

**Philip Roman Zelazo**

- Born 10/3/1940 in Ludlow, MA
- Spouse - Nancy Zelazo
- B.A. in Psychology (1962) from American International College, M.S. in Experimental Psychology from North Carolina State University, and Ph.D in Developmental and Social Psychology (1967) from University of Waterloo

**Major Employment:**

- Montreal Autism Centre – 2002-Present, Director
- McGill University – 1984-Present, Professor of Psychology
- Concordia University – 1991-Present, Clinical Consultant

**Major Areas of Work:**

- Perceptual-cognitive, social, and motor development in infancy; creation of information processing procedures to assess intellectual development among infants and toddlers; creation of treatment procedures to overcome expressive delays in development



**SRCD Oral History Interview**

**Philip Roman Zelazo**  
McGill University

Interviewed by Darwin Muir  
at Queen's University  
April 5, 2007

**Muir: This is an interview on the fifth of March, 2007 with Dr. Philip Zelazo and I'll let him clarify who he is in just a second and my name is Darwin Muir. The interview's taking place at Queens University in the Queens Biological Communications Center. Phil?**

Zelazo: Hi Darwin. Ah, the clarification is I'm Phil senior, Philip Roman, and have the good fortune of having my son in developmental psychology as well, and he's Philip David. Maybe we can talk a bit about that after.

**Muir: Sure. Okay. So let's start--let's begin by you telling us a little bit about your family background and any early experiences that may be of interest. And in particular, focus on educational and occupational characteristics of your parents. Where you were born, grew up and so on.**

Zelazo: Yeah, my place of birth is in Ludlow, Massachusetts. I was born in Massachusetts. Spent most of my childhood in Southridge, Massachusetts near Sturbridge Village, Sturbridge, Mass. and was educated in Springfield through the college years at American International College, another small college, and that's basically been my childhood experience. Small town. My parents were both children of immigrants from Poland. I guess the other significant event is that my parents were separated early in my life and my grandfather, Philip, rather Roman Szydlak for whom Philip Roman is named after, played a significant role in my childhood and was my father figure basically. So, my family experiences were as an immigrant family. I attended a modest high school and had small town experience during my childhood.

**Muir: What did your father do? What was his job?**

Zelazo: He was an auto body mechanic.

**Muir: Okay. And your stepfather?**

Zelazo: I didn't have a stepfather. My mother was a single mom when it wasn't fashionable.

**Muir: Uh-huh.**

Zelazo: Before it became somewhat more fashionable among some people anyway.

**Muir: Yeah.**

Zelazo: No it was a rough experience for her and that's why I say my grandfather was a key figure in my life. But he died when I was 13 so that part was bittersweet.

**Muir: Wow.**

Zelazo: Great while it lasted but didn't last long enough.

**Muir: Well that's very interesting. Okay. So--and you said your schooling was small town schooling.**

Zelazo: Small town and strangely I went to a small private college in Springfield, American International College, and actually that became possible on a football scholarship.

**Muir: Mm-hmm.**

Zelazo: So--

**Muir: So you were a football player?**

Zelazo: So I was a football player at American International College and it was one of those things where it got me a college education.

**Muir: Well that's really neat.**

Zelazo: Yeah.

**Muir: Okay, what about military experience. Did you have any?**

Zelazo: None. In fact I opposed the Vietnam War and grew up during the antiwar movement and that influenced, to some extent, my exodus to Canada. So, prior to that I did have--I went to American International College, as I said, for a small college experience but it was a good education and there were good influences there in psychology. Professor Richard Sprinthall and George Grosser were two people who provided a good experimental background and that was important. I then moved--I took a job for a year but then went on to North Carolina State University for a masters and at that point, turned to Canada as the war was heating up and--

**Muir: So when did you come to Canada?**

Zelazo: 1965

**Muir: And you spent how long in Canada?**

Zelazo: Two years at the University of Waterloo. I worked with Richard Walters and--

**Muir: Mm-hmm.**

Zelazo: And then two years later took the job at Queens University that you might be familiar with.

**Muir: Right, right.**

Zelazo: So.

**Muir: Well, that's a good pedigree.**

Zelazo: Yeah.

**Muir: Okay. Can you tell me more about your sort of early adult experiences that helped promote your intellectual development and your collegial experiences? Who influenced you?**

Zelazo: Yeah. Collegial experiences--I mentioned Richard Walters, or rather before that Richard Sprinthall at the American International College. And then later, when I transferred to University of Waterloo, Richard Walters was influential for--

**Muir: Social learning theory.**

Zelazo: That's right. Social learning theory which made a profound impact on me and I was really intrigued by that and by the notion of early experience which impressed me. But Walters and Park published a paper on infancy and the role of distance receptors in infancy which fed perfectly, or blended perfectly, with the early experience literature that I was reading. That we all did at that time - about Hebb. But you had mentioned the research on cataracts a minute ago and that was some early experience research that was instrumental and to me that was really exciting stuff at the time. And it was the early experience, it was the combination of the social learning and Richard Walter's interest in, although no practical work with, infancy that led me in that direction. There is an experimental background that I had, much like yours, and that plays a huge role in terms of my orientation toward child development. But it wasn't popular, as you know, and it wasn't the norm.

**Muir: That's right.**

Zelazo: So--

**Muir: But it was very--I mean the Bandura's and Walters' book for example.**

Zelazo: Oh yeah. That--

**Muir: A bible.**

Zelazo: It was a bible and I, at the time, memorized that and others literally, right? But it became a bible--somewhat to my surprise--after I came to Canada. I wanted to be in graduate school in Canada at the time, and not in Vietnam. It was somewhat surprising to me that Richard Walters had not done any empirical work with infants so it was an era where I think there were a number of us who were pretty bold and I just did a dissertation on infancy and became--in a sense--my own advisor with respect to infant studies.

**Muir: That perhaps was a good way to grow up--**

Zelazo: Yeah.

**Muir: In the field--**

Zelazo: It is.

**Muir: Rather than coming in to a lab that's already functioning like a machine and being churned out.**

Zelazo: Exactly. And the other very friendly part about my graduate experience in Canada, or at least at Queens, where I became assistant professor, was that it was pretty much--that is the curriculum was pretty much--a function of you and your advisor. And to me that's nearly ideal, as opposed to taking dozens of required courses and--

**Muir: Yeah. How did you develop your dissertation idea? Did you have a seminar that you presented on it in graduate school which turned into a thesis?**

Zelazo: No, I read and since I had nobody who was an authority to lean on, I chose the best that I saw that was interesting in social learning and early social learning, which was interesting because that translated to me to smiling and vocalizing as two dominant behaviors. And there were two people, two psychologists who stood out, one more positively than the other and that was Yvonne Brackbille with smiling and Harriet Rheingold --with vocalization. The Rheingold thing, and we could go all over the place with this conversation, but the Rheingold experience was interesting because I literally used a very good paper that she had published on vocalization in children as a model. That was it. Her's was the most rigorous work out there on the topic and in much of infancy. And I modeled my work on her approach.

**Muir: But you got this through reading rather than through visiting her lab?**

Zelazo: Right.

**Muir: Finding out how she did--what her tricks were?**

Zelazo: Exactly.

**Muir: You developed your whole procedure--**

Zelazo: Developed the whole procedure and had lots of support from Dick Walters but he had no hands-on experience. He was above board about that.

**Muir: Describe your thesis. I mean what did you actually do for your PhD?**

Zelazo: Well two parts. And this is interesting 'cause I modeled after Rheingold but Brackbill's work on smiling is really what was seminal for me because I believed the literature and this is a recurring theme and what I think is best for us as professors to teach students. I read the literature and the dogma was that smiling was a conditioned response. But when I went out and collected data, that's not at all what it looked like. In fact, we looked at smiling over days to a social stimulus - myself. And what we found was a consistent decline over trials per day and over days. In the three days, three trials, each day, there were steady declines. To me that didn't fit a conditioning perspective at all. Looking further into the literature it struck me as a much more cognitive phenomenon. In fact, I came to the conclusion that it is more like the stuff that Jerry Kagan wrote about at the time--one of the things that influenced me, which is a variation of what Piaget was saying about assimilation occurring. But, from a more neuronal perspective, creation of neural network, the creation of a mental representation to match the stimulus that was occurring following some effort. That was more like what smiling was. And I guess Jerry Kagan had a paper in the American Psychologist at the time that seemed to fit best with the data, which led to all sorts of things, not the least of which was a whole area of research on information processing. And this culminated in one sense in the development of the procedure to get at mental ability through information processing. That's something lots of people at the time were interested in looking at.

**Muir: That's right.**

Zelazo: I eventually went to work with Jerry Kagan after two years here at Queens, and that was the stuff that we worked on. But that prototype of the smile served as a model for the inclusion of all kinds of other measures, including vocalization and finally we were integrating the two again along with a host of other behaviors like social referencing and pointing and clapping and cardiac decelerations. These were all the principal measures and there are dozens of tangents along the way that were just very interesting that occurred that we followed up. For example, one problem that we were able to decipher, sort out, was the paradox that the dominant measure of attention was visual fixation. And when you used it with a host of other measures like smiling and cardiac deceleration and pointing and vocalization, even social referencing, that cluster of behaviors occurred together and fixation occurred separately. And it was--the bottom line was--that we created a scoring procedure for a more complex version of this information processing approach that we do and more complex sequential stimuli to sort out these clusters of

measures. And the cluster does not include the decrement in visual fixation. It serves as one of the prerequisites. That is, there must be attention to the visual stimulus and a cardiac deceleration and then a host of other measures, which happen to include smiling and it often occurs with positive vocalization. So we have a nice cluster but there is a divergence between that cluster and the habituation of visual fixation. So that led to a host of questions and an interesting, different perspective on the habituation approach and the literature on attention.

**Muir: I still think the field hasn't given up the idea that everything is in visual fixation.**

Zelazo: Yeah.

**Muir: In the infant social cognition literature a little bit of work that I did showed that while you have no difference at all in visual fixation you have huge differences in affect going along with your point--**

Zelazo: Right.

**Muir: That the two are orthogonal measures at times. Not necessarily always.**

Zelazo: Exactly, which adds to the complexity of it--and this is something that as of now, as of today, still has not made any impact. To get to the impact I want to point out the difference eventually between significance and impact. This is significant for dozens of reasons and this is just one little piece of it.

**Muir: Right.**

Zelazo: But it has had no impact. I don't think that you can sort out a cluster of behaviors that in my view announce the match, the formation of the mental representation for the stimulus or the event. That's on line and it is in real time as opposed to habituation, which occurs after the fact. That is, after the game is over and you're finished and bored, then you are habituated. Now you back up and you say where - somewhere earlier - the mental representation was created.

**Muir: Right.**

Zelazo: But there are distinct advantages to having the attention occur when the match is occurring and then have the focus and announce, okay now I've got it. That's the high--

**Muir: That's kinda the learning part of the procedure.**

Zelazo: Yes, and it's the high experience. Yeah, it's only the learning part, right. It's only the creation of the mental representation. So in many ways, you know, the habituation procedure, which has served us incredibly well--

**Muir: Mm-hmm. Which you've used yourself--**

Zelazo: Yeah. It still misses the point in that it has distinct disadvantages that we haven't come to fully appreciate. And I have a lot that I could say about that and have been distracted myself, in part, by a habituation technique that we used to test neonates.

**Muir: That's right.**

Zelazo: Right.

**Muir: Well, we'll go in to that briefly in a little bit. Okay. So it seems to me from what you described so far your progression in the field has been pretty straightforward. I mean--**

Zelazo: Yeah.

**Muir: In fact you've been incredibly focused compared to some people I know like myself--bouncing all over the place. But you know, you really seem to track in to your eventual field that you contributed to at an early stage and you stuck to it.**

Zelazo: Yeah. In fact it is incredibly focused and straightforward. Right. It's that the big picture hasn't even been presented but I've had this picture--and the interesting thing is - it's not always clear. That's part of the fun as you know. You discover along the way where you think something might be, actually is, and that it can be, you know, a thrill, to be validated.

**Muir: The ah-ha experience.**

Zelazo: Yeah. That's it. And so that's certainly been part of it. And the point is that it has led on a straight path and I have built on that path. But I haven't lost sight of it and it's not characterized by abrupt shifts in to new directions.

**Muir: So what--**

Zelazo: But--just one comment -- because I think to an outsider some of the work may look totally disjointed. But I'm saying it's not. It all has a pattern. For example, the motor work and the information processing research are tightly related and at some point the language research. We have a nice procedure for stimulating expressive language and that is seemingly not related but it is all part of a big picture and eventual goal that I hope I'll be able to explain in a minute.

**Muir: Well give me an idea of the big picture. This is probably a good time and then we can talk about the elements.**

Zelazo: The big picture is interesting because from the start, and I'll go back to that after, there was a time when I first got introduced to psychology, not in a very sophisticated way, but that somehow or other I had some sense that the current tests of infant mental ability had serious problems and were to me a mistake and it seems as though I knew that intuitively before I knew psychology. So that's an interesting thing that always fascinates me.

**Muir: An example would be Bayley's test ["Bayley Scales of Mental and Motor Development"]?**

Zelazo: Definitely, Bayley's test which has the best, you know, psychometric properties of any test out there and is the most widely used--

**Muir: And no correlation at all with later mental ability.**

Zelazo: Yeah. So that's--but somehow or other when I was, and this is what I mean, I was--I can remember an event when I was 15 and somebody raised that. Fifteen or sixteen in a summer school program and I had no background in this but somehow or other had become--I read a lot so I guess I must have been somewhat aware of it but I knew then that this was not sensible and that it had some serious negative implications. I remember arguing vigorously about it without knowing first hand, or having ever been there.

**Muir: Right.**

Zelazo: So that point is interesting because I never left it and I never was conscious of necessarily pursuing it until—

**Muir: An unconscious drive.**

Zelazo: Or intuition. You know intuition may be more important than anything else. And then later, and not even--this is before college, because when I went to college my first interest was physics and then I learned I wasn't prepared enough to do physics but I felt much more comfortable with psychology even though I had this keen interest and fascination with physics. Anyway, once I got, as I said, into psychology and through graduate school, I focused on early experience and a variety of experiences in learning--the role of experience and that everything is not all innate--that was a dominant kind of theme. And to follow that through to the first dissertation on smiling and vocalizing and leading to an interest in mental representations. You remember all of this was happening in the

neobehaviorist period when mental representations were just a “bogus” idea because the cognitive revolution was just beginning.

**Muir: That's right. That's right.**

Zelazo: That was 1960. For me around 1963 and '65 and from '65 to '67. I did the dissertation. In 1967 I came here--

**Muir: Right.**

Zelazo: --for two years.

**Muir: And at Queen's you did some famous work on motor development you will talk about later--**

Zelazo: Okay.

**Muir: --interview.**

Zelazo: That was right after I left Queen's--that was interesting stuff. But this is part of what I wanted to get at.

**Muir: Yes.**

Zelazo: That when I looked back on teaching myself about what are the important questions to ask in infancy given that I didn't have anybody necessarily steering me--

**Muir: Right.**

Zelazo: In one particular direction, then, one place to look was to the traditional scales. And so I got back to them--and perhaps for the first time, ironically, and discovered that one fact stood out profoundly. That at six months of age, on Bayley's scales, even though there's a mental and motor scale, they correlate .86 which said to me that they're essentially the same thing. Call them what you want, they are measures of motor development.

**Muir: Right.**

Zelazo: Right. So that meant that I should study motor development in parallel with cognitive development because, as you know, at the time, the resurgence in the work on infancy was most exciting in the information processing domain and the hypothesis that children were able to create mental representations for the events they were experiencing. And as you said, that's quite different from the notions of learning, which were pretty bare bones or radical behavioristic at the time.

**Muir: Right. Right. Well they're still using the Bayley of course, and they've added a habituation part to it but I happen to know from the work of Alan Salter and others in England that there's still zero correlation with cognitive outcome measures.**

Zelazo: Well, I mean it's not surprising. And that was the whole point so--and there were lots of people touting this so it's not an idea that was new to me but more like, join the band wagon. The potential for measuring later intelligence had much greater face validity with information processing than with measures of motor ability.

**Muir: Right.**

Zelazo: But that led to fascinating questions in the area of information processing and the area of early motor development not to mention the way it played out in the tests of intelligence. So there was this parallel work and that carries its own fascinating stuff.

**Muir: Mm-hmm. So when you left Queen's you worked on motor development and made your fame in that science paper on early walking and the role of exercise. Then you went to Harvard. Is that right?**

Zelazo: Yes.

**Muir: Then Queens?**

Zelazo: No.

**Muir: Then worked with Jerry Kagan and a few other people there?**

Zelazo: Yes. And it was actually supposed to be a leave of absence and then it was an absence. I stayed there about seven years and we had just very exciting things going on at the time. Exciting things socially and politically as well as intellectually. It was the Johnson era when there was lots of money and an incredible amount of research going on and free reign and the smiling study led to the creation with Jerry Kagan of a sequential information processing procedure--

**Muir: Right.**

Zelazo: That we published in infancy the book with Kagan, Kearsley, and myself.

**Muir: That's right.**

Zelazo: So that--

**Muir: And you did find a correlation between your measure and later estimates of IQ didn't you?**

Zelazo: Yes, and we did various ways, but there's much more to be done still in terms of writing up that work. That's, you know, one of my--

**Muir: One of your goals in retirement.**

Zelazo: That's right. Exactly. That's it. It is. Finally, I get the chance to write up some of these things and they're-- it's just rich with, you know, pregnant with implication in so many of these areas because--precisely because I tried to stay focused and I couldn't go off on too many tangents. I guess the longest and most difficult tangent in terms of time was the neonatal information processing 'cause I really wanted to it go further. But it's led to so many interesting questions.

**Muir: So tell us a little bit about the neonatal information process.**

Zelazo: The neonatal information processing procedure was an incredible story because it ties us together. That was fascinating because I had a grant from the March of Dimes and worked for about a year and a half trying to get a technique that would be usable with newborns. And as you know, and others at the time too, that's probably, 1970 or so, or '69, or '70, '71, to get a newborn to be alert and testable on any procedure seemed near impossible and you maybe got ten minutes out of 24 hours. I knew people who would go into the nursery at three in the morning and stay there for that length--to try to get a few minutes of testable time. And we ran into many difficulties. Heart rate proved to be highly unstable and erratic and I was experiencing some frustration with this because it was a two year grant and now it's already about a year and a half in. We hadn't had the technique until I met up with Ray Peters at an SRCD meeting and he told me about your work and your head turning procedure studying auditory processing and the adaptation perhaps of the Brazelton but in a nice, tight, methodologically sound procedure and it was exactly what I was looking for that we could then try to convert to an habituation - recovery procedure. And it worked beautifully. So we published quickly. In about six months time we collected data on two studies. One with rattle sounds and using between group controls where we got orientation, habituation and then changed the sound and we got recovery from the--I don't remember the types of beans that we switched, but it was a subtle and amazing distinction that--fava beans was one and I remember it was lima beans and fava beans. Something like that. And they produce a different sound that newborns can astutely detect. We had a no-change control and they just kept habituating and didn't recover and yet they recovered to a novel stimulus. So we then translated that, or used the same procedure using speech stimuli and that was with Brody, Chaika, and myself.

**Muir: Right.**

Zelazo: And the words were “beagle” and “tinder” and we put in all the controls that you're using, counter balanced everything and this incredibly, uncooperative organism started obeying this procedure nicely and led, for those two studies, a technique to get at the question of whether children under three months of age, specifically newborns, could attend to and create mental representations for events. I remember distinctly 'cause even Jerry Kagan didn't believe, at the time, that babies under three months of age could create mental representations.

**Muir: Right. They had no memory.**

Zelazo: That's it. From a point of view of the evolution of the species it simply doesn't make any sense that at three months, memory would pop in--

**Muir: Right.**

Zelazo: Like eruption of teeth - something maturational. It just doesn't seem to work that way.

**Muir: Right.**

Zelazo: Nonetheless, I think it's instructive for people to know that because it would sound unbelievable today. But as you know, even then, people weren't sure when we started doing this work--

**Muir: Right.**

Zelazo: That newborns could even see.

**Muir: Mm-hmm. Yes, isn't that amazing?**

Zelazo: Yeah.

**Muir: And they certainly had no feeling.**

Zelazo: Right.

**Muir: And they could have operations without anesthetic without experiencing pain.**

Zelazo: Exactly. Circumcisions were routinely done without--

**Muir: Yep.**

Zelazo: Without an anesthetic.

**Muir: That's right. Times have changed. In part due to your seminal work I think too. Tell us a story about newborn memory and about how that might be related to applications such as infants of mothers that are addicted, for example.**

Zelazo: That's interesting 'cause we did one study that I don't think has had much impact but that it's relevant. Susan Potter worked on it--and it was very hard collecting these data as you can imagine--and Grace Valiant. Grace and Susan Potter were able to achieve this. Grace Valiant is heroic and we always call her Amazing Grace --even Susan referred to her as Amazing Grace 'cause Susan's dissertation was on this topic. Basically we showed that mothers who had ingested cocaine had babies, relative to a control group, had babies who had difficulty with this paradigm with memory and the recovery process; they were significantly impaired.

**Muir: And this was true of every infant of mother's that had cocaine addiction. Is that right?**

Zelazo: Yeah. Experience. We measured the cocaine through--

**Muir: Umbilical artery?**

Zelazo: Meconium.

**Muir: Meconium.**

Zelazo: Yeah. Collected the meconium and documented it. Controlled for other kinds of factors to the extent that it was possible and did a very careful study with data that were painful to collect. The interesting thing is that, I think the finding that stands out with the older children is that children of mothers who had taken cocaine during the pregnancy have poor expressive language. That's one of the more reliable findings, expressive language is delayed at two and three years of life. And so there's a whole interesting question about the auditory processing early on that's affected and later expressive language delays that I think are related. We have not--

**Muir: Right.**

Zelazo: --done more than to say, at birth, seventy-two hours or so, that there is this impairment in auditory processing.

**Muir: There was a paper that you published though on one infant who turned out to look pretty normal behaviorally--**

Zelazo: Yes.

**Muir: --in that group.**

Zelazo: That's right.

**Muir: But did have the maternal cocaine ingestion?**

Zelazo: That's right, the mother ingested cocaine.

**Muir: Right?**

Zelazo: That's right which is a, just a fascinating exception I think, but that was the interesting thing; it was--I don't know how to explain it, it was an exception.

**Muir: My thought when they did the test on the amount of cocaine in the system, the baby's system--**

Zelazo: Mm-hmm, yes, the maternal cocaine did not cross the placenta.

**Muir: That there wasn't--**

Zelazo: Pardon?

**Muir: There wasn't any. Isn't that right?**

Zelazo: Mm-hmm.

**Muir: So that was a unique case physiologically.**

Zelazo: Yeah.

**Muir: But behaviorally it proved the point.**

Zelazo: Yeah.

**Muir: That the test worked.**

Zelazo: Yes, yes.

**Muir: Which I think is really incredible.**

Zelazo: Well, yes.

**Muir: Hard to believe but you know a wonderful story actually about the power of the assessment procedure.**

Zelazo: Yes.

**Muir: Okay.**

Zelazo: The work on memory has led to work with Ron Barr and Simon Young showing that glucose can enhance memory formation and the procedure seems to segregate the attention and the learning aspect from the retention aspect and that glucose does in fact enhance memory. The technique has proved - to be negotiable - without going into all the specifics--we've replicated so many pieces of it. And that gives me confidence that we're really getting at some reliable findings. Right? I mean when I say pieces, for example, there is a delay component that we've replicated now many times without glucose ingestion. The memory, using these procedures and the intervals that we were working on, about 45 seconds--

**Muir: So you habituate, you wait for--**

Zelazo: Fifty-five seconds, the ten-second usual interval and a 45 second delay and then they still remain habituated, go to 100 seconds in a different group and they are recovering.

**Muir: Okay.**

Zelazo: But then we did interesting studies, Swain, Weiss and myself, and Swain's master's thesis--it was Rachel Clifton, not Weiss, and another point of contact because you worked with Rachel as well. What we showed there was that over two days using a fixed trial procedure rather than our usual--infant control technique, that--over two days of repeated stimulation without a change, just a redundancy over two days, that the children were able to bridge a 145 second delay that we had used as the recovery delay without changing the stimulus. So we would simply delay on day one, orient and habituate, thirty trials of habituation, and then produce 145-second delay and there'd be no recovery.

**Muir: Right.**

Zelazo: Or rather there would be recovery that first day.

**Muir: Right.**

Zelazo: And then the second day we get the same stimulus and then you have the 145 second delay that we were using as our novel stimulus and this time they remained habituated. So that was--

**Muir: So that's learning over days.**

Zelazo: Yeah. Incredible.

**Muir: What about the glucose effect? What would happen as a function of time from the last meal**

Zelazo: Well in the glucose effect we show, for example, that those children with glucose can last 100 seconds as opposed to, without glucose, I'd say, 55 seconds.

**Muir: So you would encourage parents then to feed their children sugar?**

Zelazo: Well that raises an interesting question now because the whole notion of our work and lots of other work is that glucose enhances memory and with Alzheimer's patients as well. The significance of this work is that glucose enhancement of memory occurs even in two-day-old babies and that there's an optimal time for memory to occur following a feed. Yet you have people talking about sugar leading to hyperactivity in the older kids.

**Muir: That's right.**

Zelazo: And disrupting their school performance. And so it makes you question how that could happen. We haven't gone there yet.

**Muir: Right.**

Zelazo: Except that it could be--

**Muir: A u-shaped function.**

Zelazo: Yeah. Yeah, it could be. Who knows? I don't know what it is.

**Muir: Okay. Well then okay. So we've reviewed some of the newborn work that you've done and the impact of that in terms of diet and in terms of training over time and so on. And in terms of drug issues. Carry on now with the older infancy period. What you've--**

Zelazo: There is one other thing that I should add. My interest in psychology and the research on infancy had been both on a basic and applied level. I felt committed to that and when I was here, at Queens, I had a friend who was in law school and he used to taunt me, and psychologists, about the fact that we create psychologist to create psychologist and would ask, when are you ever gonna deliver?

**Muir: Deliver.**

Zelazo: And, that's right, when are you gonna do something, right, because law is such a practical, though not always so honorable, profession. It was nonetheless practical. And, the question was: are we just sitting in our ivy towers? I always felt, you know, that we should deliver and that I do want to deliver and that we should have applications and I don't think we do enough of that even today. But nonetheless, that always guided my interest, that and my wife, Nancy, at the time. She's since passed away but she was a Master's level nurse in maternal and child health and she was instrumental in our discussions and encouraging my interest in infancy and in to things like the stepping behavior which she participated in. She first introduced me to the newborn stepping behavior and the study of motor skills. Anyway, delivery was an issue. There are basic and applied questions. They are both interesting and they are equally fascinating.

**Muir: Right.**

Zelazo: --to me. The interesting basic question, and theoretical question for me, was the transition at a year. I know we've talked about the transition at three months, but I still believe that the transition at a year is profound. It just overwhelms me. I think one could honestly make a case for the discredited notion of outogeny recapitulating phylogeny. Not in the crude way that it was presented originally but in the sense of the essence of our abilities, cognitive abilities in particular, as a species coming in and being reproduced in the infant at a year. And you see it-- it's the time when the baby takes his first steps alone. He makes his first words alone. He uses tools, for the first time alone. And so I pursued those three lines of work, the first steps, the first words and distinguish object use, tool use. Right? Now these are things that really segregate us, although not as distinctly as we used to believe, not anymore. But it's still a profound transition--

**Muir: Absolutely.**

Zelazo: --in the species it comes in within a very precise fine period of time. In that study on functional play, appropriate functional object use was not present at nine and a half months, literally. We looked at a sample of children at nine and a half, eleven and a half, thirteen and a half, and fifteen and a half months of age. At nine and a half months, there were very few unambiguous instances of functional object use where infants put a telephone to the ear or babbled into a telephone, or put a hat on their head or any of a dozen--

**Muir: Right.**

Zelazo: Any of 36 different hypotheses--

**Muir: Right.**

Zelazo: That we objectively laid out. Yet two months later, all of the children showed at least one act functional act. And this is purely observational.

**Muir: Yeah.**

Zelazo: Right. So we're not doing anything to the infants; we were simply watching and this is--

**Muir: Spontaneous use--**

Zelazo: Yes.

**Muir: --which is amazing.**

Zelazo: It's amazing. Right. So they don't know what these things are in every case, but whatever they know they are using appropriately. So the telephone goes to the ear instead of to the mouth. And the motor demands are exactly the same. So what you have is this capacity to impose some thought on your behavior. Prior to that--at nine and a half months, the other part of this is that virtually 89% of all of the toy contacts and object uses were stereotypical where we define that as mouthing, waving--

**Muir: Right.**

Zelazo: Fingering and banging the objects.

**Muir: Right.**

Zelazo: That's incredible. Almost 90% of all the same things. You do the same things to the objects no matter what. And just two months later, you're sorting out.

**Muir: Right.**

Zelazo: So you get very specific behaviors occurring paradoxically in a very general array and--as opposed to very narrow and selective, specific uses.

**Muir: A standard, stereotypic, repetitive motor scheme changes to different functional actions specific to each object.**

Zelazo: Exactly. So it's that change at a year that became of interest. There's an interesting paper - actually several--that have tried to capture that and say what is the--what is the characterization of the child's mental world in the first year to be used in broad strokes for something later. So there are variations, and we can debate and there are conditions where--you can tweak each of these events in different directions; but, in general, you're doing more of the same—it turns out, cognitively. Les Cohen, in our book on newborn attention, made a very good case for that. That you get cognitively, in terms of his very elaborate research, careful research, more and more of the same things. You build on what you've got. But there are no profound shifts in the mental operations until about a year. And

that's what I've been interested in. It culminated in one paper with my son, Philip David on the emergence of consciousness because he's interested in pushing it in that direction.

**Muir: Right.**

Zelazo: But, I used the work that we had on the newborn to try to characterize what is this--what is the newborn baby, and later what is the baby, capable of--given the constraints that we see, the stereotypical behavior and other actions, for example. The story is parallel in my view for motor and mental development and that is, you get more and more of the same and you refine it and you get better at it but there is--still it's qualitatively similar until you hit a year, plus or minus a couple months, when you have some profound, probably biologically, almost certainly biologically, generated transition that is characterized by thought from minimal to recursive consciousness. But this is not unlike Edelman's work on consciousness and the notion of recursiveness consciousness. But what that does is-

**Muir: So you finally graduated to studies of consciousness inspired by your son.**

Zelazo: Right. Exactly.

**Muir: Who had good, early experience in how to motivate father.**

Zelazo: Exactly. So we actually did a really good paper together. It was an interesting forum down at the University of Montreal but, the point was that I could describe what I thought were the characteristics based on our research. And a key piece of that research is the study done by Michael Weiss, myself and Irina Swain on the discrepancy principle. And one of the ways that the research on newborns--if we want to point to the significance of infancy, the immaturity of the organism permitted us to overcome one of the most incredibly difficult obstacles in sorting this kind of problem out. This kind of problem being, is the degree of discrepancy a linear or curvilinear function of what you already know? That is, wherein lays optimal learning and the drive for new learning. Is it a linear effect or is it a curvilinear effect?

**Muir: Right.**

Zelazo: The more and more different you get from what you already know, one could say, becomes more and more important from an evolutionary point of view. But major theorists like Hebb and Piaget and Kagan have--and others, have repeatedly, almost intuitively, argued for an optimal level of discrepancy.

**Muir: Right.**

Zelazo: But to prove that--

**Muir: So too much discrepancy and you turn off basically.**

Zelazo: Exactly.

**Muir: Too little and if you've turned off because you're bored--**

Zelazo: Yeah.

**Muir: Too much and you're confused.**

Zelazo: Exactly.

**Muir: So right in the middle there, that optimal--**

Zelazo: That's right. And we did some nice studies. J. Roy Hopkins is one person who did a really nice study on bar pressing with infants with myself and Jerry Kagan and Andrew Sandra Jacobsen but the problem is that you don't have a unitary metric because infants are too bored. At three, four, five, six, or seven months--they process too rapidly; you just don't have enough information there for them to chew on. So that to make the problem--the

stimulus-- more complex, you lose control and basically you don't have a unitary metric. And you know that problem well and I think people in the area know that problem very well. So the solution was the naiveté of the newborn. Michael Weiss' dissertation varied fundamental frequency very precisely with computer generated sounds that we were able to control precisely by percentage of discrepancy from the standard, and then showed very clearly that there was an optimal level of discrepancy leading to optimal recovery and attention. And that's a 14 and 21 percent difference from the standard. We counter-balanced the stimuli. It didn't matter which stimulus was your standard. The determinant of recovery was a curvilinear relation of degree of discrepancy from the standard. And so it was a very nice pattern; it shows that there is an optimal level of discrepancy, as you just said. If it is too discrepant, we get avoidance. Avoidance because one beautiful feature of the head turning procedure is that--

**Muir: They can turn away.**

Zelazo: They turn away. Exactly. And what that does is blow away--

**Muir: Yeah.**

Zelazo: our notions of what habituation really is, because these children are acting in some way on the stimulus and if you give 'em a bidirectional response they can show you.

**Muir: Yeah.**

Zelazo: So what we got was turning away to redundant stimulus, turning away significantly, turning away to an extremely discrepancy which in this case 28 degree or percentage difference in fundamental frequency. And that's the only thing we're hearing. So the unitary metric made it possible to run the whole dimension so that you're not just getting the ascending portion--

**Muir: Right.**

Zelazo: --of a curvilinear function.

**Muir: Yep, right.**

Zelazo: And we were able to do that. So that was useful in terms of, most useful, in terms of characterizing the mental world of the infant, because they're--it's shows that they can create mental representations for events and that they have an affective aspect to it. Neonates can approach and avoid --but they are not aware that they are doing it--there is no evidence that they're aware that they're doing any of these things. So self-awareness comes in much later and they don't seem to be able to recall any events. They react. They recognize events. So those are the key features that I think help us to understand what happens-- what the child is like from birth onward at least. Onward to the end of the first year where the recursive nature comes in and as I was saying about the stereotypical behavior, that with the reverberating circuit that Hebb postulates or the fact that the memory trace can continue and I think because processing speed is increased--

**Muir: Right.**

Zelazo: --sufficiently so that they can pick it up - that allows associations to come in. So that an idea that is mentally created like a telephone to the ear, can be superimposed on the more primary stereotypical behavior and direct the behavior.

**Muir: Right. They can link the behaviors--**

Zelazo: Right.

**Muir: --together in series.**

Zelazo: Yes. And that has to do with recall. There is now work on recall showing that the recursive process comes in at about the same time as the emergent capacity for recall. To me, that is one of the key pieces, because it makes

that, along with a paper I did with another student showing that the tight interval synchrony that occurs at a year for these various responses - that is, the collection of data, looking at our own work and published norms, the norm for walking alone - first steps unaided, specifically - first words, functional object use, social referencing, and separation distress, for example, imply that there is a cognitive – maturational change that occurs towards the end of the first year of life.

**Muir: Right.**

Zelazo: With the data sets, from the work of others we were able to show that these developments all come in very tightly - and in order--that is around eleven and a half, twelve months of age.

**Muir: Right.**

Zelazo: For that to occur implies some underlying cognitive program --.

**Muir: Right.**

Zelazo: that is making possible a host of other behaviors.

**Muir: Right.**

Zelazo: And that seems to be this capacity for recursive consciousness, one way to view it, or in Kagan's terms, or in the title of one paper, "The Dawn of Active Thought," where you can start generating ideas. You're recalling past experiences and imposing them and not just responding on an automatic, more stereotypical level.

**Muir: So this is a nice layout of sort of a basic research story.**

Zelazo: Right.

**Muir: How can that fit into the applied issues that you were mentioning?**

Zelazo: Great because that does set the stage--you know what's been coming into play, what has been developing is developmental psychopathology as a field.

**Muir: Right.**

Zelazo: And the notion--the primary idea from that, that is to me the most significant and most salient, is that typical development can inform atypical development and vice versa.

**Muir: Right.**

Zelazo: Now for lots of reasons, I became interested in autism, the development of autism. Which is something that's--

**Muir: Well we know it doesn't appear until like two--**

Zelazo: Three years of age. Which brings to bear the significance of infancy and for many years--many years ago, I had committed myself to being in a tertiary care hospital setting so that I would have easy access to children with autism and not be dependent on the system--

**Muir: Right.**

Zelazo: And the vagaries of the system to run up against. Because I had a grant that was threatened by a tertiary care hospital setting where the referring physicians decided they didn't like the outcome of the work as it was going.

**Muir: Yeah.**

Zelazo: And cut off access. So--yes--so they cut off access. I made a choice and housed myself primarily in a tertiary care setting which brought me to the Montreal Children's Hospital. Before that the Tufts-New England Medical Center, but that's where the access to the children with autism was severed. So it made sense, and I thought if I'm going to study this problem then I have to be in a setting where I have free access to them.

**Muir: Right.**

Zelazo: And I was able to do that at the Montreal's Children's Hospital for many years while still being on staff at McGill, but in a less formal academic way than I would have been had I not been at the Children's. So that was a real conscious decision to get at children who had autism within the first three years of life and to study the development of autism as opposed to when psychologists usually have access which is sometime after three years. If these pieces, as you just said, have to come into place when they're developing and something may not be developing, then this is clearly, a pervasive developmental disorder. However, the fact of the matter is that people assume that it is a genetic, genetically driven, phenomenon.

**Muir: Right.**

Zelazo: They don't assume that it is psychological development gone awry, which is what I would characterize it as. Now, to know if development's gone awry, we have to know what typical development is like - in broad strokes at least.

**Muir: Right.**

Zelazo: One of those broad strokes is that the first year is fairly well programmed and you're getting a lot of experience in development but, it's largely constrained until you hit a year and then there is a profound cognitive change that makes possible a host of new behaviors. Those new behaviors include first steps, object use, tool use, first words, social referencing, pointing. A host of profoundly important behaviors that basically turn the infant into a toddler -- turn him into somebody that's more like us as adults. So what happens with autism was the question. And what happens with autism is that you get profound delays with expressive language. You get profound disruptions in behavior. You get disruptions in object use in many cases. Both of these are both motor and mental and of course social and behavioral.

**Muir: Right.**

Zelazo: So I have been interested in looking at and tying our basic work on typical development to what goes awry in the problem of autism. There's one other complication and another pathway into this and that is the work on newborn attention led to the work with Jerry Kagan and the procedures that we published in one form in the book *Infancy* with Kagan and Kearsley. Those procedures were focused on information processing mostly through the second and third years of life.

**Muir: Right.**

Zelazo: Thirteen months through about three years of age. We did exhaustive analyses of the data that we had on numerous different responses: looking time, smiling, vocalizing, twisting to get out of the situation, fretting, you name it. There are cardiac changes -- beat by beat cardiac changes. They were not predictive of mental ability until we were able to put together a cluster of behaviors with attention being constant as a measure of relevance -- of attention to the stimulus. Cardiac changes occurring at precise points along the way of the sequential stimulus and one or more expressive behaviors - vocalization, smiling, pointing, clapping, and social referencing, for example -- constitute a "recognition cluster". That procedure was tested with a sample of children who had autism. I didn't mention one other tremendously important fact about autism its diagnosis. Seventy-five percent of the cases of children with autism end up mentally retarded, but that's often dismissed--

**Muir: Right.**

Zelazo: Or presented more accurately as an afterthought.

**Muir: Right.**

Zelazo: Oh, by the way, 75 percent of the children will end up mentally retarded. Well that's co-morbidity in my view but, very few people seem concerned about that association. We came in--I came in to the problem of autism by trying to validate the information processing procedures that we had developed. It was an extension of the work we did in the book, *Infancy*, by adding in this scoring component. The clusters of behaviors announce that the child has a memory for a particular event that was presented. We came in validating the hypothesis that despite the fact that all the children had delays on conventional tests of intelligence, some were processing the information age appropriately -- that they would, in principle, not have delayed mental development but, have delays in expressive development, development gone awry. Some how or other their language and object use, became arrested and behaviors emerged that were in the way, that were disrupting their development. And it is that study that's been published but not fully. None of this has been published adequately. So it's had very little impact but hopefully this is the time to go after it. Right?

**Muir: Right.**

Zelazo: But I believe it's profoundly important and that's the distinction between impact and significance. That it's tremendously significant--

**Muir: Yep.**

Zelazo: Because although the field of autism is tremendously interdisciplinary it is not open to these ideas. They're not open to psychology in the sense of early psychological development going awry. They're interested in--

**Muir: Well, it's the expression of genes as you pointed out--**

Zelazo: Yes.

**Muir: It's the--making the money impact right now.**

Zelazo: Right.

**Muir: And certainly--**

Zelazo: Except that the genes do not have to be expressed as they now know and so things are ready to be changed some, but in practice too often we hear that story. The diagnosis of autism made at whatever age--the pieces are in place before three. Even if the child recovers many of the behaviors and is talking, using objects appropriately, and the behavior is under control, he's still regarded as severely autistic if he scored severely autistic on the ADOS under three years of age. So the assumption is you can't escape because this is a genetic problem. It's a totally circular argument and it's got to be widened --broken open.

**Muir: There are hopes in behavior therapy techniques that have made the press though and that are being supported strongly by autism societies and parents--**

Zelazo: Yes.

**Muir: --and demands that government pay for the treatment--**

Zelazo: Yes.

**Muir: --which is very expensive--**

Zelazo: Yes.

**Muir: --in Ontario at least, that's a major move right now.**

Zelazo: Yes, and applied behavior analysis and developmental – behavioral therapies are the early behavioral interventions that have had an impact, have demonstrated effectiveness. We have a treatment program based on a book that's been published with Kearsley and Ungerer, Judy Ungerer, called *Learning to Speak, a Manual for Parents*. It's primarily a program to generate compliance 'cause that's another factor that's not really recognized in children with autism. Nowhere in the DSM IV is noncompliance to talk demands identified as a characteristic of children with autism.

**Muir: But parents certainly know that.**

Zelazo: Yes. But nowhere in the DSMIV do they say: “these are children who are non-compliant.”

**Muir: But we know that.**

Zelazo: Yes, we do know about that. So treating the compliance and treating the behavior and stimulating the expressive language is terribly important and we have a program that's doing that. And that program has been written and published since 1984.

**Muir: Mm-hmm. That's exciting. Okay, I--we'll wrap this up with the last question which is: “what contribution or contributions have you had which were the most wrong headed? Where did you go awry?”**

Zelazo: Okay. One thing that was wrong headed was a study done with Judy Ungerer and Leslie Brady where we looked at--this ties to this head turning procedure -- because we looked at the work by Andre Thomas, the French neurologist and he was important--made several very important observations. One was on early stepping but another was that he observed that if you held the baby up in a vertical position and you presented a sound to the side, that the baby would lean the whole body in that direction. And that's quite independently how I got into the head turning notion but we--instead of looking at head turning, controlled the baby and blocked out the capacity to turn the head because we wanted to center the baby. So we controlled out the head turn. And we looked at eye widening and actually published a paper--I think it was in the first issue of *Infant Behavior and Development*.

**Muir: Right.**

Zelazo: *Infant Behavior and Development*, showing that we got eye widening and turning of the eyes in the direction of the sound and it actually showed the impact of that over days, so it was a long-term effect. But the paper was buried and we--the worst part of it--the wrong-headed part of it – was that we controlled out the head turning. So you can't get any worse than that. And thanks to you we got back to head turning per se. It meant that you had to adapt to the baby and the realities of it. So rather than blocking the neck and holding the child, you know, with pillows or whatever we used to center it, you used the flat hand and you repeated the stimulus and did not provide just a single sound but a repeated sound. And the baby presumably recruits the neurons and executes the behavior. So that was wrong headed but as I said, thanks to you, we came back around full circle but I don't think we would have seen it--

**Muir: Well I have to inject this. I remember you inviting me to Tufts to give a talk and when I got there, you'd set me up because you took me to your lab and you said, "All right now, I want you to tell me what I'm--what's wrong here." And you showed me your procedure with the head turning--**

Zelazo: Right.

**Muir: --with the newborns.**

Zelazo: Right.

**Muir: So what you did was to put the baby flat on its back on a table 'cause you didn't want the experimenter to interfere with the infant's responses.**

Zelazo: Right.

**Muir: And of course, what the baby did was to adopt a tonic neck reflex and turn to the right and it didn't work.**

Zelazo: Right.

**Muir: And I said, "Yes, that's right. That's wrong. That's not how you do it." And I picked the baby up, shook it a little bit, and put it in position, and it turned immediately and perfectly.**

Zelazo: Right.

**Muir: And I remember that response on your part was one of surprise.**

Zelazo: It's just because we were, you know, wrong headed. One was a mistake. Well here's one that--

**Muir: Well it's good experimental control--**

Zelazo: Right.

**Muir: But it's a problem in terms of interacting with the infant which is what--**

Zelazo: Experimenter bias.

**Muir: --psychologists learned to avoid through all kinds of tricks that they sometimes don't report in their papers.**

Zelazo: Right.

**Muir: So the message to me was, if you ever have a question about somebody's work, pin them down. Either invite them to your lab or go to their lab and say, "What am I doing?" or "What should I do to get this response?"**

Zelazo: Right.

**Muir: Because so many people, I think, give up before they should and in other cases, perhaps, it's not a replicable response.**

Zelazo: Right.

**Muir: So--well thank you very much, Phil, for this interview.**

Zelazo: Thank you.

**Muir: And I'm sure that your discussion of motor behavior will be of great interest as well.**

Zelazo: Thank you.

**Muir: Okay.**

**End of Interview**