the mother's behavior, changing the father's behavior, then temperament is not enduring. You can change it into something else. Is that right?

Schechter: Maybe this brings us back to Frances's work with high licking and low licking. I'm interested in how you can change not only within a generation but across generations, non-genomically, by different kinds of care-giving experiences.

Champagne: Yeah. We do see this stability, but under stable environmental conditions, as we've been kind of hinting to. But if you change something very intrinsic about the social environment which an individual is exposed to, then their pattern of behavior can change quite profoundly. For example, an offspring that received low levels of licking/grooming, we would predict that they would be very fearful of novelty, would be very stressed in a situation, show decreased social behavior. If we put those individuals in a big social context, so after they're taken away from their mom they're put in a big apparatus where they can engage in a lot of social interaction with same age, same sex peers—you put them in that environment for a lengthy period of time, those individuals will show an absolute change in behavior, so they will be indistinguishable from an offspring that received high levels of stimulation early on in infancy. And that is maintained into reproductive age, and they pass that information on to their offspring as well. By altering some event in the social environment of an individual, you can affect multiple generations, and similar effects can be found through social isolation and stress. So there is this notion of mismatch and match, and when there is a change that really says something about the environment, a change in the environment to which an individual should react, then there can be quite a profound change in the behavior, and temperament, I suppose.

Pfaff: Dan, before we open up the discussion to everybody here, could you or Ed or Sue give us a few sound bites about what Freud said about psychosexual development in the first three years, and then tell us how far we've come since then?

Schechter: I'm going to pass that.

Pfaff: Who remembers enough?

Nersessian: Well, I don't remember much, but I can tell you that one of his earlier papers is about the influence of the anal stage of development. He tries to understand certain traits in people, such as obstinacy, miserliness, and so on. He's not really talking about obsessive-compulsive at that moment, or that's implied, but certain character traits that people have, and he connects it to the anal phase of development. But if you read the paper carefully he puts a

tremendous amount of emphasis on what he calls ‘constitutional factors.’ Much less on the relationship of the baby with the mother. There’s nearly none of that. It’s primarily constitutionally some kids are this way and some kids are different. I think that would be where the change is. I mean some of what we are hearing is essentially saying—and I think Winnicott probably was one of the people who early on was into this—that it’s really what happens with the mother and the child that determines a lot of these ongoing behaviors and patterns.

In that context it’s difficult now as I listen to this discussion, which brings a whole set of complexity to this early way of seeing things, which is the question I asked. What is given and what is non-changeable, or is there anything? Is there anything genetically or epigenetically given that is unchangeable, as manifests later in character, or everything is changeable given the right environment and situation?

Coates: One of the ways I would think about it is that if you have kids that are out on the extremes—you have bold kids, or these very high reactive kids that Kagan has studied—if things go well for the high reactive kid, they’re going to move toward the center, but they’re not going to end up on the other end of the continuum. So I think that there’s some modification, and important modification that can happen. And if things go very poorly they could be skewed way out, but you’re not going to see them switch places with the shy and bold.

Pfaff: Of course I don’t see patients, and so I’m speaking out of school here, but perhaps not with respect to something like irritability, but with respect to good social behavior or criminal social behavior I think there are opportunities for massive reversals, and the way I picture it in this book is if the influences of genes are like rays of light coming out from DNA, that environment, particularly at critical stages like the neonatal stage or the pubertal stage acts as lenses, you can have kids who are brilliant and who, given a good environment, would be developing into good citizens. I saw this when I lived in Yonkers, actually. If they’re given a particular kind of environment, especially boys at the age of puberty, their brilliance can turn them into excellent criminals. Some of the smartest, nicest boys that I saw out there turned into some of the best criminals. So at least in that restricted domain of social behavior, I think there can be marked changes.

Nersessian: Well, you wouldn’t necessarily consider that temperament. You would consider that more as pathology, the same as a symptom formation.

Pfaff: Perhaps. Perhaps. When you were saying before maybe there are some shifts in certain traits after all, then I would have come back with a bit of word play and said if they’re shifting they’re not temperament. In other words, I’d like to have a solid definition of temperament as that which does not change, that which is enduring. The way I think of it when I talk about CNS arousal is that our ability to activate behavioral responses, if expressed in feelings on a lifetime basis, I would call that ‘temperament.’ If it’s on an hourly, or perhaps a few days, I’d call that ‘mood,’ and if it’s just for this afternoon I’d call it a ‘feeling.’ I don’t know whether those definitions are useful or not.

But answering my own question, the way I see it since Freud, you clinicians are discovering the complexities of patterns of social behaviors and emotional expressions, and you’re discovering

the multiplicity of causal roots, including roots that are rooted through the parents. And we neuroscientists are discovering exact mechanisms, whether they be hormonal or genetic or epigenetic. Of course it's a lot harder for us to do our work out there in the trenches than it was for Freud, I think, to come out with this massive theory that the rest of us have spent more than a century working out.

Maybe it's a good time to talk about questions?

Nersessian: Sure.

Pfaff: I guess the ground rules for the questioning would be there is no such thing as an awkward question.

A: Granted that temperament exists forever—I guess it's directed in terms of bonding and change of the person—wouldn't you say that more primary is the bonding that results based on the experience that the individual has so that they can become very different, even in temperament, based on what they learn, which is probably based on this environment near the proteins, that oxytocin, whatever it might be, so that this discussion, although you're scientists, is very limited in what you know because some people—not all—can change so much based on what they've gone through? Would you say that that is more significant than, say, the scientific and psychoanalytic, whatever you want to call it, in itself, to say nothing about what Ed said about, well, that was Switzerland and this is New York. That too is very important.

Carter: I think you're bringing up a really old question of nature and nurture. Maybe I'm missing your point, but I think that the history here is that people have worried about this since way before even Don and I were around in the field, so that's a long time. They would argue along the lines—let's take it out of the realm of humans for just a second and say species differences. That's kind of a temperament-like construct. I can tell you that where I am today is I vote for plasticity. I agree with you. Because even a species like a prairie vole that I thought had these sort of inborn abilities to form a pair bond, and for the fathers to be parental and so forth, all of that we can change, we humans, by just making very small changes in how I clean the cages of my animals. This is another story than the hormonal one. It's one that came afterward. Whether we pick the animals up by hand and move them to a clean cage or we pick them up in a cup and move them—and I swear to God, this sort of took my brain and turned it around, because I really believe that there was something like temperament in animals, only again, I would call it species or strains. All of you know about dogs having different—within the dog there are different strains. But Frances's work and lots of other people I think are showing later too, there's lots of plasticity left in the system. These species that adapt and change.

We often study rats because they're very good adaptors, they're a weed species. Those that change are going to trump those that don't change most of the time—not always, but most of the time. And you can go below vertebrates even to insects, and you're going to find the more plastic species, the ones that can—I think you were kind of using the word 'learning,' right? Experience—you used the word 'experience.' That's a better word. Thank you. But, anyway, the ability to change is part of the genome, and it's part of the information that the genome will accept in allowing its own genes to be turned off so you can now adapt not only yourself but the next generation. This is all kind of new. The mechanisms are new. The ideas are really old. The

idea of nature and nurture, and fighting this out, this conversation has occurred before. It occurred when Konrad Lorenz and Danny Lehrman had their arguments back in the 1950s. These are the first time I know they got a lot of publicity.

Pfaff: I'll just say that Konrad Lorenz was the Viennese animal behaviorist who won the Nobel Prize for showing that behavior could be treated as a medical and biological subject. Daniel Lehrman was the head of the Institute for Animal Behavior at Rutgers University in Newark, New Jersey.

Carter: Yeah, and these guys were arguing in a kind of theoretical way. I think Lorenz was holding pretty much to the non-plasticity, genetic, what he calls 'fixed action patterns,' 'species-typical behaviors.' He wasn't wrong, but his thinking in the 1950s, everybody's thinking in the 1950s, didn't have built into it these other mechanisms. For them to entertain the level of plasticity we now accept—we use these words: plasticity' kind of gets around the problem is it learned or not, is it experience or not, whatever all that means. Anyway, you've got these constructs, and now they're being brought to some kind of reality. That doesn't mean we're really seeing the truth. We're seeing bits of the truth where the light is shining for the moment. But we really thought once we knew about the gene that it was all figured out. A lot of people were looking for the gene for whatever we're talking about here: the gene for temperament or the gene for irritability or whatever. I think that thinking is pretty much passé—I hope it is. We're now in a more complex—so everybody here is not as interesting as we would have been twenty-five, fifty years ago, do you think? We'd have had really strong positions and we could have argued.

Pfaff: Speak for yourself, Carter.

Carter: Well, Don's more interesting. That's true. I met him in 1970, so that shows you at least how old I am. He was a child.

Nersessian: Thirty-some odd.

Carter: Thirty-some odd, exactly. That's what I mean. We're in an interesting time. We're in an exciting time. But I want to say one more thing: I'm a biologist, even though my job now calls me a Professor of Psychiatry, which is sort of a joke. It really is funny. So don't get confused—some of these people are psychiatrists and psychologists. I'm not. But I think there are things that matter to survival, and those things aren't so plastic, okay? You've got to get food into the system, you've got to breathe. There are certain pieces of our basic biology run by bits of tissue, including the autonomic nervous system, which most people don't talk about but which is quite critical, I believe, to temperament, and is regulated by peptides and is regulated by the kind of stuff that Frances has worked on. When we use a word like 'anxiety' we're just taking our big human brain and wrapping some words around biological things first. That's one of our problems. We're very limited because we have to use human constructs, and God forbid we even move over to clinical constructs, which are different.

So now, you know, there are these big books you can get, DSM-X whatever, and that determines whether you can get paid for doing therapy or not, a guide to very old medicine, especially in psychiatry. It's been very convenient to try to wrap names around these things, but I think we'll

get further when we look more deeply and we look at the evolution of things, so we can see when we look at species that aren't like ourselves quite so much. We get back down into fish, or we even go before that into insects. We're finding the genes pretty much conserved, that's my understanding. But how they're playing out is so different. We're all of us in the most exciting time it's been, but we ain't seen nothing yet.

Pfaff: I think you're right. The golden age of neurobiology.

A: I would like to hear about the fathers, because we don't speak about the fathers here, and perhaps it's a mechanism of adaptation of genetic transmission of traumatic—

Carter: Well, Frances doesn't have any fathers in her story, because she works with rats. I do. With prairie voles, the father is there in the story, but he's not, frankly, as important as the mother, because the mother provides nutrition in this very early formative period. So no matter how good he is—and prairie vole fathers are better. They spend more time being parental than the mother. But when we've sorted out the effects of some of our manipulations the variance falls over on the mom. I'm really sorry to tell you this, but moms are—in the beginning they have to work extra hard. Now they can't do that nutritional thing if they're not supported by some others. There are very few—I'm not even sure there are any—truly solitary mothers in nature. Sarah Hrdy, who writes wonderful stuff about this field, argues that humans are cooperative breeders, or communal breeders.

Pfaff: That's H-R-D-Y, the anthropologist at Berkley.

Carter: Davis she used to work at, yes. She's written a wonderful book called *Mother Nature*, and then a chapter in something that actually is out in the lobby. I think this chapter really sums it up. It's very short. It just says there were no single mothers. And there are no single mothers today. Those single mothers are supported by a network of economics or welfare or something, other relatives, other women. So although the mother has the burden in the early development, if she has a partner—I mean, that's not to say the fathers aren't important. They can certainly mess things up. Well, by that I mean—let me qualify that.

Pfaff: Yeah, gee, thanks.

Carter: Let me qualify that, because there's a great deal of data that shows—someone was saying there wasn't a sex difference, but if you look at child abuse and infanticide, it's not always the fathers but I think it's 90%, isn't it? It's really, really rare in mothers. It's quite common, statistically—they're not necessarily the biological fathers. They're the males in the families.

Pfaff: What's the informed opinion here?

Carter: I'm quoting Wilson and—

Schechter: I tend to think that it's very complex in the sense that women—we study women who are exposed to violence. The violence is most often in later years perpetrated by men, but—

Carter: But not the father.

Schechter: Not necessarily the biological father. Sometimes the biological father, or a sibling, or a grandparent. This includes physical, sexual abuse and domestic violence. But you find that some of this gets played out with a mother and an infant, and there's a spectrum of behaviors, as we heard about, from intrusive, aggressive behaviors that aren't quite abusive to frank abuse to infanticide. I think that there's no discrimination of sex, unfortunately, in that.

Carter: In that.

Schechter: We even did a study of male-perpetrated sexual abuse. The mother-daughter relationship is quite important in determining how well the child is protected. In many cases the men are usually the ones who are at fault, although there are female predators as well, female perpetrators.

Carter: Yeah. Well what I said I know came out bad. It's going to get me into trouble. But the father, if he doesn't do his part, there's trouble.

Schechter: Yes.

Carter: Or if the others aren't there—maybe it's an aunt, maybe it's a grandmother—to pick up the support role. I mean we're into a model—by the way, this human monogamy model—because I study monogamous mammals I started trying to find out where this construct came from, and it turns out that it pops up every so often, one male, one female and their offspring, but actually it's rather the exception than the rule. Most cultures have extended families, and there are males and females in those cultures doing different bits of the work, sometimes the same, sometimes different. If you've got a good male partner you're much more likely to be able to sustain yourself in the world.

Bruschweiler-Stern: In our culture.

Carter: Yes, in our culture. But that isn't the only way to do it. That's my point. There are many cultural ways of managing these things.

Pfaff: Has anybody tried to conceptualize—following up on your question—what's the difference between species in which the mother takes the leading role versus those species which are truly bi-parental?

Carter: That's a really good question, because there are these bi-parental species, as Don's saying, and they're about 3–5% of different species of mammals. And it pops up in the oddest—I mean there's no real pattern to it. Within the voles that I work with there are monogamous and non-monogamous species right there, sort of side by side, genetically very similar. I'm inclined to think that we have yet-to-be-determined genetic switches that are really pushing over, but what they're doing is probably allowing male mammals, small male mammals like I know about, to not be afraid of babies. This is just my own interpretation of the literature, but I think that the biggest problem with raising babies is that they're overwhelming stimuli, at least in animals. Maybe humans too. There's a hormonal package that humans usually go through, but we don't have to. We can be good adoptive parents, we can experience it other ways. It's not as central, but it almost guarantees that mothers will like and attend to their babies, or have some positive interaction with them.

The father doesn't have that hormonal package. He has another one that's not very well understood in these species that have been studied where the male is parental. It's not the same hormones, almost for sure. It's oxytocin/vasopressin together probably in the parental males. I think that's a dose of non-fear. It's a dose of what we call anxiolytics. And you can use drugs and males will become very good parents. Once they're through the fear stage, and especially in prairie voles, they're as good as the mom. They do everything and they do it really well. In the prairie voles—who have to go out to eat, they don't store food—the male has to take care of the baby or somebody has to be there to take care of the baby, because predators will eat the baby and there'll be no more babies.

Pfaff: In support of your fear idea, Alison Fleming at the University of Toronto has done a lot of work as far as animal behavior is concerned. In terms of human behavior I actually saw that myself. When we brought my oldest child, my daughter, home from the hospital and it was time for the diaper to be changed, my wife was terrified. She doesn't know that I looked at my daughter and said, well, how hard could this be? She's much bigger than a rat. I changed the diaper and I brought the baby out into the living room, and I got an expression of admiration that I don't think—but we have another question.

A: It's interesting how this translates, like to therapy for adults. When you work with somebody, if it's hard to change temperament by the fifth year, is it impossible to change a person's temperament when he's forty or twenty or thirty? And if the temperament is problematic or whatever, do you try to change it or do you just try to work with it and just accept it and say, this is who you are, and now we've just got to work around it?

Schechter: Well, when we see adult patients one of the goals is to help them think about their experiences in terms of their own feelings and thoughts about their interactions with different people and the better matches and the less good matches to their communications, or the responses to their communications at different formative stages in their life. One of the tools that we use as analysts is the relationship between ourself and the patient. We can tell through various moments, and I was going to say in reference to Sue Carter's comment about how there's never a single mother, that the mental representation is very powerful. You don't have to have a father there now. It could have been a father in the past, it could have been a grandfather that you carry in mind and you're able to apply. There are good influences and less good influences that come through, and they come out in the interaction within the therapy session between the therapist and the patient. That's transference, that's the fancy word that we use.

So in response to your question we try to help someone understand who they are and the responses that they like and don't like, and what's caused them suffering and what's caused them dysfunction, and how much is plastic and how much is this is who they are and it's coming to accept them. Maybe they need to avoid certain kinds of interactions, versus intra-psychically change their approach. That's very variable on an individual level.

Nersessian: Other analysts may disagree with this, but in my experience as an adult therapist/psychoanalyst, I don't ever think of temperament. It's not a subject that is in my focus.

Pfaff: Well that's because you think you're such a powerful doctor that you can change them.

Nersessian: I wish.

Pfaff: With respect to changing and adulthood, you might look into the literature on behavior modification, because if you think of different personality patterns as having stability or instability, it can be that if you use the techniques of behavior modification to move yourself from one well, so to speak, over into another well, once you're happy in that other well you will effectively have changed some aspect of your temperament. You'll be in another stable state. I don't mean you individually.

Schechter: But the issue, though, like what Susan was talking about, if you have a really shy person and that person is innately shy, you have to figure out how much of that was affected by having a mom or a dad who was constantly henpecking or browbeating, versus this could be the way, as Nadia points out—there's certain early stable traits that they have difficulty with in their relationships, and it's something that has to be teased apart. So I do use temperament, having seen lots of infants, and people who don't see infants may not think of it.

A: Some sixty years ago when I was studying these things and was full of therapeutic zeal a psychiatrist who was one of my teachers said you can go ahead and treat her if you want to, but if she gets better it wasn't schizophrenia. It depends on what you mean by temperament. Most of what we very often think of as temperament is too general. If you think about hyperactivity or high sensitivity, these are temperamental variables. But people can change enormously in the way they behave in the world with very little change in what looked like basic personality features. The systems theory takes account of that. A little change on the periphery can make an enormous change centrally.

Pfaff: Good point.

A: Taking a very general view of temperament, I've often wondered what the para-natal event—and I'll call it 'event'—has to do with one's sort of temperament. Barring significant complications during pregnancy, babies that are born breach versus pre-term versus post-date, that sort of stuff, what does it say—is there anything about who the person is that sort of influences the delivery event? I was wondering about that.

Bruschweiler-Stern: That's a hard question. I know no study about the fetus's temperament influences on the birth process. The only thing it makes me think of is maybe irritability, and depending on the pregnancy and the event, and trauma during pregnancy or high stress during the pregnancy or a very difficult delivery with even sometimes some brain damage, you can get very, very low threshold babies, very hypersensitive babies and very irritable babies, unstable and difficult, in the terms you used. That may be linked to the delivery sometimes. If it's only the delivery and it's not too bad, it may go away, and then you'll have a very nice evolution to the real temperamental traits that the baby had. But that's what I would think about it.

Pfaff: The only thing I can think of from animal hormones would be that an ideal situation for maternal behavior is to have high levels of estrogens and progesterone that was high level and is now dropping rapidly. That is a preparation for birth. But if the mother's under a tremendous amount of stress then her adrenal hormones, her adrenals, will continue to pump out progesterins and progesterone metabolites, and that's likely to influence the birth process. It's also likely to

influence the baby's behavior, especially if the baby's a male, because the progesterone metabolites can prevent the androgen from acting in the brain, and it will change the animal's behavior.

Carter: Right, and to follow up on that, all of the experiments we've done with early life experiences have affected males and females differently, usually contrary to the predictions we have when we started. Indeed males are more sensitive to a lot of things that we've done, like giving oxytocin. Lower doses affected the males more than the females. I wouldn't have expected that, but that's what we got. Handling experiments, the males seemed to be most vulnerable. I have tried to reduce that so I could study it to something endocrine, and I think this chemical vasopressin that Don mentioned that's so androgen-dependent and is so plastic, so vulnerable—we don't have time to get into its unique properties that make it change, but it allows a kind of long term effect, including just simply causing receptors to either be expressed or not for the rest of the life of the animal. Anyway, there are ways to get into these systems. I still think that the things that are most deeply necessary are more difficult to move around, and the more it's something that you need to adapt, like personality traits, temperament, it seems to me it's good to be able to change those, to be able to adapt them to the world you're really living in, to not have that hardwired. So I think that's where you'd expect—of course it's probably wrong—but that's where you'd expect differences to be most likely.

Schechter: To give just a clinical vignette, I saw a teen mom who had a very terrible history of abuse and violence exposure, and she had a male fetus, and the quickening, the kicking of the baby was perceived as damaging her body, and this fetus would grow up to be a violent man or even a rapist. the temperament of the fetus is interpreted through the mother, so it's very hard to know was this a very reactive fetus or not. Now we have better ways of studying this, but we can imagine the stress hormones that are going on during this pregnancy that are heightened and maybe sort of setting this baby's brain at a certain pitch. Then when the baby was born, a few weeks later the reflex fist was interpreted as a boxing hand: this child would grow up to be a boxer. So there's a certain rigidity that's associated with this that it takes quite an effort to work with, and we hope that we have good outcomes with these families, but there are problems.

A: I was wondering are there any studies that show the effects of early childhood trauma, like circumcision, on temperament?

Pfaff: My friend, when his child went through its bris, the major emotional effect was on him. But I don't know. Do you know?

Nersessian: Well, you remove more than just the preface with your work. You really do a major circumcision.

Bruschweiler-Stern: I know nothing about circumcision and temperament, but there is a study about pain and circumcision that's very interesting, and was very enlightening. In '84 it was published. It's the Toronto study on pain. They were studying the effect of a cream, an anesthetic cream that they would put before vaccinations to infants. The cream was very efficient, was fine, but they had a group of babies who were crying more than the others, and all of them were boys. But it was not all the boys, so they looked into it and tried to find out what was common in these boys, and all of them were circumcised after birth without anesthesia. So what was very

interesting in this study is that we found out that early acute pain leaves a trace in the memory, a procedural memory, and instead of making them stronger it makes them actually more reactive and having a lower threshold following pain later on. So I think that was a very interesting study, but it doesn't really have to do with temperament.

Pfaff: Are there more questions?

Nersessian: I have a couple of questions. One is, if oxytocin makes you, or the antagonist makes you kind of less involved with others, less attached—

Carter: Okay. Remember I'm going to answer with an animal model. I don't know about humans, but go ahead.

Nersessian: No, but I was just wondering if it's going to make you less caring and involved with the others why not use it when there is loss? If your wife dies you just take antagonist of oxytocin and you don't care.

Carter: That's a really good question. It's not quite that easy, because we don't really know anything about grief and separation, even in the animal model. We can make up any story we want on the hormonal level, and yours is as good as mine because I'm always wrong. But anyway, you'd probably do better. I would think that I'd want to give some extra oxytocin and maybe allow the person to form new bonds rather than the other way around. I certainly would never give an oxytocin antagonist to a person in grief. I'm pretty sure that would—but, again, it's just my guess. I think that would have the opposite effect.

Nersessian: The other question I had of you—I don't know if I understood you correctly. Are you saying that the licking then causes the methylation, and then that methylation is inherited?

Champagne: Well, what we think happens anyway, because it's quite new, is that the licking stimulation is a tactile stimulation, so a somatosensory sensation, and it increases levels of growth factors. This happens in humans as well. If you take pre-term infants and massage them they'll increase their rates of growth and they'll have an increase in growth factors. A lot of growth factors are transcription factors, which means they bind to DNA and keep it active. What the licking does, by increasing these transcription factors and these growth factors, is it keeps genes in an active state. So what it does is prevent methyl groups from binding onto the DNA, and as a consequence the gene is kept active during this kind of critical period of development. And that's sustained into adulthood, whereas if you don't get that tactile stimulation the gene's not active. It gets methylated, the gene is shut down, and then that's passed on through the life span.

Nersessian: Through the life span or to the next generation?

Champagne: Well it persists, so it's enduring. It'll last into reproductive age. Now tactile stimulation—so licking-grooming stimulation—by mothers affects the daughters in a very specific way. It moderates the daughters' licking-grooming behavior: so high licking-grooming moms have high licking-grooming daughters, and those daughters have high licking-grooming offspring. That's because the licking-grooming alters a gene, the estrogen receptor alpha gene, which is very important for maternal behavior. That's affected very, very early on in infancy, and

those effects endure to when those females reproduce, so they provide their offspring with more or less tactile stimulation depending on this receptor, and then that affects their offspring, so you can get multiple generations of effects through this kind of behavioral environment.

Bruschweiler-Stern: I'm so curious: is there any parallel, do you know anything about human carrying and tactile contact between mothers and their newborns?

Champagne: Well we know that it does affect oxytocin systems. And these are also affected—so high licking-grooming moms have lots of oxytocin receptor. They're very social. If you block these receptors it blocks their licking-grooming behavior as well. Tactile stimulation in humans seems to affect these systems. We don't know about methylation per se, because firstly we can't go and look in the brain of human infants. But it does seem to have very similar peripheral effects on reducing stress response and increasing levels of these peptides, which we know are quite important for social bonding.

A: I thought I'd say this after what Frances was saying, because what I have to say is from her work. People are wondering how late can you reverse temperament or traits, and her group in Canada showed that even in adulthood you could reverse the behaviors of high versus low licking offspring by giving a demethylator essentially, a deacetylase inhibitor, so at any time in the life span you could change a low licking-grooming offspring to look like a high licking and grooming offspring. That dovetails with my clinical work, where we've done the analogy of high licking and grooming model across three generations and reversing, seemingly, temperament.

A: This is very broad-based and maybe not fair, but I was curious if you could say anything about the latest insights in terms of infants that are removed from their mother within the first few days of life, whether that be given up for adoption or the mother dies or whatever the circumstance is.

Coates: If what happens?

A: If they're removed from their mother, their natural mother.

Coates: And then what?

A: Well, they may be given to foster parents or—but I'm particularly interested in the separation from the natural mother, so assuming they're given to foster parents or non-relational parents, not the father.

Schechter: I guess there's a clinical level, but it may be helpful to turn to the MacArthur study group's work in the Romanian orphanages where many infants in the Ceausescu period of Romanian history were immediately turned over to an orphanage, and most recently the MacArthur study group—the clinician among them is Charles Zena, and there's Nathan Fox who has studied temperament, and they've written a paper about the interaction of temperament and attachment disorders, and Chuck Nelson and—I'm not thinking of all the others. But essentially this group has looked at how those who are in institutional care when they're removed from their mother tend not to do as well as those who are foster-cared for. Whether it's kinship or not kinship is not known, but the caregiver matters a lot in reversing the effects well into the fifth year of life. There's certain things that change and certain things that don't change. One of the

things that has more trouble changing is indiscriminate sociability among these orphans, and yet the dis-regulation and often appearance of autism—the child can even appear to be autistic because they're so dis-regulated and out of touch with social cues—those effects are quite strong that they can become affiliated and develop good relationships.

Carter: Yeah, and along those same lines I edited a book called *Attachment and Bonding: A New Synthesis*, and the people who contributed—O'Connor, you mentioned, he argues in a nice chapter in that book that really it's a consistency of the caretaker that matters more than anything else. So in these unfortunate experiments—they were doing it more than one way. One way they would do it is every so many hours a new nurse would come, and they thought they were helping the child, I guess—well I don't know what they thought—anyway, they were doing this for some apparently easier, maybe it was easier, or some reason. They had some children who had pretty much one caretaker or two caretakers all the time, and others who had extremely random and non-reliable caretakers, and those were the kids they're saying that came out the worst, the ones with the inconsistent caretakers. But that's not my field.

Bruschweiler-Stern: Yeah, I've been in Romania in 1991 to study these babies in the orphanages, and it's not only separation. It's really a lack of human stimulation and contact. There is no continuous relationship. They are all the same. They are fed with bottles two at the same time. They are not looked at, they are not talked to, they are not touched, or very little, just to be washed under the water, cold water.

Nersessian: Was it a particular type of staff that could do this work?

Schechter: Self-selecting.

Bruschweiler-Stern: No, but the staff is very badly paid, less than the people cleaning the street. It's the last job you want to take, so nobody is trained or has any interest. Actually I've seen a pediatrician who was working there and also had her own child. She was a wonderful mother to her own child, but she could work in this kind of place, which is just hard to believe. After three years in these orphanages they switch systems, because that was the health system and they go into the educational system, so they are diagnosed recuperable—I don't know how you say that—or irreparable.

Pfaff: Yes.

Nersessian: Remediable or irremediable, yes.

Bruschweiler-Stern: Okay. 80% of them are irremediable. And 20% of them only can graduate into educational system. So it's much more than a simple separation from the mother. It's really a deprivation of any human stimulation. It's kind of an extermination camp. It's really intolerable.

Schechter: I think Sue's point, the most recent studies with—and Megan Gunner is also involved—is to look at what you said, which was random care versus regular shift, consistent nurses versus foster care. You see a steady slope, so foster care does the best, steady but rotating caregiver, and then random care. The consistency and dependability of the care giver—

Carter: But you could also see that if you're in this random—from the caretaker's point of view, you wouldn't get attached to the babies as easily either, so you would be willing or able to be in that setting where the care was so bad.

Schechter: Yeah.

Carter: That it was really just nutritional and even marginal nutrition.

A: I wonder if you could say something about the role of intelligence or cognitive abilities—if it's even possible to test such things or know about such things in newborn children. I mean temperament, obviously very important, but it's only one part of what we think of as a human being. I don't know if there's any research on this or if we're able to understand how those factors might interact, I mean if different cognitive abilities or intelligence might interact in different ways with temperament and with the care giver.

Schechter: I can think of two contradictory findings related to trauma. One is that the more intelligent one is the less likely it is that one will develop psychopathology related to trauma, such as Post Traumatic Stress Disorder. However, if you treat a parent and an infant or young child with dyadic psychotherapy you can raise the IQ of the child demonstrably and significantly.

Bruschweiler-Stern: It's the performance, it's not the IQ. Probably, I don't know. What I think in newborns is interesting—and we can probably relate to that anyway—is that if you're well regulated you're open to the outside world and you're open to learn, and then you get smarter and you know more things and you use your brain. If you're not well regulated and you need to constantly reshape yourself or you're worried about your own regulation, then you're not open to learning and to interacting and to relate.

A: In 1975 I was leading a number of mother and baby and father and baby groups, and my goals were to improve the relationship. This was in an upper middleclass suburban metropolitan area, and this was not problem oriented. A lot of the parents, mothers more than fathers I would say, would talk about the good baby and the bad baby—not even the easy baby and the difficult baby, but the good baby and the bad baby. In an attempt to take the judgment off I started to talk about temperament, and it was far too complex for the parent to really hold onto. They could understand it intellectually, but they couldn't hold on to it, and I became more and more frustrated as I started with some of these babies at three weeks and saw—you know, time goes very fast with babies. So I developed this kind of idea about matching and mismatching hierarchies through the senses.

In other words, your baby is visual and you're auditory—you need to communicate with your baby more visually. I don't need to go into all the complexity of it. But the situation you talked about with the woman whose baby was kicking her—so we would say before the baby was born, that must be a kinesthetic baby. And even just say, well, she's not kinesthetic so therefore that's different, but just to see it in a completely non-judgmental kind of way. And though I don't work in that way anymore—I see basically adults—I still feel an urgency to do what both of you do in many ways, which is to see a dyad very early and to try and help the parent to really tune into their baby.

Champagne: A triad.

A: A triad, yes. So I guess my question is, is there anything from your world, the scientific world if you will—

Carter: This is all science.

A: —that talks more to the clinical world than my very, I think simplistic kind of model?

Champagne: Well in my laboratory anyway we spend a lot of time just watching. It's more of a mother and fourteen or fifteen babies, but trying to really look at the interaction at that level. It is quite dynamic. You certainly see the mother's state interacting with the characteristics of the pups. We're doing an experiment right now where we have pups that are very high ultrasonic localizers, so they scream a lot, which the mother picks up on, and so we can cross-foster—what happens when you cross-foster those pups to a mom who's not used to that kind of stimuli, so if you're receiving signals that you're not used to how does that affect the behavior. That's kind of the approach that we take when we're looking, trying to characterize that interaction and see where these characteristics are emerging.

One area that I think really needs to be looked at a lot more in animal models is the prenatal environment. Especially in the field of temperament, if an infant's born with something that means it's innate. And yet this individual, this developing organism, has been exposed to nine months, in humans, of an environment that we don't know how that environment interacts with this developing organism. So much is going on in terms of organization of the brain and laying down this whole framework which will determine how an infant will behave, and genes from the mother are interacting with these foreign genes that are developing inside her. This is something we don't really know a lot about, so I think that animal models could be used to look at this question.

Bruschweiler-Stern: Do you get more attached to certain rats more than others?

Champagne: Do I get more attached?

Bruschweiler-Stern: You, yeah.

Champagne: I like to see them engaging with their offspring.

Pfaff: They're quite amazing.

Champagne: They're very dynamic.

Pfaff: In my research often we'll order from The Animal House, which would be up in Maine or in Massachusetts, a mother who has just begun to nurse let's say nine or ten babies, and they put that animal in a cage, and it goes out in a truck to the tarmac to the plane, back onto the tarmac, back onto a truck, arriving in my lab, and that mother is still taking care of those babies like crazy. It's quite admirable.

So, if we're just about wrapping it up, I'll touch the two ends of the continuum. On the one hand, for those that want to read about genetic hardwiring of behavior the best source I can think of would be a book by Robert Cloninger. He's a Professor of Psychiatry at Washington University in St. Louis. It's I think his most recent book and has a very colorful title, but I don't remember it. About 2005.

Following on from the first question—what about the effect of an individual experience—I'll wrap up our discussion by quoting a professional comedian. This professional comedian was asked when did he know he was going to be a comedian. And he said, "At the age of three." Somebody looked at him and said, "How could you know that you were going to become a professional comedian at the age of three?" And he said, "Well, I was at my parents' party and somebody asked me what did I think when I came out of my mommy's tummy?" And he said, "When I came out of my mommy's tummy I felt that I was in an even bigger tummy." Everybody laughed, and because they laughed he knew he was going to become a comedian, and indeed he was. So even an individual experience—

Thank you for coming.