RESEARCH OPPORTUNITY PROGRAM
299Y/399Y PROJECT DESCRIPTIONS 2019-2020
FALL/WINTER

Name and Title: Dr. Daphna Buchsbaum
Department: Psychology

TITLE OF RESEARCH PROJECT: Computational Models of Cognitive Development

Number of 299Y Spots: 1 Number of 399Y Spots: 1

OBJECTIVES AND METHODOLOGY:
In recent years, probabilistic computational models using Bayesian analysis have been successfully applied to a wide range of inference and reasoning problems faced by young children, including word and category learning, cause and effect learning, trust in social informants, and making mentalistic inferences about other’s goals, intentions and beliefs. Probabilistic computational models using Bayesian inference are a natural way to approach understanding how prior biases and different sources of evidence contribute to children’s behavior. The general methodology of this approach is to look at cognition in terms of abstract computational problems, identify the optimal solution to those problems, and compare that solution to human behavior. In particular, the first step involves considering the assumptions and capacities of learners. Bayesian models work by using Bayes’ rule as a normative model of how an idealized learner with some pre-existing expectations or biases about how the world works, can update their beliefs, in light of new data.

DESCRIPTION OF STUDENT PARTICIPATION:
This project is for dedicated and motivated students interested in gaining research skills and experience to help prepare both for future research projects (e.g., thesis) and for graduate school. Students will work closely with the faculty supervisor and lab manager, as well as other lab members and will be involved in all aspects of the research process. Students will be expected to attend and participate in regular (weekly or bi-weekly) lab meetings and to spend approximately 10 hours a week working in the lab.

1) Participating in lab meetings, including discussion of current research issues and projects in the lab, discussion of the theoretical motivations of the models and empirical studies students are working on, and discussion of the findings of other empirical and theoretical papers
2) Assisting with a variety of necessary research tasks in the lab, particularly developing computer-based experiments using Amazon Mechanical Turk and survey software such as Qualtrics, Inquisit, or PsyTurk. This may also involve creating custom web experiments using Javascript and HTML, interacting with SQL databases to retrieve and store data, and writing scripts to preprocess data.
3) Assisting with the development of computational models of cognition. This will include programming (generally in MATLAB, R or Python).
MARKING SCHEME (assignments with weight and due date):

Evaluation of participation in lab work over term. This includes attendance and contribution to lab meetings, and conducting research in an efficient, effective, and professional manner including consistent attendance and timely completion of programming and experiment design when required. December 2, 2019 and April 1, 2020 40% of total mark.

Lab Journal. Students are expected to keep a research journal/work log to record lab activities every week including lab hours, tasks and progress, research ideas, and comments on discussions and assigned articles. In particular, this also includes documentation of experiment and model development, and clearly commented and well-documented code. Journal and interim research report (contained within journal) due November 8, 2019, and whole journal submitted again on April 1, 2020 for grading: 20% of total mark.

Final Project Report. Students will prepare a scientific poster for presentation at the annual Faculty of Arts and Science Undergraduate Research Forum in March OR write a final paper (approximately 6-8 pages) in the form of a scientific article (mid-March, after Research Forum): 20% of total mark.

Lab meeting presentations. Students are expected to give a short (approximately 15 minute) presentation to the lab each term. 20% of total mark.
Name and Title: Dr. Daphna Buchsbaum  
Department: Psychology

TITLE OF RESEARCH PROJECT: How Do Social Context and Physical Knowledge Influence Causal Learning In Dogs?

Number of 299Y Spots: 1  
Number of 399Y Spots: 1

OBJECTIVES AND METHODOLOGY:  
All animals live in a causally complex world, where they must learn not only to predict the consequences of events, but also to act causally on the world themselves. How do animals learn these kinds of causal relationships, especially when the world presents them with sparse, ambiguous data or with multiple, conflicting sources of evidence? This ongoing research project builds on previous research with children and monkeys to investigate the causal reasoning abilities of pet dogs. Dogs provide an interesting comparison, because they may have better social cognition skills than monkeys, but poorer understanding of the physical world. To address this, we present pet dogs with a series of puzzle-boxes that dispense treats. Having observed a human demonstrator acting on the puzzle-boxes, dogs have an opportunity to interact with the boxes themselves. The actions that they copy can tell us something about their understanding of cause and effect, and how different social and physical cues influence this. Testing takes place in our lab at U of T and several offsite locations (e.g. dog training facilities).

DESCRIPTION OF STUDENT PARTICIPATION:  
This project is for dedicated and motivated students interested in gaining research skills and experience to help prepare both for future research projects (e.g., thesis) and for graduate school. Students will work closely with the faculty supervisor and lab manager, as well as other lab members and will be involved in all aspects of the research process. Students will be expected to attend and participate in regular (weekly or bi-weekly) lab meetings and to spend approximately 10 hours a week working in the lab (or on lab-related tasks). This should include regular availability on at least 1 weekend day every week. Due to the nature of scheduling participants some flexibility is required. Students will participate in the research project in some of the following ways:
1) Participating in lab meetings, including discussion of current research issues and projects in the lab, discussion of the theoretical motivations of the studies students are working on, and discussion of the findings of other empirical papers
2) Assisting with experimental data collection, working and handling with pet dogs
3) Assisting with a variety of necessary research tasks in the lab such as coding video data, stimuli creation, data entry, recruiting and scheduling participants
4) Assisting with data analysis and preparing data for publication
5) Students with a programming background may be given the option of assisting with the development of computational models of cognition and of computer-based experiments

**MARKING SCHEME** (assignments with weight and due date):

**Evaluation of participation in lab work over term.** This includes attendance and contribution to lab meetings, and conducting research in an efficient, effective, and professional manner including consistent attendance and timely completion of programming and experiment design when required. December 2, 2019 and April 1, 2020 40% of total mark.

**Lab Journal.** Students are expected to keep a research journal/work log to record lab activities every week including lab hours, tasks and progress, research ideas, and comments on discussions and assigned articles. In particular, this also includes documentation of experiment and model development, and clearly commented and well-documented code. Journal and interim research report (contained within journal) due November 8, 2019, and whole journal submitted again on April 1, 2020 for grading: 20% of total mark.

**Final Project Report.** Students will prepare a scientific poster for presentation at the annual Faculty of Arts and Science Undergraduate Research Forum in March OR write a final paper (approximately 6-8 pages) in the form of a scientific article (mid-March, after Research Forum): 20% of total mark.

**Lab meeting presentations.** Students are expected to give a short (approximately 15 minute) presentation to the lab each term. 20% of total mark.
RESEARCH OPPORTUNITY PROGRAM
299Y/399Y PROJECT DESCRIPTIONS 2019-2020
FALL/WINTER

Name and Title:  Dr. Daphna Buchsbaum
Department:  Psychology

TITLE OF RESEARCH PROJECT:  Are Children Sensitive to Information Received from Others in a Social Learning Task?

Number of 299Y Spots:  1       Number of 399Y Spots:  1

OBJECTIVES AND METHODOLOGY:
Learning from others is a rich source of information for children, but children must also have strategies to assess the quality of the information they receive. Children are often faced with complex social learning problems, where they receive information from multiple people, who may themselves have shared information, and who may provide information that conflicts with each other, or with the child's own perceptions. In this study, we examine how children learn from groups of people who may differ in the source and quality of their knowledge. This is an important question not only for understanding the mechanisms underlying children’s social learning abilities, but also for understanding how and when ideas and behaviours spread through populations, leading to cultural change.

DESCRIPTION OF STUDENT PARTICIPATION:
This project is for dedicated and motivated students interested in gaining research skills and experience to help prepare both for future research projects (e.g., thesis) and for graduate school. Students will work closely with the faculty supervisor and lab manager, as well as other lab members and will be involved in all aspects of the research process. Students will be expected to attend and participate in regular (weekly or bi-weekly) lab meetings and to spend approximately 10 hours a week working in the lab (or on lab-related tasks). This should include regular availability on at least 1 weekend day per week. Due to the nature of scheduling participants some flexibility is required. Students will participate in the research project in some of the following ways:
1) Participating in lab meetings, including discussion of current research issues and projects in the lab, discussion of the theoretical motivations of the studies students are working on, and discussion of the findings of other empirical papers
2) Assisting with experimental data collection, working with young children
3) Assisting with a variety of necessary research tasks in the lab such as stimuli creation (including both physical toys and story books and computer programs and displays), data entry and coding, recruiting and scheduling participants
4) Assisting with data analysis and preparing data for publication
5) Students with a programming background may be given the option of assisting with the development of computational models of cognition and of computer-based experiments

MARKING SCHEME (assignments with weight and due date):
**Evaluation of participation in lab work over term.** This includes attendance and contribution to lab meetings, and conducting research in an efficient, effective, and professional manner including consistent attendance and timely completion of programming and experiment design when required. December 2, 2019 and April 1, 2020 40% of total mark.

**Lab Journal.** Students are expected to keep a research journal/work log to record lab activities every week including lab hours, tasks and progress, research ideas, and comments on discussions and assigned articles. In particular, this also includes documentation of experiment and model development, and clearly commented and well-documented code. Journal and interim research report (contained within journal) due November 8, 2019, and whole journal submitted again on April 1, 2020 for grading: 20% of total mark.

**Final Project Report.** Students will prepare a scientific poster for presentation at the annual Faculty of Arts and Science Undergraduate Research Forum in March OR write a final paper (approximately 6-8 pages) in the form of a scientific article (mid-March, after Research Forum): 20% of total mark.

**Lab meeting presentations.** Students are expected to give a short (approximately 15 minute) presentation to the lab each term. 20% of total mark.
RESEARCH OPPORTUNITY PROGRAM
299Y/399Y PROJECT DESCRIPTIONS 2019-2020
FALL/WINTER

Name and Title: Dr. Michael Mack (Assistant Professor)
Department: Psychology

TITLE OF RESEARCH PROJECT: The Mutual Interaction of Attention and Memory in Category Learning

Number of 299Y Spots: 1 Number of 399Y Spots: 1

OBJECTIVES AND METHODOLOGY:
How do we learn effectively such that knowledge is not only retained for the long term, but can also be flexibly adapted when learning goals change? Answering this question requires understanding a number of core cognitive processes: attending to key information, evaluating sampled information in light of prior knowledge stored in memory, and updating knowledge with new information. By integrating the neuroscience of memory and attention with formal psychological learning models, our lab is investigating both how attention is guided by prior knowledge in new learning and how new conceptual knowledge is formed through the interaction of attention and memory. Experimental studies in the Mack Lab target both of these questions by asking how the neural machinery of attention is tuned during successful learning and how memory structures in the brain are influenced by dynamic learning goals in forming new knowledge. Our lab utilizes a combination of behavioural, eye-tracking, and neuroimaging paradigms, as well as mathematical modeling.

DESCRIPTION OF STUDENT PARTICIPATION:
The Mack Lab is looking for motivated students who are interested in gaining research skills in computational cognitive neuroscience. Programming experience and computational skills are preferred but not mandatory. Depending on prior experience, students may be involved in a variety of tasks:
1. Developing stimuli for experiments
2. Assisting with preparing experimental scripts for online experiments
3. Assisting with data collection for behavioural, eye-tracking, and neuroimaging experiments
4. Assisting with analyzing behavioural, eye-tracking, and neuroimaging data
5. Writing research reports
6. Attending and participating in regular lab meetings

Students are expected to spend approximately 10 hours per week in lab working on research tasks. Students will gain experience with experimental and statistical software, such as Matlab, Python, R, Inquisit, and learn how to run behavioural and eye-tracking experiments.

MARKING SCHEME (assignments with weight and due date):
Final marks will depend on four factors:
1. **In-lab participation and work**: Students’ overall research performance will be evaluated according to attendance and participation in lab meetings, efficient and timely completion of assigned research tasks, and professional conduct. December 1, 2019 and April 1, 2020; 40% of total mark.

2. **Lab journal**: Students are expected to keep a weekly log of their research in a lab notebook hosted on the lab's Basecamp account. The notebook should document all experimental design and analysis decisions, as well as updates on data collection. The lab journal, with an interim progress report included in the journal, should be turned in on December 1, 2019. The journal should be submitted again on April 1, 2020; 20% of total mark.

3. **Final project report**: Students will prepare a scientific poster for presentation at the annual Faculty of Arts and Science Undergraduate Research Forum in Spring 2020 OR write a final paper (approximately 6-8 pages) in the form of a scientific article. Either option is due April 1, 2020. 20% of total mark.

4. **Lab meeting presentations**: Students are expected to give a short (approximately 15 minute) presentation during lab meeting by April 1, 2020. 20% of total mark.
RESEARCH OPPORTUNITY PROGRAM  
299Y/399Y PROJECT DESCRIPTIONS 2019-2020  
FALL/WINTER

Name and Title:  Jessica Sommerville, Professor  
Department:  Psychology  

TITLE OF RESEARCH PROJECT:  The Developmental Origins of Altruism

Number of 299Y Spots:  1  
Number of 399Y Spots:  1

OBJECTIVES AND METHODOLOGY:
The ability to engage in altruism – acting to promote someone else’s welfare, even at a risk or cost to the self – may be a uniquely human ability. Philosophers, psychologists and scholars alike have long debated when (and whether) altruism arises in the course of development. In order to act altruistically, young children must not only be able to detect the needs of other people, but they must also be willing and able to enact behaviors to meet those needs, even when doing so involves sacrificing one’s own time, energy, or resources. This project examines how children detect and weigh the needs of others, against the costs to the self, to decide whether (or not) to act altruistically, from the second year of life through the preschool period. Students working on this project will investigate these questions, and in doing so, will provide new insights into the nature of altruism, and may ultimately contribute to the creation of strategies intended to promote altruism in young children.

The primary methodology involves interactive tasks with toddlers and young children. The research will be conducted in typically developing infants but may subsequently be adapted to use as diagnostic markers in children at risk for autism (i.e., children with siblings with autism).

DESCRIPTION OF STUDENT PARTICIPATION:
Students are considered full members of the laboratory and will have the opportunity to participate in the research project in a number of ways:

1) Students will engage in literature review and discussions regarding socio-moral cognition and behavior. ROP students are valuable members of the laboratory and thus regular attendance at lab meetings is required.

2) Students will have the opportunity to contribute to the design of their experiments and will assist with data collection and participant recruitment. Participants will be typically developing infants. Opportunities for testing infants at higher risk of developing autism may be available.

3) Students will assist with data entry and statistical analysis, which will include training on EXCEL and SPSS. Opportunities for computer programming training (e.g., R or MATLAB) also exist.
4) Students will gain valuable training in effective scientific communication (e.g., writing research reports, preparing data for publication, and oral presentations).

For all aspects of the project, students will work closely with the faculty supervisor. The skills gained by working on this project will provide important experience to prepare for graduate school and beyond.

**MARKING SCHEME (assignments with weight and due date):**

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<th>Assignment</th>
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<tr>
<td><strong>Lab research journal.</strong> Students are expected to keep a research journal/work log to record lab activities every week including lab hours, tasks and progress, research ideas, and comments on discussions and assigned articles. These journal entries are to be emailed to the lab manager, direct graduate student or postdoc supervisor, and Prof Sommerville. We will provide the student with a template. They are due every two weeks.</td>
<td>20%</td>
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<tr>
<td><strong>Participation in day-to-day lab duties.</strong> Active participation in the lab and the specific research project is the most important element of the ROP experience. This is measured by attendance and contribution to weekly lab meetings, and conducting research in an efficient, effective, and professional manner. Students will receive grades at the half-way point in the term (20%) and at the end of term (20%).</td>
<td>30%</td>
</tr>
<tr>
<td><strong>Lab meeting presentations.</strong> Students will give two short presentations (approximately 10-15 minutes) during lab meetings: one will occur early in the term and will describe the research the student is planning to conduct (10%) and the other will be given by the last week of term and will describe the results from the student’s research project (10%).</td>
<td>20%</td>
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<tr>
<td><strong>Final poster or paper.</strong> Students will prepare a scientific poster for presentation at the annual Faculty of Arts and Science 299/399 Research Forum OR write a final paper (approximately 6-8 pages) in the form of a scientific article. The final paper is due on the last day of classes.</td>
<td>30%</td>
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RESEARCH OPPORTUNITY PROGRAM
299Y/399Y PROJECT DESCRIPTIONS 2019-2020
FALL/WINTER

Name and Title: Jessica Sommerville, Professor
Department: Psychology

TITLE OF RESEARCH PROJECT: Mining the Infant Brain: The Origins of Socio-Moral Cognition and Behaviour

Number of 299Y Spots: 2                         Number of 399Y Spots: 2

OBJECTIVES AND METHODOLOGY:
Recent evidence suggests that even before infants can crawl and speak they are starting to think about the social and moral world. For example, infants can distinguish good people from bad people, and detect when people act unfairly. Yet, many questions remain regarding these early sensitivities, including the ways in which they are similar to or different from those of older children and adults, the mechanisms that underlie early socio-moral cognition and behavior, and whether infants can implement this knowledge into their own behavior. Students working on this project will investigate these questions, and in doing so, will provide new insights into the origins and nature of infants’ concerns about the social and moral world. In addition, students may have the opportunity to contribute to experiments that seek to facilitate socio-moral concerns and behavior in infants and young children.

The primary methodology involves infants’ visual attention and psychophysical responses (including pupil dilation and EEG/ERP). The research will be conducted in typically developing infants but may subsequently be adapted to use as diagnostic markers in children at risk for autism (i.e., children with siblings with autism).

DESCRIPTION OF STUDENT PARTICIPATION:
Students are considered full members of the laboratory and will have the opportunity to participate in the research project in a number of ways:

1) Students will engage in literature review and discussions regarding socio-moral cognition and behavior. ROP students are valuable members of the laboratory and thus regular attendance at lab meetings is required.

2) Students will have the opportunity to contribute to the design of their experiments and will assist with data collection and participant recruitment. Participants will be typically developing infants. Opportunities for testing infants at higher risk of developing autism may be available.

3) Students will assist with data entry and statistical analysis, which will include training on EXCEL and SPSS. Opportunities for computer programming training (e.g., MATLAB or Python) also exist.

4) Students will gain valuable training in effective scientific communication (e.g., writing research reports, preparing data for publication, and oral presentations).
For all aspects of the project, students will work closely with the faculty supervisor. The skills gained by working on this project will provide important experience to prepare for graduate school and beyond.

**MARKING SCHEME (assignments with weight and due date):**

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<th>Weight</th>
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<tr>
<td><strong>Bi-weekly journal and/or documentation of research process.</strong> These worklogs are to be emailed to lab manager, direct graduate student or postdoc supervisor, and Prof Sommerville. We will provide the student with a template. They are due every two weeks.</td>
<td>20%</td>
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<tr>
<td><strong>First half of term participation in day-to-day lab duties.</strong> Active participation in the lab and the specific research project is the most important element of the ROP experience. This is measured by attendance and contribution to weekly lab meetings, and conducting research in an efficient, effective, and professional manner. The grade for this component will be provided to the student by the halfway-point in the term.</td>
<td>15%</td>
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<tr>
<td><strong>Lab meeting presentation to propose project.</strong> This short presentation (approximately 10-15 minutes) will be given during lab meeting and will describe the research the student is planning to conduct. This presentation will be given before the halfway point in the term.</td>
<td>10%</td>
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<tr>
<td><strong>Lab meeting presentation to describe findings.</strong> This short presentation (approximately 10-15 minutes) will be given during lab meeting and will describe the results from the student’s research project. This presentation will be given by the last week of term.</td>
<td>10%</td>
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<tr>
<td><strong>Final paper.</strong> Students will produce a final report (approximately 10 pages) which follows the format of a scientific paper, including an Abstract, Introduction, Methods section, Results section and Discussion. The final paper is due on the last day of classes.</td>
<td>30%</td>
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<tr>
<td><strong>Second half of term participation in lab duties.</strong> As with lab duties for the first half of term, this includes attendance and contribution to weekly lab meetings, and conducting research in an efficient, effective, and professional manner. In addition, where applicable, it will include the ROP FORUM presentation.</td>
<td>15%</td>
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