ADDRESS BY PROFESSOR RENEE BAILLARGEON

RECIPIENT OF THE INTERNATIONAL PRIZE 2013 OF THE FYSSEN FOUNDATION

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Dear President of the Fyssen Foundation and Members of the Board of Directors and of the Scientific Commitee, dear Colleagues, Ladies, and Gentlemen,

I am enormously grateful to the Fyssen Foundation for awarding me the 2013 International Prize in research on human cognitive development. This is an amazing honor, especially considering the many, many researchers who have made deep and lasting contributions to this field of research. In addition, the Prize money will help support a new line of research in my lab it might have been difficult for me to conduct otherwise. The letter I received from President Lallier last December informing me I had won the Fyssen Prize was really the best Christmas present ever!

One of the many things I love about science is its cumulative nature: as researchers, we build on the efforts of those who came before us, just as in time others will build on our own efforts. This realization led me early in my career to develop my "brick model" of science. As a researcher, I have the chance to lay one brick in the wonderful structure of science; my job is to make my brick as big and as solid as I can, so that it moves developmental science forward as much as possible and does not crumble when others attempt to build upon it. During my lifetime, my name will be inscribed on my brick, but it will very soon fade away. Still, my brick will remain and hopefully will help support research efforts into the future.

Now, in preparing this speech, I had to ask myself: what are key components of my brick so far? My work examines how infants make sense of the world around them and focuses on causal reasoning in four core domains: physical, psychological, biological, and sociomoral reasoning. In what follows, I will briefly describe one finding from each domain. All of these findings were obtained with the violation-of-expectation method, which I helped develop and which takes advantage of infants' natural tendency to look longer at events that violate, as opposed to confirm, their expectations.

Physical Reasoning

When I began doing research on early physical reasoning, Piaget's theory of cognitive development dominated the field of infant cognition. One central claim of Piaget's theory was that young infants lack a capacity for mental representation and hence cannot represent hidden objects. Part of the evidence for this claim came from manual-search tasks: after observing a toy being hidden under a cloth, infants younger than about 8 months typically make no attempt to retrieve the toy. Piaget suggested that young infants do not yet realize that the toy is an objective, permanent entity that continues to exist when hidden from view. My students and I showed that, contrary to Piaget's claim, even very young infants give evidence that they can represent hidden objects when tested with tasks that do not require them to plan and execute manual-search actions. For example, in a violation-of-expectation experiment with 4.5-month-olds, a screen lay flat in front of a tall box; next, the screen rotated through a

180-degree arc, in the manner of a drawbridge, until it lay flat in the space formerly occupied by the box. Infants detected a violation in this impossible event, suggesting that they represented the continued existence of the hidden box and expected the screen to stop against it. In another experiment with 3.5-month-olds, an experimenter's gloved hand lowered a block inside a container and then slid the container forward and to the side to reveal the block standing in the container's initial position. Infants again detected a violation in this event, suggesting that they represented the existence of the hidden block inside the container and expected the block to move with the container to its final position. In yet another experiment with 2.5-month-olds, a cover was lowered over a toy duck, slid to the side, and then lifted to reveal no duck. Infants again detected the violation in this event, suggesting that they represented the existence and invisible displacement of the hidden duck and hence expected it to be revealed when the cover was lifted. These and other results from my lab indicated that even very young infants are capable of representing and reasoning about hidden objects in sophisticated ways. As time went on, similar results were obtained by other labs in North America and Europe. Together, these converging results contributed to the demise of Piaget's theoretical claims concerning cognition in infancy, and they supported the emergence of new theories granting infants innate knowledge in core domains.

After it became clear that young infants can represent hidden objects, my students and I turned to other facets of infants' physical world. For many years now, we have been working on developing a precise model of how infants represent, interpret, and learn about various physical events including occlusion, containment, and support events. We are continually expanding and revising our model using various behavioral methods, and we hope to soon also begin using the tools of developmental neuroscience to test critical predictions from the model.

Psychological Reasoning

Let me now move on to our work on early psychological reasoning. At the time we began our research, it was widely assumed (following work by Perner, Gopnik, Wellman, and others) that children younger than about 4 years of age do not yet understand that agents can hold and act on false beliefs. False-belief understanding was generally viewed as a major milestone in the development of psychological reasoning or "theory of mind", attained only through important conceptual, linguistic, and executive-function advances. Most of the evidence for this conclusion came from tasks in which children are required to answer a direct question about the likely behavior of an agent who holds a false belief. In a classic task developed by Baron-Cohen, Leslie, and Frith (1985), children listen to a story enacted with props: Sally hides a marble in a basket and then leaves; in her absence, Anne moves the marble to a nearby box; Sally then returns, and children are asked the test question, "Where will Sally look for her marble?" Beginning at about age 4, children typically answer correctly and point to the basket (where Sally falsely believes the marble is); in contrast, most 3-year-olds point to the box (where the marble actually is), suggesting that they do not yet understand that Sally will hold a false belief about the marble's location. However, my students and I found that toddlers and even infants give evidence that they can represent an agent's false belief when tested with tasks that do not require them to answer a direct question about the agent's likely behavior. For example, in one violation-of-expectation experiment with 15-month-olds, an agent hid a toy in a green box; next, in her absence, the toy moved to a yellow box. When the agent returned, infants detected a violation if she searched for the toy in the yellow box, suggesting that they expected her to falsely believe the toy was still in the green box. In another experiment with 14.5-month-olds, an agent first

gave evidence that she preferred a doll with blue hair over a toy skunk. Next, in the agent's absence, the doll was hidden in a plain box and the skunk in a box with a tuft of blue hair attached to its lid. When the agent returned, infants detected a violation if the agent searched for the doll in the plain box, suggesting that they expected her to falsely believe that the tuft of hair belonged to the doll and hence to falsely conclude that the doll was hidden in that box. Similar results have now been obtained in labs across North America and Europe, as well as in remote field sites around the world, providing evidence that false-belief understanding emerges early, and universally, in human development.

Biological Reasoning

Let me now move on to our work on infants' biological reasoning. At the time we began our research, it was widely assumed (following work by Carey, Hatano, and others) that children under about 3 years of age do not yet possess biological expectations about animals. According to this view, toddlers and infants think of animals simply as animate entities, with a physical capacity for self-propulsion and a psychological capacity for agency. My collaborators and I decided to investigate whether infants might in fact possess additional, biological expectations about animals. In our first project, we asked whether 8-month-olds would expect novel entities they identify as animals to have filled insides. Infants first saw a tall can give evidence that it was self-propelled: it moved back and forth across the apparatus floor on its own. Next, the can gave evidence that it was agentive: it held a lengthy "conversation" with an experimenter, using varying quacking sounds. Finally, the experimenter lifted the can and rotated it to show that it was entirely hollow, like an inverted bowl. Infants detected a violation in this event, suggesting that they identified the can as an animal and expected it to have filled insides. Interestingly, infants held this expectation only when the can was both self-propelled and agentive: they held no expectation about the can's insides when it was only self-propelled or only agentive. Together, these results raise fascinating questions about infants' expectations about the function of animals' insides, which we are now pursuing with glee in increasingly gory experiments!

Sociomoral Reasoning

Finally, let me describe some of our work on early sociomoral reasoning. This topic has been the focus of intense research in many infancy labs over the past few years, and it is yielding striking findings about the core principles that underlie human intuitive sociomoral cognition. Our first project focused on the principle of fairness. At the time we began this research, it was widely assumed (following work by Turiel, Killen, and others) that moral principles such as fairness do not emerge until about the preschool years. My collaborators and I decided to investigate whether infants might demonstrate an expectation of fairness when tested with a very simple third-party situation. In one violation-of-expectation experiment, 19-month-olds were first introduced to two animated puppet giraffes. Next, an experimenter brought in and distributed two toys. Infants detected a violation when the experimenter gave both toys to the same giraffe, suggesting that they expected her to divide the toys equally between the two giraffes. In our next experiment with 21-month-olds, we asked whether infants' concept of fairness reflects a simple concept of equality, where all individuals are expected to be treated equally, or whether it reflects a more sophisticated concept of equity, where individuals are expected to be treated as they deserve. An experimenter first instructed two assistants to put toys away into transparent bins. In her absence, one assistant put away all the toys while the other assistant continued to play. When the experimenter returned, she gave a reward to each assistant, even though she could see that one had done no work at all. Infants detected a

violation in this event, suggesting that they realized that rewards should be given only to those who have worked to deserve them. We are now testing 9-month-olds with similar events, with promising results, suggesting that infants in the first year of life already possess a sophisticated, equity-based concept of fairness.

Conclusion

The various findings I have described paint a very consistent picture: in each of these fundamental domains of causal reasoning, infants are born with a skeletal explanatory framework that enables them to represent, reason, and learn about events. By studying infants, we can thus not only understand the developmental origins of our adult cognitive abilities, but also shed light on the basic cognitive structure of the human mind.

In closing, please allow me to reiterate how deeply honored I am that the Scientific Committee and Board of Directors of the Fyssen Foundation have chosen to award me the 2013 Fyssen Foundation International Prize.

With gratitude and best wishes,

Renée Baillargeon