



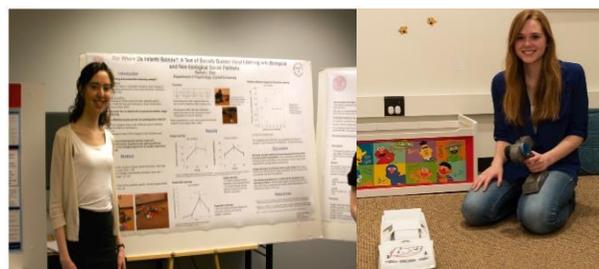
Babbles and Birdsongs

Newsletter

What matters for infant vocal learning? Using social robots to explore social mechanisms

Starting early in development, infants are immersed in an environment in which parents and other caregivers provide social stimulation and feedback, which support later language and cognitive development^{1,2}. In studying how this feedback directly supports learning, researchers have shown that when caregivers respond contingently (in a structured, prompt timeframe) to infants' behaviors, infants quickly learn to modify their behaviors in response, such as by changing the quality, structure, or frequency of their vocalizations^{3,4,5}. This learning in turn relates to later language⁵, suggesting that factors aiding vocal learning (i.e., contingent responsiveness) might be important for later outcomes.

Why do infants learn from caregivers' contingent responses? One idea is that contingent feedback alone is enough to support vocal learning for younger infants, while an alternative is that the identity of the social partner (e.g., whether the infant knows the partner, or whether the partner is human) also matters necessarily for learning. To explore these possibilities, honors thesis student Rachel Elkin conducted a thesis in 2011 under the guidance of Drs. Michael Goldstein and Jennifer Schwade, in which 7-month-old infants interacted with either a novel human social partner, or a robot social partner (a remote-controlled toy car). During the interaction, the human or car responded contingently, first by silently leaning or driving forward, then by expressing adult-like vowel sounds in response to infants' vocalizations. To assess whether infants were learning from the social partners' responses, Elkin next had the human or car engage in a short "still face" period, in which they stopped responding to the infant. Based on prior work with caregivers, Elkin predicted that if infants had learned to associate their vocalizations with social feedback, then they would increase their vocalizations in response to the lack of feedback in the still face. Elkin also predicted that infants would show improvements in the sound quality and complexity of their vocalizations, based on the contingent responses they had received.



Left: Class of '11 undergraduate Rachel Elkin, presenting her honors thesis at the Cornell Psychology Department's 2011 annual poster session. **Right:** class of '15 undergraduate Claire Foster practices driving the remote-controlled car used for this project.

What Elkin actually found was intriguing. First, infants who interacted with the car showed a greater increase in vocalizations during the still face, and their total rate of vocalizations increased following the still face. Additionally, infants interacting with the car showed an increase in vocal complexity during the still face, producing more consonant-vowel vocalizations. In contrast, infants who played with human strangers did not show increases in vocal quality or complexity. However, these infants' vocalizations did decrease in the 2 minutes following the still face (suggesting some recognition of the change in responsiveness), and their total vocalization rate increased following the still face. These findings suggested that while some elements of vocal learning were observable in both conditions, vocal quality increased more for infants interacting with the car.

Why might infants have learned better from the car than the human? Because infants have a history of interacting with humans generally, one possibility is that the human partner's responses carried a weaker "signal-to-noise" ratio. That is, human social partners don't always have the opportunity to respond to infants' vocalizations in everyday settings, and some of the actions adults perform are not related to their infants' actions (e.g., talking on the phone). Thus, infants' history with humans might have promoted infants to attend less vigilantly to the novel human's responses. Along the same lines, infants' lack of social experience with the car (and the car's overall novelty) may have aided short-term learning. But, it is unclear what the effects would be if infants were to build up a history of interaction with the car like they have with humans. Nonetheless, these pilot results suggest that contingent responsiveness may be both necessary and sufficient for early vocal learning.

Since 2011, we have continued recruiting participants for this study, and are currently seeking 7-8 month-old infants to come visit us. If you would like more information, please see our contact information below. We look forward to seeing you!

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Current Studies

This fall, we are excited to have a number of continuing studies as well as a few new projects exploring infant attention, word learning and social development. Here are some of the projects we are currently working on:

- **Attention Shift:** This study explores how infants 6-7 months old use social cues to guide their attention and learning. On Day 1, you and your baby will play in the lab playroom for ten minutes just like you would at home, and on Day 2, your baby will play for 10 minutes with a new experimenter who varies the timing of her interactive behavior. We will then show your baby some videos of objects and animals, and see how he or she attends to the videos after the social interaction.
- **Babbling with People and Robots:** In this study, we are interested in exploring which features of social interactions facilitate learning in infants 7-8 months of age. Specifically, we would like to see if your infant changes the way he or she vocalizes while interacting with either an unfamiliar adult or a toy remote control car that can make sounds. On Day 1, you and your baby will play together and explore our lab playroom for 30 minutes. On Day 2, your baby will play with a new adult or the car for 35 minutes, during which time the new partner will respond to certain behaviors of your child in different ways. During these play periods, we will be recording your baby's vocalizations to determine how your baby changes his or her vocalizations in response to the new partner's feedback.
- **Interaction and Reward:** We are currently recruiting families with infants who are 9 or 10 months old for a one-visit study that seeks to determine whether the reward that infants experience in different types of interactions impacts how well they learn. For this study, after a brief warm-up play period, infants will interact with two social partners who will play with your baby with different styles in two visually distinctive rooms. We will be observing whether your infant's preference for one of these rooms predicts how well they can then learn from a social partner in either room.
- **Learning from Video:** This one-session study seeks to assess whether videos can be modified to facilitate learning in infants and toddlers. During the study, your 18-20month-old infant will watch videos teaching him or her how to put together three separate toys. The format of the video instruction will vary depending on the condition your infant is assigned to. We will then examine how your infant puts the toys together based on what was presented in the video.
- **Child Learning in Social Settings:** In addition to our infant studies, we are also currently recruiting 3-year-old children and their families to assist us in a one-visit study exploring how children learn through interactions with their caregivers. In this study, you and your child will complete a series of puzzles and story-telling tasks together, and you will fill out questionnaires regarding you and your child's everyday social interactions. Through this, we hope to assess how children's general social experience influences the structure of their social interactions during learning tasks.



Third-year graduate student Melissa Elston displays one of our Cornell BABY Lab t-shirts (one of the many prizes that our infant scientists can choose from!)

To learn more or sign up for any of these studies, please give us a call at 607-254-2229, or email us at babylab@cornell.edu. You can also sign up via our website at <http://babylab.cornell.edu/parents/parent-contact-form/>. We would love for you to come visit us!

Summer 2015 Conference Highlights

This spring and summer, B.A.B.Y. lab members participated in two diverse conferences showcasing the latest advancements in developmental research. The first was the *Society for Research in Child Development* 2015 Biennial meeting in Philadelphia, featuring over 4,000 program presentations from researchers studying various aspects of infant and child development. During this conference, graduate students Gina Mason and Melissa Elston co-chaired a symposium highlighting how research on infant sensorimotor development and dyadic coordination might inform the development of later communicative skills, both for typically-developing children and for children at risk for autism. The symposium was titled: *The role of social and sensorimotor coordination in communicative development of typical and at-risk infants*, and featured talks from Dr. Kaya de Barbaro (UCSD; currently at Georgia Tech), Prof. Linda Smith (Indiana University), Jessie Northrup (UPitt), and Dr. Gordon Ramsay (Emory University; Marcus Autism Center). The symposium was well-attended overall, providing an opportunity for researchers across basic and applied disciplines to interact and discuss how their findings inform one another's research.

This summer, we also attended the fifth joint IEEE International Conference on Development and Learning and on Epigenetic Robotics (ICDL-EPIROB 2015), held at Brown University. This conference fosters crosstalk between researchers from various disciplines (e.g. Developmental Psychology, Robotics, Computer Science/AI, Neuroscience) who are interested in the processes underlying sensorimotor, cognitive and social development. As part of the first day's events, Profs. Michael Goldstein and Chen Yu (Indiana University) coordinated a half-day workshop entitled, "Mechanisms of Learning in Social Contexts", which included speakers and poster presentations highlighting cutting-edge research in infant/nonhuman early social learning and socially-mediated perceptual organization. Graduate students Gina Mason, Melissa Elston, Samantha Carouso and Katerina Faust each presented posters at this event, discussing their latest research findings. Thank you to the families (both human and avian) who make our work possible!



Young zebra finches need a little help from mom and dad to learn to sing

Contributed by Katerina Faust and Samantha Carouso

Just as human babies babble before they learn to speak, young songbirds produce 'subsung' before they learn to sing their adult song. Thus, our lab also studies the vocal learning process in the zebra finch, a small bird from central Australia. Just like humans have a difficult time learning new languages later in life, zebra finches have the easiest time learning song during a 'sensitive period' early in their development. Also like human infants, whose language learning is reinforced by caregivers' reactions to more advanced vocalizations, zebra finch song learning is helped along by their parents' responses to their gradually improving song.

In the zebra finch, only the males sing, in order to attract a female mate. Young males try to learn to sing the same song as their father, but their mother can help with the learning process even though she does not sing herself. Since the mother's preferred song is that of her mate, this is the song she finds most arousing,

and she will respond to arousing song elements with a small movement of her wing, called a 'wing stroke'. Males notice wing strokes, and are highly motivated to elicit more from females around them. When young zebra finch song learners cause a female to display a wing stroke, this serves as a reinforcement signal, and encourages the young male to produce more song elements like that in the future. This reciprocal feedback gradually shapes a male zebra finch's song into one which females find the most attractive. Our lab studies socially guided learning in the zebra finch by watching natural interactions between parents and young learners, to find relationships between the amount of feedback a young male receives and how well he ultimately learns his song. We also manipulate the amount of feedback a young learner receives, either by using an artificial female (a video of a female controlled by an experimenter) or by reducing a learner's interest in social cues using hormones. Young birds who are the most socially motivated to pay attention to their parents, or who have parents that are more attentive and responsive to their developing songs, end up with the best-learned songs.

Social learning is also potentially influenced by individual characteristics, which can shape both individual behavior and dyadic interactions. Another current project in the lab is to study whether stable individual differences in behavior (animal personality) lead to differences in parental behavior, such as response to juvenile song, which could result in different song learning outcomes. As a first step for this project, zebra finches were assessed on personality traits such as aggression, preference to associate with familiar or unfamiliar birds, and degree of exploration in a novel environment. It turns out that there are clear individual differences between the birds, and these characteristics could also lead to changes in behaviors in social contexts. For example, perhaps some mothers are more likely to give wingstrokes in response to their son's immature song, or wingstrokes from certain mothers might carry more weight, and thus have a greater influence on shaping juvenile song. In this manner, personality could potentially influence the communicative development of juvenile zebra finches.



Alumni Spotlight: Senior Class of 2015

We would like to extend our warmest congratulations to our class of '15 graduates: Claire Foster, Tabitha Kim, Julia Ridley, and Sylvia Rusnak! Last year, each of our senior students completed thesis projects with us, investigating various aspects of social and communicative development in human infants and songbirds. On the baby side, Claire and Sylvia explored social learning in toddler-age children, examining how differences in social interactions with new social partners might impact word learning (Claire) and learning from video (Sylvia). Sylvia is currently continuing her research in developmental psychology with Dr. Rachel Barr at Georgetown University, where she is pursuing a graduate degree. Claire is now a research fellow in Developmental and Computational Social Neuroscience at the Yale Child Study Center, and she also plans to continue on to a graduate program, one that combines her clinical and developmental research interests.

On the bird side, thesis student Julia Ridley investigated whether female zebra finches' preferences for young males' developing songs are influenced by how well the male learns his song from his tutor (as measured by song similarity), while Tabitha Kim explored how a hormone known as *arginine vasotocin* (similar to oxytocin) affects song learning in young male zebra finches, by experimentally manipulating the levels of this hormone in very young birds. For her thesis, Tabitha was awarded the T.A. Ryan award, a prize honoring the best student thesis within the Department of Psychology in a given year. Both Julia and Tabitha plan to continue on to graduate programs in Psychology/Neuroscience this coming year; currently, Julia is gaining additional research experience in a laboratory affiliated with the University of Pittsburgh Medical Center, and Tabitha is working as a research assistant in Rachel Smith's laboratory at Texas A&M. As we recognize our '15 seniors, we celebrate their achievements and wish them the very best for future years!



From left to right: Tabitha Kim, Julia Ridley, Prof. Michael Goldstein, Sylvia Rusnak and Claire Foster celebrate completion of the students' undergraduate degrees and honors theses as part of the Cornell Psychology department's graduation day ceremonies.

Meet your Researchers!

Michael H. Goldstein, Ph.D.

Michael Goldstein is the director of the lab. He is Associate Professor in the Psychology Department at Cornell University. He received his B.A. from University of Colorado – Denver in 1993 and his Ph.D. in developmental psychology and animal behavior from Indiana University in 2001. Dr. Goldstein has received the David Kucharski Young Investigator Award from the International Society for Developmental Psychobiology and the Distinguished Early Career Contribution Award from the International Society on Infant Studies. His research is currently supported by the Eunice Kennedy Shriver National Institute for Child Health and Human Development and the National Science Foundation. Dr. Goldstein studies the development and evolution of vocal learning via comparative work in human infants and songbirds. In general, he is interested in all kinds of socially guided learning. Thus he focuses on the developmental processes by which knowledge is acquired from the social environment. His publications have appeared in top-tier journals such as Proceedings of the National Academy of Sciences and Psychological Science, and he is on the editorial boards of Developmental Psychobiology and Parenting: Science and Practice. He has three cats, and enjoys nature photography and mountain climbing.



Jennifer A. Schwade, Ph.D.

Jennifer Schwade received her Ph.D in Child Psychology from the Institute of Child Development at the University of Minnesota in 1999. She then did post-doctoral training in Linda Smith's cognitive development laboratory at Indiana University. She was a visiting professor and research associate at Franklin and Marshall College from 2001 – 2004. Jennifer is now a Research Associate in the Department of Psychology at Cornell University and co-director of the Eleanor J. Gibson (BABY) Lab. She enjoys cooking and gardening at the farmhouse she shares with her husband and three cats.



Gina M. Mason

Hi families! I am a fifth year graduate student in Perception, Cognition and Development, and my current work is focused on how social interactions influence early attention development in human infants. As an undergraduate, I worked with children and adults with Down syndrome at the University of Arizona, exploring medical, environmental and genetic factors relating to differences in cognition and attention. For my dissertation, I am hoping to translate my current work on social interactions and attention in typical development to inform research and intervention for children with neurodevelopmental conditions such as autism and ADHD. When I'm not working with infants and families in the lab, I enjoy making music, dancing, good books, campfires, summer, exploring the outdoors via land and water, and connecting with friends and the community through local events and volunteering.



Samantha V. Carouso

I am a fourth year graduate student in Behavioral and Evolutionary Neuroscience, studying various mechanisms of socially guided learning in zebra finches. As the daughter of a diplomat, I grew up all over the world, and while living in the Caribbean, South Africa, Australia, and Thailand I was fascinated by the local bird life from a young age. This led me to study Biology as an undergraduate, focusing on animal behavior and communication. Before coming to Cornell, I spent several years studying vocal learning in African grey parrots at Brandeis, and worked in a Harvard neuroscience lab studying the visual object recognition system. I am fascinated by how animals interpret the world around them, how they communicate, and how they learn to do so. The mechanisms by which baby songbirds and baby humans learn to vocalize are strikingly similar, and I hope our lab's research will lead to a mechanistic understanding of vocal learning across species. When I'm not working with birds, I love reading, creative writing, baking, building things, rescuing animals, and contra dancing.



Meet your Researchers! (Cont.)

Melissa Elston

Hi! I am a third year graduate student studying Perception, Cognition, and Development, but mostly I focus on development in babies! During my undergraduate years, I worked with Dr. Chen Yu studying how parent-child interactions influence language learning, as well as how infants learn by picking up on the statistical information of the language they are surrounded by every day. This work prepared me for my time in the B.A.B.Y. Lab, where I now study the reward that infants experience during sensitive interactions as well as how parental sensitivity and contingency impact how infants learn from a social partner. In my spare time, though, I enjoy writing fiction, ice skating, and just about any type of creative craft project that you can imagine!



Katerina Faust

I am a second year graduate student in the Behavioral and Evolutionary Neuroscience area. I'm interested in studying animal personality and small group dynamics, in the contexts of development and social learning. Currently, I'm studying ways to analyze zebra finch personality, and how certain personality traits might influence interactions with their offspring, potentially altering song learning outcomes. As an undergraduate at Colby College, I majored in Biology with a concentration in Neuroscience. I investigated the factors influencing the response of other species of wild birds to playbacks of black-capped chickadee mobbing calls. I've also worked as a research assistant with Project Puffin, studying seabirds such as puffins and endangered terns in the Gulf of Maine. In my free time, I love to read, write stories, kayak, mountain bike, visit the waterfalls around Ithaca, and wander the trails at the Lab of Ornithology.



Clara Freeman

I am a senior majoring in Psychology with minors in History and Spanish. I joined the lab in the summer of 2014, and this year I will be working on my honors thesis. My study aims to understand how parenting styles work by looking at specific parental behaviors.

I hope to continue with research after graduation, and eventually make my way to a PhD program in clinical psychology. Outside of the lab I enjoy hiking, yoga, cooking, and travel, among other fun things.



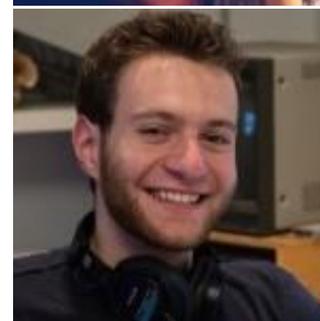
Anna Fasman

I am a senior in the College of Arts and Sciences. I started working in the B.A.B.Y. Lab at the beginning of my sophomore year and have loved every second of it! I am currently working on my honors thesis exploring how infants learn from video and what aspects of video help facilitate learning in infants under two years. Outside of lab, I am involved in the Greek community on campus. I am also the sports editor at the Cornell Daily Sun, Cornell's daily newspaper. I hope to eventually go to graduate school for clinical psychology.



Ian Prager

I am senior undergraduate majoring in Psychology. I have been in the BABY Lab since 2013, and am currently working on an honors thesis to investigate the behavioral mechanisms that produced learning differences in a hormonal manipulation from a previous study involving zebra finches. In my (increasingly scant) free time, I enjoy learning foreign languages, finding out-of-the-way places, and kitten caretaking.



Summer Fun! B.A.B.Y. Outreach at the Ithaca Arts Festival

Each year since 1977, the city of Ithaca has held an annual 4-day summer festival showcasing music, arts, and creativity in the Ithaca community. This year's *Ithaca Festival of the Arts* took place from May 28th-31st, 2015 under the theme "Better Together," to highlight the diversity of cultures and perspectives that come together in the Ithaca community through creative expression and shared celebration. As part of this year's events, members of the B.A.B.Y. lab hosted a set of activities for toddlers, children and parents that allowed families to learn more about the themes of the lab while also fostering creativity and participation among the youngest festival attendees.

For toddler-aged children, graduate students Gina Mason and Melissa Elston held a "playscapes" exploration activity, in which toddlers and children could play in two different areas with diverse sets of toys and materials. One area held "nondeformable" objects, such as blocks and toys with a pre-set form (cars, hammers, plastic balls) that could not be re-shaped. The other area held "deformable" materials, including child clay and wet sand. Parents were encouraged to allow their children to explore the two play areas, to discover the diverse creative affordances offered in each distinct play environment. Other lab members helped to supervise and discuss with parents the ways in which our research explores how early environments can shape learning and development in infants and children.

To showcase the bird side of our work, graduate student Katerina Faust hosted a nest-building activity for older children, designed to interactively showcase one of the many ways in which avian parents care for their young. Alongside this activity, she and graduate student Samantha Carouso joined together to discuss with parents the comparative similarities between avian and human parental care, describing how research in both species can inform us about the processes underlying early social learning and communicative development.

This year's festival was the first in which the B.A.B.Y. lab hosted a set of activities, and we were thrilled to meet and interact with many families and children in the Ithaca community. We look forward to participating again next year!



Left: students Melissa Elston, Reade Otto-Moudry, Gina Mason and Katerina Faust get ready for the first day of the Ithaca Festival! Middle: a) supplies for making birds' nests, and b) a finished demonstration bird nest constructed by Katerina Faust. Right: children's creations in the deformable play area.

TinyEyes: how infants see the world

Contributed by Katerina Faust

Have you ever wondered what your baby sees? At birth, infant vision is very poor. In the first couple months, as they struggle to gain control over the muscles that allow them to focus their eyes, and as the brain areas responsible for vision mature, they can't clearly see much further than 8-10 inches away. Conveniently, that's about the distance to their parent's face as they are being held, which provides an easy way to become familiar with the sights, sounds, scents, and warmth of their caregiver. Besides lacking visual acuity (the "sharpness" of an image), infants also have difficulty perceiving contrast, and their color vision takes time to fully develop. At around two months they start to be able to perceive some color differences. In the next few months, infants can better coordinate the movements of both eyes, resulting in improvements in depth perception. By the time a baby is 6 months old, he or she has visual acuity that is closer to that of an adult, and improved color vision. However, adult levels of visual acuity are not reached until babies are at least a year old.

Now that we've covered the vision capabilities of young humans, how do they compare to those of young birds? Young zebra finches are altricial, meaning that they are born with immature sensory systems and require parental care. When they first hatch, their eyes are sealed shut, and won't begin to open for 6-7 days. As adults, however, they can see even more wavelengths of light than we can, because they can perceive ultraviolet (UV) light, which they make use of while foraging and choosing their mates⁶.

In both birds and babies, we see examples of slowly developing sensory systems. There are many benefits to this altricial form of development, one of them being that the visual system can "inherit" information from other sensory systems. Despite having poor vision, young of both species can potentially learn the auditory and tactile cues of their parents fairly early on. Once their vision develops, they can then match the sight of their parent with the familiar sounds and warmth, a form of associative learning.

For further information on infant visual capabilities and development, you can visit the website of Dr. T. Rowan Candy, head of the Visual Development Lab at Indiana University (<http://www.opt.indiana.edu/people/faculty/candy/index.html>), and Tinyeyes, a website created by Drs. Alex Wade and Robert Dougherty that allows you to visualize what an infant would see at various stages of development (<http://tinyeyes.com/index.php>). (Example below: newborn, 3 months, 6 month, adulthood, for an image 2 feet away)



Contact Us

Do you have any questions, comments or thoughts that you would like to share with us? We would love to hear from you! If you have a question about the lab or our research, please use the contact form on our website at <http://babylab.cornell.edu/sample-page/>. Alternatively, you can:

Call: (607) 254-BABY (2229)

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For questions about the newsletter or suggestions about future editions, please feel free to contact Gina Mason (gmm89@cornell.edu) or Katerina Faust (kmf224@cornell.edu). We're always looking for ways to improve our newsletter, so we would love any suggestions or feedback!



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