Alumni's Presentations

Session 1 Monday, June 18th at 11:30-12:30

From the sleep lab to the Sleep Ecology, embracing real-world sleep research

Felipe Benjamini

There is a large body of literature evaluating the role of sleep in cognition. The absolute majority of those studies are performed in laboratory settings providing important clues to the role of sleep in preparing the brain for learning as well as for memory consolidation and also evocation. Notably, a theory describing the function of sleep is still lacking. Sleep is a behavioral state with characteristic physiological traits that are highly plastic and subjected to a multitude of factors. Evaluating this multifactorial relationship between sleep and biological, environmental, and sociocultural aspects may provide important insights on the function of sleep. In this talk I will summarize my work on the field of Human Sleep Ecology.

Social influences on children's motivation

Julia Leonard

Childrens perseverance correlates with long-term academic outcomes. Yet effort is a limited resource: we cannot try hard at everything. This talk explores the fundamental question of how young children learn how to allocate effort. Across two behavioral experiments, we show that social evidence informs childrens persistence. In the first study, we show that preschool-age children integrate information from adults actions, outcomes, and testimony to decide how hard to try on novel tasks. Children persist the longest when adults practice what they preach: saying they value effort, or giving children a pep talk, in conjunction with demonstrating effortful success on their own task. In the second study, we demonstrate that social learning about effort is present in the first year of life and generalizes across tasks. Collectively, this work shows that young children use social evidence to rationally deploy effort and elucidates malleable social factors that positively impact childrens persistence.

Should I believe my teacher or my own eyes?

Hanna Marno

Observed associations between events can be validated by statistical information of reliability or by testament of communicative sources. In three studies, we tested whether 18-month-old toddlers, 6-7-year-old children, and great apes learn from their own observation of efficiency, assessed by statistical information on reliability of interventions, or from communicatively presented demonstration, when these two potential types of evidence of validity of interventions on a novel artifact are contrasted with each other. Subjects observed two adults, one operating the artifact by a method that was more efficient (2/3, 3/4 or 2/2 probability of success) than that of the other (1/3, 1/4 or 0/2 probability of success). According to the results, both human children and great apes tended to choose the less reliable method to operate the artifact when this method was demonstrated in a communicative manner. This finding demonstrates that, in certain circumstances, intentional teaching may override statistical evidence during observational learning. Such a bias can serve fast and efficient transmission of knowledge, presumably both in the case of humans and great apes.

Alumni's Presentations

Session 2 Tuesday, June 19th at 11:30-12:30

How the Native Language Influences Second Language Processing: An Investigation of Bilingual Phonotactic

Max Freeman

Knowing more than one language influences how speech sounds are processed during comprehension. We examine how experience with multiple languages transforms the way in which speech sounds are perceived. We tested if Spanish-English bilinguals perception of second-language words was influenced by native-language rules for combining speech sounds (i.e., phonotactic constraints). In Spanish, words cannot start with an s+consonant, as in English strict, and a vowel must be added at the beginning, estricto. Participants were asked if they heard a vowel at the beginning of conflicting (strict) and non-conflicting words (work). Bilinguals heard the e vowel when it was not present with conflicting words, so strict became estrict. However, when participants decided if two words they heard were the same or different (conflicting: strict, egg versus non-conflicting: work, egg), bilinguals did not respond differently across conflicting and non-conflicting word pairs. These results demonstrate that bilinguals alter second-language input to align with native-language rules when the words beginning sound is in focus. Bilinguals experienced interference from native-language rules during second-language comprehension. Bilinguals perceived second-language speech input in line with native-language rules for combining sounds. Overall, the findings from this study confirm that bilinguals perceive their native language during second-language comprehension, further supporting that bilinguals two languages are highly interactive.

Ecological learning: How children adapt their active learning strategies to achieve efficiency

Azzurra Ruggeri

How do young children learn so much about the world so efficiently? This talk presents the results of recent studies investigating theoretically and empirically how children actively seek information in their physical and social environments as evidence to test and dynamically revise their hypotheses and theories over time. In particular, it will focus on how children adapt their active learning strategies, such as question-asking and explorative behavior, in response to the task characteristics, to the statistical structure of the hypothesis space, and to the feedback received. Such adaptiveness and flexibility is crucial to learn in situations of uncertainty, when testing alternative hypotheses, making decisions, drawing causal inferences and solving categorization tasks.

Number transcoding and mathematics achievement in children

Ricardo Moura

A landmark on the development of numerical cognition is the ability to convert between different notational systems of number. This ability, often called numerical transcoding, is one of the most basic abilities acquired by children during their first school years. Transcoding imposes some difficulties especially for children in early schooling, who are not completely familiar with the syntax of the Arabic notation. My aim in this field of research is to investigate how the learning of numerical transcoding and the understanding of the place-value syntax of the Arabic notation impact on mathematical learning. In previous research, I studied number transcoding abilities in children with mathematics difficulties. Results revealed significant differences between children with mathematics difficulties and typical achievers, from the first to the fourth grades, in both Arabic number reading and writing, but with effect-sizes decreasing with grade. Importantly, in middle elementary grades, children with mathematics difficulties showed higher error rates in numbers with higher syntactic complexity. An analysis of the erroneous responses suggested that, in early elementary school, children with mathematics difficulties struggle with both place-value syntax of Arabic numbers and with the acquisition of a numerical lexicon. In middle elementary school, the difficulties observed in children with mathematics difficulties were specific to the syntactic composition of Arabic numbers. Now I am starting a study about early number syntax and lexicon knowledge in young children and its impact on later mathematics achievement.

Alumni's Presentations

Session 3 Tuesday, June 19th at 18:00-19:00

Training intuitive proportional reasoning in children and its impact on symbolic math abilities

Camilo Gouet

The understanding of symbolic fractions is crucial for school mathematics yet children struggle for years to master it. Some researchers have suggested that part of the difficulty with fractions lies in their lack of an intuitive (nonsymbolic) basis. However, recent studies have shown positive correlations between childrens intuitive sense of proportions and their knowledge of symbolic fractions. In this talk I will present the results of two training interventions aimed at extending these observations by testing causal links from intuitive to symbolic proportional reasoning and other math abilities in 4th grade children. We will see that nonsymbolic proportional reasoning is trainable in children through computer games, and that this training transfers to symbolic proportional reasoning and geometry skills. These effects, however, depend on whether nonsymbolic proportions are instantiated with spatial (continuous) or discrete stimuli. These results will be discussed in light of other studies that have raised the importance of intuitive proportional reasoning in children math thinking.

Eye movements provide insight into individual differences in children's analogical reasoning strategies

Ariel Starr

Analogical reasoning is considered a key driver of cognitive development and is a strong predictor of academic achievement. However, it is difficult for young children, who are prone to focusing on perceptual and semantic similarities among items rather than relational commonalities. For example, in a classic A:B::C:? propositional analogy task, children must inhibit attention towards items that are visually or semantically similar to C, and instead focus on finding a relational match to the A:B pair. Competing theories of reasoning development at- tribute improvements in children's performance to gains in either executive functioning or semantic knowledge. Here, we sought to identify key drivers of the development of analogical reasoning ability by using eye gaze patterns to infer problem-solving strategies used by six-year-old children and adults. Children had a greater tendency than adults to focus on the immediate task goal and constrain their search based on the C item. However, large individual differences existed within children, and more successful reasoners were able to maintain the broader goal in mind and constrain their search by initially focusing on the A:B pair before turning to C and the response choices. When children adopted this strategy, their attention was drawn more readily to the correct response option. Individual differences in children's reasoning ability were also related to rule-guided behavior but not to semantic knowledge. These findings suggest that both developmental improvements and individual differences in performance are driven by the use of more efficient reasoning strategies regarding which information is prioritized from the start, rather than the ability to disengage from attractive lure items.

Training Math abilities with The Number Race in second grade children

Yuniel Romero

In recent years technology has been increasingly used in the classroom environment. Many educational games and applications available in multiple electronic devices are supposed to promote cognitive development. However, evidence concerning the efficacy of this tools to foster academic attainment across developmental age is scarce. We carried out a randomized controlled study to evaluate the effectiveness of the Number Race (NR) adaptive video game on a sample of second grade primary school students. An experimental group (N=15) was trained during 20 sessions and a waiting-list control group (N=16) underwent normal school activities. Participants were assessed before and after the intervention with a neurocognitive battery tapping reasoning skills, verbal working memory, inhibitory control, language development, basic number processing and academic achievement. Preliminary findings indicate that only children trained with the NR improved significantly in math achievement while both groups show gains in several measures of domain general skills. This work expands on previous literature in the field suggesting that the NR is a promising tool to promote mathematical skills in school-age children.

Alumni's Presentations

Session 4 Wednesday, June 20th at 11:30-12:30

Learning from sequential information at birth

Ana Fló

Numerous studies have shown that infants start learning from the linguistic input they receive early on. While different learning mechanisms have been pose for the problem of language acquisition, an important one is the use of distributional information in the input. Young infants can detect regularities in the distribution of syllables in continuous speech and use it for segmentation, but importantly, this ability is not restricted to the language domain. Instead, it extends to sequentially presented information across domains and modalities. Despite the vast research on statistical learning, very little is known about how this is implemented in the brain. This question becomes particularly interesting in the case of young infants, whose brain will go through important developmental changes till its adult form. I will present a series of studies using EEG and fNIRS exploring statistical learning capacities at birth, how information extracted from the input is encoded, and the underlying functional networks. We found consistently that neonates can extract and recognize words after a brief familiarization of a few minutes with continuous speech. fNIRS results show functional connectivity patterns, which predicted learning and a different functional connectivity dynamics while neonates hear continuous speech containing structure vs. random syllables. EEG recordings show neural entrainment during the presentation of speech with a regular structure.

Educating Children with Autism: Perspectives from Social Neuroscience

Laura Edwards

Social visual engagement (SVE) refers to the way in which infants visually explore, engage, and ultimately learn from and adapt to their surrounding world from the very first moments of life. Children with autism spectrum disorder (ASD) show atypical patterns of SVE, which may emerge from as early as the first 6 months of life. In this presentation, I will talk about studies that I am currently conducting, as well as those that I hope to develop and implement in the future, which use eye-tracking-based SVE measures to better understand the mechanisms that underlie imitation, language and literacy development, and/or positive development through arts-based education, in children with ASD.

Brain-to-Brain Synchrony in Real-world Learning

Ido Davidesco

The human brain has evolved for group living, and yet, the neural mechanisms involved in real-world social interactions are still considered to be the dark matter of social neuroscience (Schilbach et al., 2013). In my research, I take a multi-person neuroscientific approach by simultaneously measuring the brain activity of groups of people in real-world environments (specifically students and teachers in classrooms) using portable EEG technology. In the first study, brain activity was recorded from a group of 12 high school students throughout one semester during regular classroom activities, including lectures and group discussions. The extent to which brain activity was synchronized across students predicted how engaged students were: students who were more engaged in class exhibited higher brain synchrony with their peers. Further, brain-to-brain synchrony also predicted social personality traits of students, namely the desire to be a part of a social group and empathy. Effective teachers seem to be on the same wavelength with their students, and therefore, in a follow-up study, my colleagues and I tracked the brain activity of a new group of students and their teacher. Student-to-teacher brain synchrony reflected how close each student felt toward the teacher, and student-teacher closeness predicted learning outcomes: students who felt closer to the teacher retained class content better. Taken together, this line of research demonstrates that brain-to-brain synchrony can capture dynamic social interactions in natural environments.

Alumni's Presentations

Session 5 Thursday, June 21st at 11:30-12:30

School-based curricular programs in Brazil: preventive interventions for cognitive development in low-income context

Chrissie Ferreira

I will address two projects that aimed to enhance cognitive abilities in school context. First, I will present results from School-Based Program Heroes of the Mind (PHM) to promote executive Functions (EF) in the classroom developed as part of my doctorate. The PHM is composed of six comics histories and four modules including 42 activities to promoting EF. A small-scale pretest-posttest study was conducted in three groups of 7-11 years old children. Results showed that the intervention vulnerable group presented more expressive gains with greater effect size in working memory, cognitive flexibility, phonemic verbal fluency, and there were transferring effects to other cognitive and academic functions such as visual attention and written skills. In addition the control group was the only one that significantly reduced the scores in fluid intelligence. The study showed that a systematic and long intervention implemented with vulnerable children was able to improve performance in EF. Second, I will briefly introduce a new starting project regarding a Preschool Intervention to Enhance Poor Children's School Readiness in Brazil in collaboration with Elizabeth Spelke Lab. Preschool is a crucial period for learning language and skills building on core cognitive systems, when interventions may increase school readiness, especially for poor children. However, few preschool interventions have focused on mathematical or social cognition, despite the relevance of these domains to success in school and life. We propose to design and evaluate a new game-based intervention aimed at improving the poorest childrens learning both of school mathematics and of mental state concepts that are an essential part of learning to learn.

Reading comprehension in Quechua-Spanish bilingual children in Perú. The role of individual, socioeconomic and linguistic variables

María Fernández

Speakers of indigenous languages in Per are required to master written Spanish for academic and professional success due to the lack of an offer of higher education in their native languages. This study analyzed reading comprehension in 8 year-old Quechua-Spanish bilinguals based on the Young Lives open access data base. Results show that it mainly depends on the language in which bilinguals are taught at school: children attending Spanish-only schools outperformed those educated in both Spanish and Quechua. This may appear surprising considering that evidence on bilingual development suggests children that are instructed in their own language develop better both the first and the second language. Reading comprehension is also influenced by socio-economic status. Finally, vocabulary, listening comprehension and reading fluency are linguistic predictors of this ability. In sum, even though school provides instruction almost exclusively in Spanish, Quechua-Spanish bilingual children in Peru face a difficult challenge: they must learn to write and read in a second language and they must do this from vulnerability circumstances since their communities have lower socio-economic status than non-indigenous. Children growing in disadvantaged families have been shown to be more likely to become poor readers, due to greater exposure to poorer home learning environments, and threatening health and living conditions (Buckingham et al., 2014). School (and preschool) plays an extremely important role in this scenario: it must provide children with the knowledge and abilities that will allow them to live to their true potentials.

What brain potentials can tell us about reading comprehension in children (and adults)

Angel Tabullo

We'll start with a brief description of the Event-Related Potential method and those brain potentials that are most commonly observed in psycholinguistic studies: N400, LAN and P600. Then we will discuss how brain potentials can inform and test hypothesis from neurocognitive models of reading comprehension. Finally, we will present: 1) the results of an experiment from our lab about predictability and constraint effects on brain potentials during sentence processing and their relation with reading comprehension ability in adults, and 2) a project to investigate the relation between syntactic and semantic processing of written sentences and reading comprehension, as well as the influence of cognitive and socioambiental factors, in children.

Alumni's Presentations

Session 6 Thursday, June 21st at 18:00-19:00

Improving arithmetic achievement with videogames: a short-term intervention study in Cuban school-aged children

Nancy Estevez

To date, interventions based on the use of video games have shown to improve basic numerical processing and arithmetic achievement. The goal of the present study was to assess the effect the video games Dots and Letters in arithmetic achievement; in a group of Cuban school-aged children. One hundred and fourteen 3rd and 4th graders from the general primary education system at Centro Habana Municipality, Havana, Cuba; were evaluated and included in one experimental group (EG), one active (ACG) and one passive control group (PCG) per grade, matched by grade, gender and results in the pretests. Pre/posttests included intellectual capacity tests, reading fluency and comprehension tests, arithmetic fluency and achievement tests and working memory assessments. The children played during 4 weeks, 20 minutes a day. The Dots game training produced a significant increase in arithmetic fluency and verbal working memory; as well as a significant increase in arithmetic achievement, not explained by exposure to pedagogical instruction. The "Letters" game produced a significant increase in reading achievement. The intervention effect sizes were moderate. The results suggest that there is, at least, a relative overlap between the neurocognitive networks underlying numerical processing and working memory; and that these networks are relatively independent from those involved in fluency and reading comprehension.

Tracking the neurocognitive mechanisms of arithmetic

Pedro Pinheiro-Chagas

Mathematics is one of the most remarkable human inventions, however we still lack a comprehensive understanding of how the brain computes even simple arithmetic problems. In this talk, I will present a series of studies in which I used time-resolved measures of behavior and brain activity, combined with machine learning techniques to track, parse and characterize the series of covert processing stages involved in mental calculation, as well as to better understand the neural architecture, dynamics and causal role of the underlying brain networks. I will show how a simple model, which assumes that additions and subtractions are computed by a stepwise displacement on a spatially organized representation of numbers, the 'mental number line', is powerful to explain behavior performance and brain activity. Next, I will demonstrate with intracranial recordings that, additionally to the traditional parieto-frontal network of numerical processing, the ventral-temporal cortex is critically involved in mental calculation and its engagement is both format and modality independent. Finally, I will show that magnetoencephalography decoding can reveal the cascade of unfolding processing stages underlying arithmetic and decision-making at a single-trial level. Overall, I will provide insights on how elementary mathematical concepts are implemented in the brain and discuss new approaches for large-scale and fine-grained assessment of mathematical abilities in children.

Bridging the gap: Integrating developmental cognitive research and educational practice to strengthen students' number knowledge

Zachary Hawes

There is a growing need to build an infrastructure that promotes and provides opportunities for collaborative and productive exchange between the disciplines of education and cognitive science. In this presentation I will report on the design, implementation, and effects of an in-service mathematics Professional Development (PD) model for educators of Kindergarten2nd Grade. The intervention involved working closely with K-2 educators over an 18-week period and was centered around the shared goal of improving students numerical thinking. More specifically, the intervention was designed to achieve two goals: 1) To introduce and broaden educators knowledge of content related to the science of learning with a particular focus on research related to numerical cognition, and 2) to use this knowledge to design and implement classroom-based activities/lessons aimed to improve young childrens numerical reasoning. Thus, central to this approach was the integration of research and practice. Results revealed that compared to a control group, teachers in the experimental group demonstrated gains in both their self-perceived as well content knowledge in the area of numerical cognition. Children in the experimental classrooms made larger improvements than children in the control classrooms on measures of mental arithmetic, number line estimation, and a

standardized test of numeration. Both groups of children made highly similar gains on measures of spatial and EF skills. Thus, the gains made by the experimental group were highly specific to lessons/activities designed and implemented as part of the PD. Taken together, our findings provide preliminary support and proof of concept for the current PD model as a potentially viable approach to better integrating research and practice.

Alumni's Presentations

Session 7 Friday, June 22nd at 11:30-12:30

Integrating memories: How congruency and reactivation aid integration of old and new memories

Marlieke van Kesteren

In education we continuously build up knowledge. Successful knowledge building has been suggested to occur through reactivation of prior knowledge during new learning in item-specific perceptual brain areas. This reactivation is proposed to yield integration of new with old memories, supported by the medial prefrontal cortex (mPFC) and medial temporal lobe (MTL). Possibly as a consequence, congruency of new information with prior knowledge is known to enhance subsequent memory. Yet, it is unknown how reactivation and congruency interact to influence memory integration, and how these factors affect educational learning. To investigate this question, we used an AB-AC inference paradigm in both educational and fMRI settings. University students first studied an AB-association followed by an AC-association, so B and C were indirectly linked through their common association with A, an unknown (pseudo)word. Moreover, BC-associations were either congruent or incongruent with prior knowledge, and participants were asked to report subjective reactivation strength for B while learning AC. Behaviourally, we expected both congruency and reactivation to enhance subsequent associative memory for the inferred BC-association. This was corroborated in both the behavioural and fMRI studies. In the brain, we found parametric effects of congruency and reactivation on univariate and multivariate activity patterns in perceptual areas, MTL, and mPFC. These outcomes show beneficial effects of both congruency and reactivation strength on memory formation, and provide insights into the neural mechanisms underlying these processes. Finally, I will present data from a current experiment examining how these factors can improve statistics learning in university students.

The promiscuous reward system: insights for education

Patricia Bado

Reward sensitivity can refer to the intensity of our affective responses to different rewards in life. Since it can affect various aspects of child development and functioning, it is important to understand its neural correlates, behavioral overlaps and development across lifespan. My PhD project aimed to understand how basic reward processes influence broader motivations in humans using neuroimaging techniques. For this purpose, our group has been studying reward anticipation and receipt using different reward types (e.g. monetary, food and social-affiliative rewards). I will briefly talk about the neural correlates of multiple reward in young adults and their association with impulsivity from a clinical sample with ADHD (Rio de Janeiro, Brazil). I will then discuss some cultural differences in reward sensitivity and intergenerational associations, current projects in collaboration with Human Developmental and Neurobiology (Okinawa Institute for Science and Technology, Japan). Finally, I will also mention (and hope to get some insights from LA School) my pos-doc project using longitudinal fMRI data in children from a high risk cohort for psychiatric disorders in Porto Alegre, Brazil.

Child cognitive development in rural poverty. Studies by an interdisciplinary team

Maria Hermida

While poverty all over the world is more typical and extreme in rural settings, interventions to improve cognition in low socioeconomic status (SES) children are for the most part based on studies conducted in urban populations. I will present the results of two studies in child cognitive development in rural context aimed to fill this gap. In the first study we analyze how poverty in rural contexts affects child cognitive performance and compare it to urban context. Also, we studied which aspects of context (rural and urban) and SES pose the main risks to cognitive development. Differences between childrens scores in rural and urban settings were observed and some variables emerged as candidates to explain those differences. In the second study, we did a zoom-in on low SES rural preschoolers cognition to analyze which environmental and individual variables could explain better individual cognitive differences in that context. We identified one dimension of temperament as a predictor of individual differences in non-verbal learning achievement. Both studies, that should inform educational interventions and programs, were seeded by networking and exchanges of ideas that started in previous LA School editions.