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DIRECTOR’S MESSAGE

Dear Vice Chancellor Khargonekar, Dean Maurer, IMBS Colleagues, and others,

This has been a year of transition for the IMBS. Don Saari retired after 14 illustrious years as Director, and I took over as Interim Director. There has, however, been no let up in the scale and scope of IMBS activities. The IMBS is unique, not only on campus but internationally, in its devotion to the creative application of mathematics to the social and behavioral sciences. It is the only research institute with this purpose. Being centered around a methodology and not a subject matter, the IMBS is constantly contributing to vital, emerging areas of research. It is an essential part of the connective tissue of the university, bringing together scholars from across campus (our members alone come from at least five UCI schools). Our activities in the 2017-2018 academic year, reviewed in this annual report, clearly illustrate the breadth and importance of the work done through the IMBS, its cross-disciplinary nature, which is not well supported in the departmental system, and the spillovers it creates for departments and programs across UCI.

Overview. This year the IMBS held three major conferences, the Luce graduate student conference, 24 colloquia, 12 seminars, added 7 new members, hired a Postdoctoral Fellow, and co-sponsored the International Economics Association Roundtable held in Cambridge, UK in July 2017. IMBS members held $16,338,568 of active grants during the year. We welcomed the first two Falmagne Chairs, Zygmunt Pizlo and Jeffrey Rouder, hired by the department of Cognitive Sciences to UC Irvine and the IMBS. In doing so, we were able to honor Dina and Jean-Claude Falmagne for their gift which endowed these chairs, as well as Jean-Claude’s long and distinguished history with the IMBS. A third Falmagne Chair will be hired through the IMBS this year.

Active Research Fields. The work done by IMBS members is at the forefront of a large number of emerging and rapidly evolving fields. Reviewed in Section II.D, this work includes mathematical analyses of the spread of false beliefs (Cailin O’Connor and James Weatherall), natural language acquisition (Lisa Pearl and Gregory Scontras), cancer and virus dynamics (Natalia Komarova), the evolution of social networks (Carter Butts), veridicality in human and artificial cognition (Zyg Pizlo), identity-based inequality (Cailin O’Connor and Jean-Paul Carvalho), identity formation and extremism (Stergios Skaperdas, Mike McBride and Jean-Paul Carvalho), control theory applied to biological systems (Steve Frank), spatial risk analysis (Robin Keller), color cognition (Kimberly Jameson, Natalia Komarova, and Kim Romney), game decomposition (Don Saari), evolution and learning in games (Brian Skyrms, Simon Huttegger and Louis Narens), algorithmic game theory (Vijay Vazirani), train arrival times (Tom Trogdon), and behavioral biases in decision-making (Igor Kopylov).

Conferences. The IMBS hosted three major conferences during the year. Further details are contained in Section V.

The first conference, titled ‘Symmetry and Invariance in the Natural and Behavioral Sciences’, was held on 17-18 November 2017 (organizers: Louis Narens and Zyg Pizlo). The conference welcomed Zygmunt Pizlo (the new Falmagne Chair in Cognitive Sciences) to UC Irvine and the IMBS. The concepts of symmetry and invariance provide a unified framework for understanding a large number of phenomena in
the natural, biological and social sciences. The conference examined how these concepts are applied in
mathematics, physics, biology, psychology, engineering, philosophy and social dynamics. Participants
gained an understanding of how seemingly disparate phenomena have the same underlying structure and
can be modeled using analytical techniques imported from different fields. The conference had special
relevance to modeling human and artificial cognition. There were twelve presentations from scholars
working in mathematics, computer science, evolutionary biology, cognitive science and game theory.
The second conference, titled ‘Identity, Cooperation and Conflict’, was held on 13-14 April 2018 and co-
sponsored by the Center for Global Peace and Conflict Studies (CGPACS) at UCI (organizers: Jean-Paul
Carvalho and Stergios Skaperdas). The conference covered exciting developments in the mathematical
and statistical analysis of identity. As the title suggests, special emphasis was placed on the role of identity
(ethnic, religious, gender, etc.) in human cooperation and conflict. Presentations were made by 14 leading
scholars from a range of disciplines including economics, political science, evolutionary biology and
anthropology. Specific topics covered included the emergence and persistence of social identity, identity-
based inequality, and extremism.

The third conference, titled ‘Quantitative Approaches to Language Science’, was held on 4-5 May 2018
and co-sponsored by the Department of Language Science and the Center for Language Science at UCI
(organizers: Lisa Pearl and Gregory Scontras). The conference covered important recent advances in the
mathematical modeling of natural language. The field has progressed rapidly but in a fairly uncoordinated
manner. This conference brought together leading scholars in the field to disseminate existing work,
harmonize analytical approaches, and lay the groundwork for future research collaboration. One aim of the
conference was to boost the newly established Department of Language Science and the Center for
Language Science at UCI. Eight presentations were made by scholars from fields such as linguistics,
computer science, and cognitive science.

The fact that two of these conferences were co-sponsored by other UCI departments/centers is one
indication of the connections the IMBS forges across campus. In addition, the IMBS co-sponsored the
International Economic Association [IEA] Roundtable on the Economics of Religion held at the University
of Cambridge on 10-11 July 2017 (organizers: Sriya Iyer, Jared Rubin and Jean-Paul Carvalho).

**Graduate Training.** The PhD program with a concentration in Mathematical Behavioral Sciences had
nine full-time students this year (and one part-time). IMBS graduate training activities are set out in section
IV. Initiatives were made to more closely involve students in the Institute’s activities. In particular,
students were able to meet with the speaker and myself every Thursday before the colloquium to discuss
their research. As usual, students ran and mostly presented in the Friday IMBS lunchtime seminar. The
Luce Graduate Student Conference was held on 1 June 2018 and featured ten outstanding presentations by
PhD students. The Institute sponsored Cole Williams to attend the IEA Roundtable in Cambridge, UK.
Finally, the Jean-Claude Falmagne Dissertation Award was jointly won by Cole Williams and Timmy Ma.
Many of the students participating in IMBS events were from outside the MBS program, from departments
as diverse as mathematics, logic & philosophy of science, computer science, language science, economics,
political science and cognitive science. This provides some idea of the spillovers generated by the
interdisciplinary work nurtured by the IMBS.

**Grants.** IMBS members held $16,338,568 of active grants during the year. Most of these funds ran
through the members’ departments, as we have no incentive to have grants go through the IMBS (as we see
none of the overhead credited to us). Were this to change, we would have incentive to encourage members
to run grants through the IMBS and would make a vigorous push in this direction.
**Challenges.** The IMBS has had many illustrious members beginning with its Founding Director, Duncan Luce. Today, our membership includes eight National Academy Members. The challenge is to bring together a new generation of scholars involved in interdisciplinary applications of mathematics to the social and behavioral sciences, for whom the IMBS will become an intellectual home. Over the past year, we have seen substantial contributions to IMBS activities made by James Weatherall (Professor, Logic & Philosophy of Science), Igor Kopylov (Associate Professor, Economics), Cailin O’Connor (Assistant Professor [now Associate], Logic & Philosophy of Science), Tom Trogdon (Assistant Professor, Mathematics), Ines Levin (Assistant Professor, Political Science) and Gregory Scontras (Assistant Professor, Language Science). Trogdon, Levin and Scontras were made IMBS members this year. In addition, we added a further four new members:

- Vijay Vazirani, Distinguished Professor of Computer Science, UCI
- Jeff Ely, Charles E. and Emma H. Morrison Professor of Economics, Northwestern University
- Laurence Iannaccone, Professor of Economics, Chapman University, and Director of the Institute for the Study of Religion, Economics, and Society
- Robert Akerlof, Associate Professor of Economics, Warwick University

Joanna Kerner, the IMBS Administrator, was the reason that we were able to accomplish so much in this transition year. Her knowledge and diligence are critical to the ongoing success of the Institute. The next year will be a crucial phase in the transition process with a new Falmagne Chair being hired through the IMBS and a new permanent Director being appointed. We look forward to another exciting and productive academic year.

In closing, I would like to mention the passing of Bill Batchelder. Bill served as director of the IMBS from 1999-2003. In November 2015, the IMBS marked Bill’s 75th birthday and honored his scholarship with the conference "Cultural Consensus Theory, Multinomial Processing Trees, and Cognitive Psychometrics." Only this June, Bill served as chair of the Falmagne dissertation award committee. The IMBS will install a plaque to honor Bill and his time as Director in the Luce Conference Room at our upcoming Fall Welcome event on October 4th.

Sincerely,

Jean-Paul Carvalho
Interim Director, IMBS
I. ORGANIZATION AND ADMINISTRATION

A. Administration

The Interim Director of the Institute for Mathematical Behavioral Sciences is Associate Professor Jean-Paul Carvalho. He reports both to the Dean of the School of Social Sciences and to the Vice-Chancellor for Research. An Executive Committee for consultation and decision-making regarding the long-term direction of the Institute assists the Director, (section B below).

The staff of the Director’s office consists of an Administrator, Joanna Kerner. Presently, some bookkeeping and personnel matters are being taken care of by the School of Social Sciences.

Interim Director: Jean-Paul Carvalho, 2017- present


Graduate Director: Louis Narens
Administrator: Joanna Kerner

B. Executive Committee 2017-18

Carter Butts, Professor of Sociology
Michelle Garfinkel, Professor of Economics
Marek M. Kaminski, Professor of Political Science
Michael D. Lee, Professor of Cognitive Sciences
Mark Machina, Professor of Economics, UC San Diego
Brian Skyrms, Professor of Logic and Philosophy of Science
Hongkai Zhao, Professor of Mathematics

II. RESEARCH

A. Current Research Programs

There are 70 members of the Institute for Mathematical Behavioral Sciences (IMBS) and their research interests are listed in Appendix A.

The IMBS is roughly partitioned into five research clusters. These are listed below and should be considered as informal intellectual groupings, rather than formal structures.
Measurement Theory, Foundational Issues, and Scaling Models:
Barrett, Batchelder, Burton, Falmagne, Johnson, Maddy, Narens, Romney, Skyrms, and Weatherall

Statistical Modeling:
Cognitive: Baldi, Batchelder, Dosher, Eppstein, Falmagne, Iverson, Lee, Pearl, Romney, Scontras, Smyth, Steyvers, Trogdon, and Yellott
Economic: Brownstone, Poirier, and Saari
Sociological/Anthropological: Boyd, Butts, Faust, and White

Individual Decision Making: Birnbaum, Keller, Kopylov, Machina, Narens, and Saari

Perceptions and Psychophysics:
Vision: Braunstein, Chubb, D’Zmura, Hoffman, Iverson, Palais, Pizlo, Romney, Sperling, Srinivasan, Wright, Xin, Yellott, and Zhao
Psychophysics and Response Times: Brownstone, Falmagne, Iverson, Jameson, Narens, and Yellott

Social and Economic Phenomena:
Economics and Game Theory: Branch, Brownstone, Brueckner, Burton, Carvalho, Duffy, Frank, Garfinkel, Komarova, Kopylov, Levin, McBride, O’Connor, Poirier, Saari, Skaperdas, Skyrms, and Vazirani.
Public Choice: Carvalho, Cohen, Glazer, Grofman, Kaminski, Keller, Taagepera, and Uhlaner
Social Networks: Batchelder, Boyd, Butts, Faust, Noymer, Romney, Vazirani, and White
Social Dynamics and Evolution: Butts, Carvalho, Frank, Huttegger, Narens, Romney, Saari, Skyrms, Smyth, Stern, and White

B. Publications

The members who have replied report a total of 191 journal publications (published or in press) for the current academic year. These are listed in Appendix B.

The IMBS has a technical report series that is available to all members and qualified graduate students who are submitting a paper to a refereed journal or book. The series editor is Jean-Paul Carvalho. Appendix C lists the technical reports issued during the academic year. Technical reports since 1993 can be found under “printed resources” on the Institute’s web site at http://www.imbs.uci.edu/research/technical.php.
C. Public Talks and Colloquia

IMBS members actively participated in numerous off-campus research seminars and conferences. The members who replied gave a total of 214 talks listed in Appendix D. Their awards and achievements for this year can be found in Appendix E.

D. Summaries of Research Findings

An important aspect of the Institute is the research conclusions developed by its members. What follows is a sample of what has happened this year.

Measurement Theory, Foundational Issues, and Scaling Models

Jeff Barrett

This last year I have been working primarily on applications of evolutionary epistemology to problems in epistemology.

James Weatherall

Along with Cailin O’Connor (UCI) and Justin Bruner (ANU/Groningen), I have used simple models of scientists trying to solve a problem to study how psychological considerations, such as trust and conformism, can influence the beliefs of communities of scientists. We find simple, well-motivated heuristics for individuals, such as trusting evidence more when it has been produced by scientists who you believe have been successful in the past, can have severe negative effects on the ability of communities of scientists to learn the truth about the world. In particular, we find that both trust heuristics and conformism can lead to situations in which communities of scientists become polarized, holding opposite beliefs and failing to persuade one another despite the availability of arbitrary amounts of high quality evidence. As O’Connor and I argue in our forthcoming book *The Misinformation Age: How False Beliefs Spread*, these and related mechanisms are likely present in broader society, and may explain the emergence of polarization about both political issues and also matters of fact (such as whether anthropogenic climate change poses serious health and economic risks). We have also studied how these mechanisms may be exploited by industrial or political interests to affect the beliefs of scientists or the public, so that communities can gather high quality evidence that clearly supports one position, and yet all or most members of that community can come to believe the opposite position.

Statistical Modeling

David Eppstein

This year I published a new book on discrete geometry with Cambridge University Press and gave three major international invited talks on it. I served as program chair for the 16th Scandinavian
Symposium and Workshops on Algorithm Theory (SWAT2018), in Malmö, Sweden. I was also elected as a fellow of the American Association for the Advancement of Science.

**Michael Lee**

My work continues to focus on modeling human decision making and individual differences, especially through the application of Bayesian methods and real-world data. Highlights this year have included (a) developing method for detecting fine-grained switches in cognitive processes, and applying this to crowd-sourced prediction data and models of strategy use in decision making; (b) a paper with Irina Danileiko using a model-based approach to the wisdom of the crowd in category learning; and (c) new empirical work evaluating the role of meta-cognition in improving forecasting.

**Gregory Scontras**

This year, I have continued research on adjective ordering preferences. From English to Hungarian to Mokilese, speakers exhibit strong ordering preferences in multi-adjective strings: “the small brown box” sounds more natural than “the brown small box.” Previously, I had shown that in English an adjective’s distance from the modified noun is predicted by the adjective’s meaning: less subjective adjectives occur closer to the nouns they modify. This year, I have followed up on this finding by investigating

(i) why subjectivity should play the role it does in adjective ordering (spoiler: pressures from successful reference resolution, where less subjective content is more useful, deliver subjectivity-based preferences),

(ii) when stable preferences develop in English-speaking children (spoiler: around age four, although these early preferences appear to simplify adult subjectivity-based preferences), and

(iii) whether we find similar preferences in Spanish and Tagalog (spoiler: we do find subjectivity-based preferences in Tagalog, but in Spanish, where multi-adjective strings are formed via conjunction (e.g., “the small and brown box”), we fail to find stable preferences at all).

**Lisa Pearl**

A related set of findings concerns how the cognitively immature minds of children solve the various tasks involved in native language learning (called language acquisition). Pearl (2018) discusses how computational and mathematical modeling are invaluable tools for scientists who want to understand the language acquisition strategies that children use for learning language structure, known as syntax. This is because modeling provides a way to concretely realize a theory about a learning strategy, apply that strategy to realistic language data, and see the results of the learning strategy. This approach can be used for a wide range of syntactic phenomena and offers
insights that cannot be found by using theoretical or experimental methods alone. Savinelli, Scontras, & Pearl (2017) demonstrate this by articulating a formal model of language understanding that accounts for how children and adults understand ambiguous utterances in context. For example, suppose you and a friend are watching horses jump over a fence, and two of three horses you watch make it over. Then suppose your friend turns to you and says, “It looks like every horse didn’t make it over the fence” (every-not). You as an adult are able to interpret this as meaning “Not all the horses made it over” (which is true in this context), rather than interpreting it as “All the horses didn’t make it over” (which is false in this context). However, four- and five-year-old children struggle to interpret this the way adults do, instead falling back on the false interpretation (All the horses didn’t). By building a formal model that can match the qualitative behavior of both adults and children, we determined that the most likely cause of children’s non-adult behavior was due to their developing abilities that manage conversational and real world context (pragmatic factors), rather than other equally plausible alternatives (e.g., not being able to generate the not all interpretation in time - a processing factor).

Interestingly, for other utterances, adults behave more like children in not being able to access the interpretation that is true in context. For example, suppose we watch two horses, and one jumps over a fence while the other doesn’t. The utterance “Two horses didn’t jump over the fence” (two-not) is true only under the interpretation of “It is not the case that two horses jumped over the fence” (because only one did), while it’s false under the interpretation “For each of two horses h, h didn’t jump over the fence.” In this case, adults typically struggle to access the true interpretation. Savinelli, Scontras, & Pearl (2018) demonstrate how the same formal model of language understanding that was able to capture children’s interpretation behavior for the every-not scenario is able to account for adult interpretation behavior in the two-not scenario. Notably, adult behavior in the two-not scenarios has the same underlying pragmatic causes as children’s non-adult behavior in the every-not scenarios. This suggests that there’s continuity in the development of this kind of pragmatic context management when it comes to language understanding.

Another finding by Pearl & Sprouse (under review) concerns how children integrate different types of information when learning the linguistic behavior of verbs. In particular, verbs differ by the syntactic frames they can be used in and how their arguments are interpreted. For example, while both try and seem can be used in the frame The penguin ___ to climb the hill, only seem can be used in the frame It ___ that the penguin climbed the hill. As another example, both melt and climb can be used in the intransitive frame X ___ (The ice melted, The penguin climbed). However, the interpretation of the subject is different for each verb: in The ice melted, something is happening to the ice; in The penguin climbed, nothing is happening to the penguin — instead the penguin is doing something. Children learn these verb behaviors by inferring abstract classes of verbs, where each verb class has a distinct collection of behaviors. To do this, children draw on both syntactic cues (like syntactic frames) and conceptual cues (like animacy and event roles). By using a Bayesian framework to formally model different theories of how children integrate these information sources to learn verb classes, we were able to articulate the trajectory of learning assumptions children are likely to have from three to five years old. This trajectory suggests there
are different timelines for ignoring vs. heeding surface morphology on verbs (like the past tense -ed in English), for a simpler vs. more flexible event role representation, and for not expecting vs. expecting a mapping between that event role representation and syntactic positions like subject, object, and indirect object. From a theoretical standpoint, it suggests that a mapping between event roles and syntactic positions is not present in younger children, and so is less likely to be something built into Universal Grammar (the innate, language-specific knowledge children utilize to learn their native languages so rapidly and so effectively).

In follow-up work, Pearl & Sprouse (in prep.) investigate how English children might learn the correct mapping between event roles and syntactic positions by five years old, given the data they encounter. Using a formal quantitative metric that determines an exact threshold when children will make a generalization from noisy data, we find that only certain theories of how children represent event roles will allow the correct generalization to happen. In particular, if children assume fixed event role categories where, for example, category_1 always maps to the highest syntactic position (and so on), the data English children encounter will be far too noisy for them to generalize a mapping. In contrast, if children assume a relative ordering among event roles, where the higher event role present -- whichever one that may happen to be -- maps to a higher syntactic position, the data English children encounter are amenable to generalizing the mapping correctly. This more theoretically-oriented work provides developmental support for a relativized approach to event role representations, rather than an absolute fixed one -- a hotly debated topic within the theoretical linguistics literature.

Bates & Pearl (in prep.) also investigate the development of complex syntactic knowledge, this time considering the impact of socioeconomic status (SES) on the relevant syntactic input. In particular, there are known differences in the quantity and quality of child-directed speech across SES. We investigate wh-dependency constraints, known as syntactic islands, as a concrete case where quantity and quality of high-SES child-directed speech was previously assessed by Pearl & Sprouse (2013). Using quantitative analysis and cognitive modeling to assess low-SES child-directed speech samples, we find that low-SES children’s complex syntactic input, in terms of wh-dependencies, is quantitatively and qualitatively similar to that of high-SES children: the wh-dependencies (i) have similar distributions in the high-SES and low-SES input samples, and (ii) would allow a low-SES child to successfully acquire knowledge of the same syntactic islands that a high-SES child would from high-SES input. Interestingly, at least one key building block for syntactic island knowledge comes from a different source in low-SES children’s input, but is crucially still present. This suggests that the linguistic evidence for more complex syntactic knowledge like syntactic islands, in contrast with more foundational linguistic knowledge, may not differ by SES.

Another finding by Bates, Pearl, & Braunwald (in prep.) concerns the early emergence of syntactic category knowledge, such as not, no, and -n’t belonging to an abstract category of Negation. The age when children develop knowledge of different syntactic categories is hotly contested, with some studies arguing for development before age two while others disagree. Experimental studies suggest that some open-class categories like Noun and Adjective (which can
have new words added to them) may have early forms as young as 14 months old; in contrast, it’s unclear when closed-class categories like Negation (which can’t have new words added to it) are available. Using quantitative metrics that assess the underlying representations generating observable verb phrases, we found support for adult-like closed-class categories — but not for adult-like open-class categories — in a child just under the age of two. This provides empirical support for the very early development of closed-class categories. In particular, while only rudimentary forms of open-class categories may be available early in development, our findings suggest that more mature closed-class categories develop early.

Bar-Sever, Lee, Scontras, & Pearl (2018) use quantitative analysis to investigate the development of adjective ordering preferences, which determine the relative ordering of adjectives in multi-adjective strings. This is why “small gray kitten” is preferable to “gray small kitten” in English and many other unrelated languages. Recent work in adults has suggested that ordering preferences are related to the perceived subjectivity of the adjective (i.e., If I say, “The kitten is gray” and you say “The kitten isn’t gray”, can we both be right? If so, this is a subjective adjective.) We use corpus analysis and quantitative metrics to connect children’s linguistic input, potential underlying representations regarding adjective ordering, and linguistic output. Our quantitative assessment demonstrates that abstract knowledge is likely to underlie children’s preferences at age four (but not earlier), though this abstract knowledge is not yet based on adjective subjectivity. This suggests that children initially track the word-level statistics of their input when determining adjective ordering, but shift to a more compact, abstract representation by age four -- though they must still refine their representation further before becoming adult-like.

Nguyen & Pearl (2018) also use corpus analysis to investigate children’s understanding of the passive construction in English. For example, at three, children can understand “Alex was hugged by Emma” but struggle to correctly understand “Alex was loved by Emma” until age five. Several factors have been proposed to explain the general delay in understanding passives, including verb frequency and the lexical semantics of the verb. Corpus analysis coupled with a meta-analysis of 12 experimental studies suggested that the lexical semantic profile of a verb strongly influenced when children understood the verb’s passive form, and suggested a developmental trajectory that qualitatively matched the available experimental results. This contrasted strongly with verb frequency factors, which didn’t have any correlation. This finding makes specific predictions about the age when children should understand certain verbs in the passive and not others, based on the collection of lexical semantic features the verb has.

Pearl & Phillips (2018) uses computational modeling to investigate the task of speech segmentation, which is the process of identifying individual units like words in fluent speech. As anyone who has ever listened to a foreign language knows, there are rarely any overt markers of word boundaries - it often sounds like one long stream of sounds. Instead, listeners who know the language unconsciously impose boundaries to identify the words being spoken. Infants typically are able to do this for their native language as early as six months old. In our studies, we examine two speech segmentation strategies proposed for infant use, implement these strategies concretely via mathematical formalizations, and apply them to realistic language data that infants would
hear. One interesting problem concerns the evaluation of these segmentation strategies — given how young children are segmenting speech (six months), it seems unlikely they would achieve perfect adult segmentation immediately. In fact, we know that segmentation errors persist for several years after (ex: undersegmentation errors like “That’s a” segmented as a single word “thatsa”, and oversegmentation errors like “behave” segmented as “be” and “have”). So how do we tell if a segmentation strategy is generating good enough segmentations (and importantly, the kind a six-month-old might generate)? We discuss assessing the utility of the generated output, with the idea that language acquisition is a process that unfolds over several years. So, the output of one process is the input to the next. Using various ideas for what segmented output might be used for later on in acquisition, we discover that segmentation strategies that produce more adult-like segmentations may not be the best ones for infants to have. Instead, strategies that generate undersegmentation errors may actually be preferable to ones that generate oversegmentation errors, irrespective of which strategy generates a more adult-like segmentation.

A finding in the area of natural language processing concerns automatic detection of deception in text across different content domains, such as product reviews, emotionally-charged topics such as the death penalty, and interview questions. Current automatic deception detection approaches tend to rely on cues that are based either on specific lexical items or on linguistically abstract features that are not necessarily motivated by the psychology of deception. Notably, while approaches relying on such features can do well when the content domain is similar for training and testing, they suffer when content changes occur. Vogler & Pearl (in prep.) investigates new linguistically-defined features that aim to capture specific details, a psychologically-motivated aspect of truthful vs. deceptive language that may be distinctive across content domains. To ascertain the potential utility of these features, we evaluate them on datasets representing a broad sample of deceptive language, using both standard statistical analysis and as part of a deception detection classifier. We find that these linguistically-defined specific detail features are most useful for cross-domain deception detection when the training data differ significantly in content from the test data, and particularly benefit classification accuracy on deceptive documents.

Another finding in natural language processing concerns automatic sentiment analysis; the simplest version of sentiment analysis is to determine whether a text is positive or negative. Negation words -- that is, words like not -- often disrupt state-of-the-art approaches, and most negation-handling strategies don’t take into account the meaning of the content being negated. Yet, words with the same basic sentiment score (such as nice and beautiful, which are perceived as equally positive) can have very different sentiment when negated: not nice is perceived as far more negative than not beautiful. Hii, Yuen, & Pearl (in prep.) consider the specificity of a word or phrase’s meaning; we investigate automatically-extractable heuristics of how specific a word is, such as its frequency of use (less frequent words may be more specific) and how varied the contexts are that it appears in (words that appear in more narrow contexts may be more specific). We find that incorporating meaning specificity into negation handling is beneficial in “hard” cases, where improper negation handling leads to the opposite sentiment (for example, a negative review being labeled as positive). This kind of error is immediately noticeable to humans, and is best handled by our linguistically-informed strategy.
Tom Trogdon

In collaboration with Aukosh Jagannath (Harvard) I performed a statistical analysis of train arrival times in the New York City subway system. Guided by a 2008 study of Krbalek and Seba, we looked for random matrix statistics. Specifically, we compared the empirical distribution of train spacings with the theoretically known distribution for the spacing between eigenvalues of a random, complex, Hermitian matrix. Krbalek and Seba’s work indicates that the presence of random matrix statistics in a transportation system is desirable for efficiency. We confirmed what many New Yorkers know: The #1 line exhibits random-matrix-like statistics and is more efficient while the #6 line exhibits nearly Poissonian statistics and less efficient.

Carter Butts

It is a basic observation that, however small it may sometimes feel, the social world is getting larger: at 7 billion people, the world's population is over 1,000 times larger than it was in ancient times, and growing apace. That growing population translates to more people with whom to interact, a process made ever easier by transportation and communication technology. Yet, for all this expansion, our personal networks - the set of people with whom we share social relationships - have remained fairly constant over time. Modern people do not have thousands of times as many friends as those living in ancient times, and we certainly do not have thousands of times as many sex partners. This phenomenon, in which the average number of ties one has on a given relation remains roughly constant a network size changes, is known as constant mean degree scaling, and it turns out to be a very common property of social networks. While the prevalence constant mean degree scaling has been known for many decades, capturing in theoretical models of social networks has proven trickier: most models of network structure either take this property to be true by fiat (thus providing no explanation) or fail to regenerate it. One very common proposed explanation for constant mean degree scaling is that individuals simply have a limited capacity for sustaining ties, and this limitation in turn keeps our numbers of partners from growing out of control. As I show in a forthcoming paper in the Journal of Mathematical Sociology, however, this simple explanation has problems: taken by itself, it leads to a world in which nearly everyone is completely saturated with relationships, unable to form new ones until old ones are lost. As this is not the case, we need an alternative model. In my JMS paper, I demonstrate that we can account for mean degree scaling by the action of what are known as hidden degrees of freedom; that is, social processes that we do not directly observe when we study a social network, but that are nevertheless taking place “under the hood.” In particular, I demonstrate that a simple model in which ties can only be formed within social and/or physical settings within which individuals move can account for the observed properties of social networks. Intriguingly, a key aspect of this process is that it is based on fleeting interactions that occur much faster than tie formation or dissolution processes (a phenomenon known as time scale separation). While these fleeting acts of migration are “blurred out” on the time scale of the
Individual Decision-Making

Robin Keller

When environmental or societal outcomes are defined over a geographic region, measures of spatial risk regarding these outcomes can be more complex than traditional measures of risk. One of the main challenges is the need for a cardinal preference function that incorporates the spatial nature of the outcomes. We explore preference conditions that will yield the existence of spatial measurable value and utility functions, and discuss their application to spatial risk analysis. We also present a simple example on household freshwater usage across regions to demonstrate how such functions can be assessed and applied.

Citation: L. Robin Keller and Jay Simon (UCI Merage alumnus), “Preference Functions for Spatial Risk Analysis”, Risk Analysis, special issue on Spatial Decision models, Version of Record online: 7 SEP 2017 | DOI: 10.1111/risa.12892, Appeared online in early view prior to print: http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1539-6924/earlyviewAbstractArticlePDF(1822K)

Igor Kopylov

This year I have developed a combinatorial approach to modeling subjective states and multi utility representations. I apply the new method to three structures---- complete and transitive preferences, incomplete dominance relations, and choice functions – that are given over finite menus. These structures can be modeled together or separately. In particular, upt to k subjective states can be derived from monotonic preferences over menus that have at most k elements or from choices in menus that have at most k+1 elements. Applications of this method are also studied in continuation projects that I am pursuing in part with Junying Zhao, an MBS graduate student. Second, I have completed major revisions of two of my previous projects for Journal of Economic Theory and Journal of Risk and Uncertainty.
Kimberly A. Jameson

During 2017-2018 Kimberly A. Jameson continued research along six related areas of empirical investigation and basic research and development.

(1) As founding P.I., Jameson continues to serve as Project Lead for collaborative Discovery Eye Foundation Funded empirical and theoretical work on Adult Macular Degeneration (AMD) and color photopigment opsin genetics in collaboration with Maria Cristina Kenney MD PhD at the Gavin Herbert Eye Institute in UC Irvine Medical School. This project has recently received awards for extending the work to establish, among other advances, a Core Opsin Genotyping Facility which will develop a novel, internationally shared resource for academic/scientific researchers, providing full human photopigment opsin genotyping assessment and profiling. This is a resource that currently does not exist for basic research purposes and which would greatly enhance investigations internationally that aim to investigate basic and clinical research efforts related to Rhodopsin and Photopigment opsin genetics.

(2) Jameson continues her collaboration with Vladimir Bochko (Vaasa University, Finland), Kirbi Joe (IMBS graduate student) and Keith Goldfarb (Blackthorn Media, Los Angeles, CA) on the development of image processing algorithms and filters for depicting color scene processing variations across observers with dissimilar photopigment opsin phenotypes, yielding two IMBS technical reports (and a third substantially revised IMBS technical report).

(3) On her National Science Foundation funded research Jameson led research into the mathematical modeling of color category evolution among communicating artificial agents (with IMBS affiliates Louis Narens Cognitive Sciences and Natalia Komarova, Mathematics) which yielded a publication in JOSAA, an IMBS technical report, and two research manuscripts. With Komarova (as doctoral thesis chair), Jameson and Narens also assisted and advised Department of Mathematics Graduate Student Nicole Fider on thesis research which has now been developed into manuscripts.

(4) Jameson also continues her collaborations with A. Kimball Romney & Tim Satalich, IMBS faculty, and most notably Kirbi Joe MBS Graduate Student, on developing novel psychophysical investigations of color perception metameric relations.

(5) Jameson also ran a cognitive research lab imbs.uci.edu/colorcoglab/ColorCognitionLab.html consisting of Psychology and Social Behavior undergraduates on empirical investigations into individual variation and universals in human color cognition, color naming and categorization. During 2017-2018 this group engaged in statistical analyses and research the literature towards
manuscript preparation for results on the topic of bilingual individuals naming and conceptualization of color.

(6) Also for her NSF funded research, Jameson continued implementation and management of the public research resource *ColCat: Color Categorization Wiki*, assisted by Sergio Gago PhD, in *Calit2* for the NSF funded project. Jameson has supported student programmers to upgrade the implementation of the Wiki in 2018.

**Hongkai Zhao**

We characterize the intrinsic complexity of a set in a metric space by the least dimension of a linear space that can approximate the set to a given tolerance. This is dual to the characterization using Kolmogorov n-width, the distance from the set to the best n-dimensional linear space. We start with approximate embedding of a set of random vectors (principal component analysis a.k.a. singular value decomposition), and then study the approximation of random fields and high frequency waves. We provide lower bounds and upper bounds for the intrinsic complexity and its explicit asymptotic scaling laws in terms of the total number of random vectors, the correlation length for random fields, and the wave length for high frequency waves respectively.

**Zyg Pizlo**

Psychophysics refers to the branch of Experimental Psychology that deals with the study of Sensation and Perception. A consensus has grown up among experts in Psychophysics during the last hundred years that the human being's percepts are inferences that are based on a minimum, or simplicity principle, which is applied to the currently available sensory data. These educated guesses play the critical role in establishing *veridical* perceptual representations of the 3D environment, where by “veridical” I mean that the percept agrees with what is “out there.” These veridical representations cannot be achieved without making use of symmetries, much like those known in Physics, where they are essential for characterizing our physical world and deriving the conservation laws. But, unlike in Physics, the important role that symmetry plays in Psychophysics has only been demonstrated and explained within the last ten years. Symmetries represent regularities in our physical world. These symmetries also serve as the source of the redundancies that are inherent in 3D objects and that make vision possible. I proposed that the similarity between the mathematical formalisms used in Physics and in Psychophysics is not coincidental, and that exploring this similarity can benefit the sciences called Perception and Cognition.

**Social and Economic Phenomena**

**Jan K. Brueckner**

The effects of land-use regulation have been extensively studied by urban economists. Gauging these impacts requires measurement of the scope of local regulation, and such measures have been generated by a number of different surveys of local governments, which tally the various types of regulations in place. While information on the regulation’s scope is valuable, it does not provide
an answer to a different important question. The question concerns the stringency land-use regulation. A stringency measure gauges the degree to which regulations cause land-use characteristics to diverge from free-market levels. For example, in the case of building heights, a stringency measure would capture the degree to which regulated heights fall short of those that would be chosen in the absence of regulation. A new measure of stringency relies on the intuitive proposition that relaxing a stringent regulation raises land value per square foot by more than relaxing a less-stringent one. To identify stringency, the log of land value per square foot (from a data set of vacant land transactions) is regressed on the log of the regulated building height for the parcel and other covariates, and the resulting height coefficient constitutes the stringency measure. This method is applied to data from five US cities, and the results show that stringent building height regulation exists in New York (with the Manhattan being the most stringent borough) and Washington DC, which has a well-known height limit.

Jean-Paul Carvalho

This year, I have continued working on foundational issues in the economics of identity, culture and religion using game-theoretic techniques. My projects include:

1. A book volume titled *Advances in the Economics of Religion* which I co-edited with Sriya Iyer and Jared Rubin which brings together leading scholars to take stock of developments in the rapidly growing field and chart directions for future research. The volume will be published by Palgrave in 2019.

2. A paper titled “Religious Clubs: The Strategic Role of Religious Identity” which will be published in *Advances in the Economics of Religion*.

3. With Christian Dippel, an analysis of the evolution of political institutions in the Caribbean after the emancipation of slaves and the gradual replacement of white planters by colored merchants in the island’s legislative assemblies. A working paper titled “Elite Identity and Political Accountability: A Tale of Ten Islands” was produced.

4. With Bary Pradelski, a paper titled “Identity-Dependent Inequality” which studies how underrepresentation of particular groups, especially minorities can arise even when populations are equally productive, and persist indefinitely.

Steve Frank

I began a new line of work that applies engineering control theory to the study of biology systems. That work led to a tutorial book on control theory published by Springer, which I developed to teach myself the principles of the subject. I recently released my first preprint that applies the control concepts to biology (first article listed below). The broad theme concerns error-correcting feedback, which is perhaps the greatest principle of design in both human-engineered and
naturally designed systems. Feedback control has received much attention in engineering, but within biology, there is no comprehensive theory or understanding of the evolutionary dynamics of feedback control and its consequences genetics and biology.

One interesting aspect concerns how error correction within a system compensates for fluctuations in the performance of the system's components. That intrinsic robustness of feedback weakens the direct selective pressure on individual components of a system. Weakened selective pressure on components likely increases their genetic variability and their stochasticity of expression. Although I have discussed those ideas in prior publications, there has been limited work on how control architecture influences the selective pressure on components and the broad consequences for biological variability.

Another interesting problem concerns the differences between the control architecture of human-engineered systems and the regulatory networks within genomes. Gene expression is influenced by many factors, such as transcription factors, methylation, histone codes, DNA folding, intron sequences, RNA splicing, noncoding RNA, and other factors. Vast wiring connectivity links genomic influence to a trait.

An engineer following classic principles of control theory would design a simpler system with fewer connections. Genomes are overwired. They have far more nodes and connections than classically engineered systems. That leads to the question: Why are genomes overwired?

Ami Glazer

I am examining the quest by Amazon for a city to house its second headquarters. Results show that cities with Republican mayors were less likely to submit offers, that most cities did not want to reveal the contents of their offers, or that they even made any offers, that in selecting the twenty finalist cities Amazon favored cities with a population over 1 million, and cities with good mass transit, but that Amazon did not show partisan bias in selecting finalists.

Bernie Grofman

In 2017 I was again asked by a federal court to serve as Special Master, this time in redrawing County Commission and School Board districts in San Juan County, Utah. This is a rural county that is almost perfectly evenly divided between Navajo and non-Navajo residents, but in which Navajo voters had, thanks to gerrymandered lines, never had a majority of elected representatives. The previous plans for the County Commission and School Board has been invalidated as racial gerrymanders, and the redistricting plans the County and the School Board proposed as remedy were found also to be racially tainted. I am pleased to say that the Court ordered plans I had drawn for the Court will be used in the 2018 election. These plans created a racially neutral plan with an even balance between districts in which Navajos and non-Navajos were in the clear majority, together with one “swing district” for each jurisdiction whose outcome in racial terms could not readily be predicted.
I am the senior author of two Amicus Briefs in court cases involving challenges to partisan gerrymandering. Each brief argued that egregious partisan gerrymandering should be made unconstitutional. In Wisconsin, my 2017 Amicus was filed with the U.S. Supreme Court. That case will be decided sometime in 2018. In Pennsylvania, my 2018 Amicus was filed with the Supreme Court of the State of Pennsylvania. That court invalidated the state’s congressional plan as a partisan gerrymander and, when the Governor and legislature were unable to agree on a remedy plan, the Court issued a plan of its own that is being used in 2018.

Marek Kaminski

Most of my recent work has been connected to the topic of electoral reform and the comparison of single-member districts (SMDs) versus Proportional Representation (PR) systems. I have given several lectures and presentations for top Polish politicians and completed a book that was intended to provide the main source of references on electoral reform introducing SMDs. In the book, I discuss both empirical findings on SMDs and the formal properties of voting methods in the context of Polish politics. In a most recent article I extend formally the concept of a “spoiler” to PR systems and investigate how spoilers affected Polish politics between 1991 and 2015.

Michael McBride

With a co-author, I experimentally studied the relationship between rule-following behavior and social beliefs. In a laboratory experiment, we found that the willingness to follow social rules is sensitive to information about the social environment and the beliefs about others' willingness to follow rules. This work is still in progress.

Cailin O’Connor

This year my research focused especially on using models to understand epistemic communities, like those in academia and industry research. I produced ten new papers. These focused mainly on modeling scientific groups, and also on modeling the emergence of inequitable norms. In addition, I have produced some experimental work on the emergence of linguistic meaning with co-authors. Along with IMBS member Jim Weatherall, I wrote a book titled *The Misinformation Age*, which discusses the social spread of false beliefs, and will be published with Yale University Press in January 2019. My monograph *The Dynamics of Inequity* is now accepted at Oxford University Press.

Don Saari

Most of this year has been devoted toward completing long, long overdue projects. One was a book, “Mathematics Motivated by the Social and Behavioral Sciences,” which is an NSF project (based on my series of 10 lectures) and completed during fall term. It published in February 2018 by SIAM (Society for Industrial and Applied Mathematics).
A second book, with Dan Jessie, is being written; it is on the decomposition of games. As a brief explanation, it is appreciated how games (such as the Prisoner’s Dilemma, Battle of Sexes, Hawk–Dove, ultimatum, etc.) exhibit a tension between individual actions and cooperative opportunities. But, this tension is hidden; it must be extracted from the analysis. The decomposition (which is unique and follows from Representation Theory of mathematics) makes the analysis simpler by explicitly separating the two parts. We expect the book to be completed by the end of the summer.

Rein Taagepera

Take the number of seats in a representative assemble and the number of seats in districts through which this assembly is elected. From just these two numbers, Votes from Seats deduct the number of parties in the assembly and in the electorate, as well as the size of the largest party. Four laws of party seats and votes are constructed by logic and tested, using scientific approaches rare is social sciences.

Vijay Vazirani

Over the last year, my research was concentrated around two problems: (1). The outstanding open problem, within theoretical computer science, of obtaining a fast parallel, NC, algorithm for finding a perfect matching in a graph. (2). My graduate student, Tung Mai, and I introduced and studied the problem of finding stable matchings that are robust to errors in the input. Even though the area of finding robust solutions to algorithmic and optimization problems is a mature one, surprisingly enough, the stable matching problem has not been studied from this viewpoint.

Under the first problem, Nima Anari and I solved the thirty-plus year old open problem of obtaining an NC algorithm for planar graphs. Under the second, Mai and I explored the deep structural properties of lattices of stable matching instances to give a polynomial time algorithm for the special case that the erroneous instance is obtained from the given one by permuting (arbitrarily) the preference list of any one boy or any one girl.
### III. IMBS FACULTY RESEARCH SEMINARS AND LABORATORIES

#### A. Research Seminars

The research activities of the Institute often result in graduate research seminars. Among those this year:

<table>
<thead>
<tr>
<th>Instructor</th>
<th>Title</th>
<th>Term</th>
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<tbody>
<tr>
<td>Jeff Barrett</td>
<td>Foundations of Quantum Mechanics</td>
<td>Spring 2018</td>
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<tr>
<td>Bill Batchelder</td>
<td>Mathematical Models of Cognitive Processes</td>
<td>Spring 2018</td>
</tr>
<tr>
<td>Carter Butts</td>
<td>Analysis of Network Data (Sociology)</td>
<td>Winter 2018</td>
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<tr>
<td>Jean-Paul Carvalho</td>
<td>Microeconomic Theory</td>
<td>Winter 2018</td>
</tr>
<tr>
<td>Jean-Paul Carvalho</td>
<td>Economics of Identity &amp; Culture</td>
<td>Spring 2018</td>
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<tr>
<td>David Eppstein</td>
<td>Weekly seminar on theoretical computer science</td>
<td>F,W,S, 17-18</td>
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<tr>
<td>Steve Frank</td>
<td>Evolution with strong emphasis on theoretical concepts</td>
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<tr>
<td>Ami Glazer</td>
<td>Workshop in Industrial Organization and Corporate Welfare Studies</td>
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<tr>
<td>Simon Huttegger</td>
<td>Reading group on formal epistemology</td>
<td>F,W,S 17-18</td>
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<tr>
<td>Marek Kaminski</td>
<td>Game Theory</td>
<td>Fall 2017</td>
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<tr>
<td>Marek Kaminski</td>
<td>Voting Theory</td>
<td>Winter 2018</td>
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<tr>
<td>Robin Keller</td>
<td>Operations Analytics</td>
<td>Fall 2017</td>
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<tr>
<td>Robin Keller</td>
<td>Decision Analysis</td>
<td>Spring 2018</td>
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<tr>
<td>Cailin O’Connor</td>
<td>Philosophy of Modeling</td>
<td>Spring 2018</td>
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<tr>
<td>George Sperling</td>
<td>Seminar on Vision</td>
<td>Winter 2018</td>
</tr>
<tr>
<td>Narens &amp; Skyrms</td>
<td>Social Dynamics</td>
<td>F&amp;W 2017-18</td>
</tr>
<tr>
<td>Brian Skyrms</td>
<td>Evolution of Signaling</td>
<td>Spring 2018, Stanford</td>
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<tr>
<td>Vijay Vazirani</td>
<td>Computer Science Theory Seminar</td>
<td>Spring 2018</td>
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<tr>
<td>James Weatherall</td>
<td>Philosophy of Cosmology Seminar</td>
<td>Spring 2018</td>
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<tr>
<td>James Weatherall</td>
<td>Philosophy of Physics Reading/Working Group</td>
<td>Fall 2017 – Spring 2018</td>
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</table>

**Seminars presented while on visiting faculty status:**

**Stanford University**

<table>
<thead>
<tr>
<th>Instructor</th>
<th>Title</th>
<th>Term</th>
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<tbody>
<tr>
<td>Brian Skyrms</td>
<td>Evolution of Signaling</td>
<td>Spring 2018</td>
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</tbody>
</table>
B. Research Laboratories

**Mathematical Reasoning for the Sciences**  
Faculty Organizer: **Don Saari**

As labeled by the students, “Don squad.” This weekly discussion group identifies and discusses research issues coming from the social and behavioral sciences. An interesting aspect is how a goal is to identify what kinds of mathematics needs to be invented, or modified, to address these issues. Weekly meeting times scheduled each quarter to accommodate class and teaching schedules.

**Experimental Social Science Laboratory (ESSL)**  
Faculty Organizer: **Mike McBride and John Duffy**

The Experimental Social Science Laboratory (ESSL) is a computer laboratory for the experimental study of individual and interactive decision making. Located at SBSG 1240, the laboratory can conduct computer-based experiments of up to 40 subjects, but ESSL also has capabilities to conduct internet-based experiments. ESSL is available for use by researchers of all social scientific disciplines who conduct experiments according to the standards of experimental economics. ESSL personnel are affiliated with many departments in the UCI School of Social Science, including Economics, Anthropology, Cognitive Sciences, Logic and Philosophy of Science, Political Science, and Sociology, and also with departments in the School of Social Ecology and Paul Merage School of Business.

**Social Network Research Group (SNRG)**  
Faculty Organizer: **Carter Butts**

The Social Network Research Group (SNRG) is a weekly meeting of researchers in the social network area. The SNRG welcomes discussions and/or presentations of current theoretical, methodological, and/or empirical work on or of relevance to the study of social structure. Discussion of “early phase” research and preliminary findings are especially welcomed, as are presentations by students and newcomers to the field. The SNRG meets weekly throughout the academic year, at a time and place that is determined on a quarterly basis. Attendance is open to all interested members of the university community, and “drop-ins” are welcome. The SNRG also is an activity of the UCI Center for Networks and Relational Analysis (www.relationalanalysis.org).

**Cognition and Color Reading Group**  
Research Organizer: **Kimberly Jameson**

A weekly discussion group of published research articles, or participants' on-going research interests, on topics of cognition and color perception. Topics covered in recent years include: Color perception correlates of photopigment opsin genes, psychophysical investigations of heterochromatic luminance discrimination, adaptive optics imaging of the human retina, comparative color vision behavior, neural correlates of human color perception, individual
variation and color perception, color vision diagnostics and clinical applications, etc. Research topics discussed typically focus on higher-order aspects of color processing, exploring front-end processing issues when they bear on phenomenology. Meeting location: SSPA 2142

Meeting time: Fridays, 11:00 am - 12:30 pm; meeting dates designated at the beginning of each quarter. Schedule posted at: http://www.imbs.uci.edu/~kjameson/ColorCogFALL2017.html

**Social Dynamics**  
Faculty Organizer: **Brian Skyrms**  
Social Dynamics is a research seminar, where graduate students and faculty present research projects, and there is vigorous critical discussion.  
Instructors: Louis Narens, Don Saari, and Brian Skyrms  
Meets fall quarter on Tuesdays, 2:00 - 5:00 p.m. on 7th floor of the Social Science Tower.

**Computational Models of Language Reading Group (CoLa)**  
Faculty Organizer: **Lisa Pearl**  
Topics of interest for the group include computational models of language learning, computational learning theory, principles underlying models of language acquisition and language change, and models of information extraction from language by humans. We meet four times a quarter for about an hour, and it’s usually a nicely feisty discussion.  
Day/time to meet will be updated on the website.

**IV. GRADUATE TRAINING**

**A. Ph.D. Students**

Louis Narens is the Director of the MBS graduate program.

The following is our current roster of 10 students enrolled in the Ph.D. program in Mathematical Behavioral Sciences during the current academic year. They are listed in Appendix F.

Nikhil Addleman  
Lucila Arroya  
Calvin Cochran  
Steven Doubleday  
Maryam Gooyabadi  
Santiago Guisasola  
Kirbi Joe  
William Leibzon  
Joseph Nunn  
Junying Zhao

Noted academic and research related achievements by our MBS graduate students include Kirbi Joe who was selected to participate as a fellow at the 2018 Santa Fe Institute Graduate Workshop in Computational Social Science, and both Maryam Gooyabadi and Kirbi Joe, who received the
Social Sciences Associate Dean Fellowships for Winter Quarter, thus freeing up the both from their TA responsibilities to focus on dissertation research.

B. Graduate Activities

While the formal part of our graduate program is small, the actual impact on the UCI graduate program is more extensive. MBS graduate students meet weekly with the interim director and weekly colloquium speaker to discuss current research, allowing for expanded interaction and networking opportunities with professors and researchers.

Efforts to further develop graduate students’ current research are demonstrated in Kirbi Joe’s participation as a fellow at the Santa Fe Institute’s Summer Graduate Workshop in Computational Social Science (GWCSS), Nikhil Addelman’s paper presentation at the International Conference on Game Theory, and Calvin Cochran’s and Maryam Gooyabadi’s paper presentations at the 18th International Symposium on Dynamic Games and Applications.

C. Friday Research Presentations

This IMBS activity was coordinated by MBS graduate students and participants Nikhil Addleman and Maryam Gooyabadi. Weekly research meetings give space for graduate students and faculty to gather on Fridays from Noon – 1:00 p.m. in the Luce Conference Room to introduce research they are working on. Graduate students from surrounding graduate programs participate on a regular basis with our weekly Friday lecture section and our annual graduate student conference. This year, presentations included a graduate student from Claremont University’s Neuroeconomics Studies and a postdoctoral fellow from Caltech’s Social and Informational Science Lab. The presentations are followed by discussion periods afterwards.

This year’s presentations are as follows:

**October 6**
ALEXANDER BOCK
Visiting Researcher
RG Information Systems and Enterprise Modeling
Institute for Computer Science and Business Information Systems
University of Duisburg-Essen

**October 27**
KIRBI JOE
MBS Graduate Student
“Determining Minimized Flicker Settings: An application of Digital Micro-mirror Devices to examine human color vision genotypes”
November 3
ED HOPKINS
Visiting Professor
School of Economics
University of Edinburgh
“Higher Education as a Signal of Non-Cognitive Skills: Self-Control Preferences in a High Temptation Environment”

December 1
CALVIN COCHRAN
Graduate Student
Mathematical Behavioral Sciences
UC Irvine
“Hierarchical Models for the Evolution of Compositional Language”

January 13
Louis Narens
Professor
Cognitive Sciences
Logic and the Philosophy of Science
UC Irvine
“A Multiple World Approach to Contextuality”

January 26
PATHIKRIT BASU
Linde Postdoctural Fellow
Caltech
Social and Informational Sciences Lab
Department of Computing and Mathematical Sciences
“On interim rationality, belief formation and learning in decision problems with bounded memory”

February 16
NIKKI FIDER
Graduate Student, Mathematics
“A study of color category boundaries”

March 2
ADRIANA KRAIG
Graduate Student
Claremont Graduate University's Center for Neuroeconomics Studies
“The Neurophysiology of Corporate Apologies”
April 6
AYDIN MOHSENI
Graduate Student, Logic and Philosophy of Science
“Truth and Conformity on Networks”

April 27
TRAVIS LACROIX
Graduate Student, Logic and Philosophy of Science
“Power by Association”

May 11
Lucila Arroya and Kirbi Joe
MBS Graduate Students
“Accommodation dynamics for comparing utilities with others – An Empirical Application of Narens, L. and Skyrms, B., 2017”

May 25
Joseph Nunn
MBS Graduate Student
“Human-Inspired Stock Price Time Series Forecasting Using Deep Learning to Integrate Varied Data”
D. Duncan Luce Graduate Student Conference

IMBS sponsors a yearly graduate student conference where students in the MBS program, as well as other students whose research interests are related to MBS, present their research. The graduate organizers of the 17th Annual conference were MBS graduate students Nikhil Addleman and Maryam Gooyabadi.

IMBS Luce Graduate Student Conference
Friday, June 1, 2018
SSPA 2112

<table>
<thead>
<tr>
<th>Time</th>
<th>Session I</th>
<th>Session II</th>
<th>Session III</th>
<th>Session IV</th>
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<tbody>
<tr>
<td>9:00</td>
<td>Welcome Reception</td>
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<tr>
<td>9:20</td>
<td>Lucila Arroyo, MBS</td>
<td>Joseph Nunn, MBS</td>
<td>Santiago Guisasola, MBS</td>
<td>Aydin Mohseni, L&amp;PS</td>
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<td></td>
<td>Altruism and Guilt: An fMRI Study</td>
<td>Learning Agent Controllers from Emergent Behavior</td>
<td>A New Perspective into Potential Games</td>
<td>Confirmation Bias, News, and Belief Polarization</td>
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<tr>
<td>9:45</td>
<td>Kirbi Joe, MBS</td>
<td>Nishtha Sharma, Economics</td>
<td>Nikhil Addleman, MBS</td>
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<td>10:10</td>
<td>Maryam Gooyabadi, MBS</td>
<td>Erya Yang, Economics</td>
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<td></td>
<td>Surveying for Ideological Components: A Cultural Consensus Approach</td>
<td>Optimism and Pessimism in Bargaining and Contests</td>
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<td>10:35</td>
<td>Break</td>
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<tr>
<td>11:45</td>
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<tr>
<td>12:20</td>
<td>Lunch</td>
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<td>1:50</td>
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<td>2:15</td>
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<tr>
<td>2:40</td>
<td>Break</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>3:00</td>
<td>Aydin Mohseni, L&amp;PS</td>
<td></td>
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</tr>
</tbody>
</table>
3:25 Calvin Cochran, MBS
Synonyms, Bottlenecks, and Chains in Lewis Signaling Games: An Empirical Study

3:50 Closing Remarks and Cake Reception

E. Jean-Claude Falmagne Dissertation Award

Each year, IMBS presents the Jean-Claude Falmagne Dissertation Award to a graduate student for the best dissertation that uses mathematics to develop conceptual advances for issues coming from the social and behavioral sciences. Going beyond the use of mathematics for computational purposes, the intent is to award a dissertation that uses concepts from mathematics to reach new conclusions. The prize is $1,500. Last year IMBS selected Hannah Rubin, 2017 graduate of Logic and Philosophy of Sciences for her dissertation, “The Explanatory Value of Inclusive Fitness for Evolutionary Theory.”

Graduate students Timmy Ma, mathematics, and Cole Williams, economics, are the 2018 IMBS Jean-Claude Falmagne Dissertation Award co-recipients.

Ma transferred from El Camino Community College to UC Berkeley where he received his bachelor’s degree in mathematics. In June, he earned his Ph.D. in mathematics at UC Irvine. His dissertation, “A Nonlinear Approach To Learning From An Inconsistent Source,” focused on mathematical modeling of language learning. Over the past several years, Ma dedicated time to develop his teaching and was a Pedagogical Fellow for his department. Ma will begin his postdoctoral fellowship at Dartmouth College in the fall.

Williams received his bachelor's degree in economics and mathematics UC Riverside in 2013. He earned his Ph.D. in economics at UCI in 2018. Cole's research is in information economics. His dissertation, “Heterogeneity in Learning,” focused on social learning in environments with heterogeneity. He is currently a postdoctoral researcher on the Information Acquisition, Diffusion and Disclosure in Markets project at the University of Vienna.
V. COMMUNICATION

A. IMBS Conferences

The director’s statement expanded on the areas of interest for this year’s research conferences. We are providing the following conference agenda to give a more in-depth look at the scope of our presentations.

University of California, Irvine
Institute for Mathematical Behavioral Sciences (IMBS)
November 17 & 18, 2017, SSPA 2112

Conference on Symmetry and Invariance in the Natural and Behavioral Sciences

ABSTRACT

Symmetry is one of the fundamental concepts in math and physics. It refers to the invariance of systems and phenomena in the presence of transformations. Said more simply, symmetry refers to regularities in nature. This simple definition makes it clear that symmetry is a very general concept because biological, psychological, as well as engineering systems and phenomena are also characterized by regularities. It is universally agreed that without symmetry, science, as we know it, could not exist. Furthermore, the same could be said about all of our arts.

Symmetry and invariance are usually used as synonyms because the same mathematical formalisms can be applied to both concepts. The choice of one of these terms rather than the other seems to depend on the historical conventions operating in individual specialties, as well as on the preferences of the individuals, who talk about symmetry and invariance. One may, however, have a preference for considering symmetry the more general concept because symmetry often includes the concept of redundancy, invariance does not. We call biological and engineering objects “symmetrical” precisely because they are characterized by redundancy, which means that one part of the object is identical, or at least similar to another part of the same object. This is surely true when we consider the bodies of animals, all of which are mirror symmetrical, plants that are mirror-, rotationally- and/or translationally-symmetrical, as well as man-made objects whose symmetry usually depends on the function they serve. Redundancy can also be present in signals as well as in objects. Redundancy in biological, psychological and engineering signals allows one to compress them and transmit them in a more economical way. Arguably, there is even a more important property inherent in the redundancy of signals, namely, redundancy allows one to derive new invariants when the signals undergo many-to-one and one-to-many mappings, as they always do in visual, auditory and haptic perception.
This workshop will explore all of these many aspects of symmetry as it is used in mathematics, physics, biology, psychology, engineering and philosophy. The ubiquity of symmetry, combined with well-established formalisms to deal with it, make symmetry a particularly good candidate for interdisciplinary interactions and collaborations.

**Schedule of Talks**

**Friday, November 17, 2018**

10:00AM | Welcome and opening remarks: Jean-Paul Carvalho, UCI  
10:10AM | Don Saari, UCI, *Hidden symmetries inherent to decision methods*  
10:50AM | Steve Frank, UCI, *Common probability patterns arise from simple invariances*  
11:30AM | Break  
11:50AM | Jean-Claude Falmagne, UCI, *Meaningfulness as a Symmetry and Invariance Axiom with some Examples of Derived Laws*  
12:30PM | Lunch Break  
2:00PM | Zyg Pizlo, UCI, *The Role of Symmetry in Veridical 3D Shape Perception*  
2:40PM | Don Hoffman, UCI, *Symmetry Does Not Entail Veridicality*  
3:20PM | Natalia Komarova, UCI, *Symmetry in evolutionary dynamics: case studies from medicine to language*  
4:00PM | Break  
4:20PM | Yanxi Liu, Penn State, *Computational Regularity: Theory and Applications*  
5:00PM | Tony Norcia, Stanford, *Neural and computational foundations of human symmetry processing*  
5:40PM | Adjourn

**Saturday, November 18, 2018**

10:00AM | Ronaldo Vigo, Ohio University, *An Invariance-based Foundation for Cognition: Accounting for Key Empirical Results on Conception, Perception, and Choice with Generalized Invariance Structure Theory*  
10:40AM | Geoff Iverson, UCI, *ROCs, dual ROCs and symmetric ROCs*  
11:20AM | Break  
11:30AM | Simon Huttegger, *Role of symmetries in inductive inference*  
12:10PM | Louis Narens, UCI, *Generalized Symmetry*  
12:50PM | Closing Remarks, Jean-Paul Carvalho, UCI  
1:00PM | Conference Adjourns
Conference on Identity, Cooperation and Conflict

ABSTRACT

Cooperation and conflict have played critical roles in human evolution and the structure of social and economic systems. This conference aims to build a richer, more unified understanding of the role of identity in cooperation and conflict. The conference brings together leading scholars from a range of disciplines including economics, political science, evolutionary biology and anthropology. Topics covered include identity formation, identity-based inequality, and extremism. The emphasis will be on models of identity, while novel data, experiments and case studies will also be presented.

Schedule of Talks

Friday, April 13, 2018

10:00AM Opening Remarks: Jean-Paul Carvalho & Stergios Skaperdas, UCI
10:10AM Peter Richerson, UC Davis, Cultural Group Selection Play an Essential Role in Explaining Human Cooperation: A Sketch of the Evidence
10:50AM Cristina Moya, UC Davis, How did culture change human reasoning about groups?
11:30AM Break
11:50AM Robert Akerlof, University of Warwick, Group Identity
12:30PM Lunch Break
2:00PM Michael McBride, UCI, Identity and the Escalation of Conflict
2:40PM Deborah Hall, ASU, Costly Signaling, Group Identity, and Perceptions of Trust
3:20PM Break
3:40PM Christian Dippel, UCLA, Leadership and Social Norms: Evidence from the Forty-Eighters in the Civil War
4:20PM Jared Rubin, Chapman University, The Cultural Transmission of Trust Norms: Evidence from a Lab in the Field on a Natural Experiment
5:00PM Adjourn

Saturday, April 14, 2018

9:30AM Jeff Kopstein, UCI, Intimate Violence: Anti-Jewish Pogroms on the Eve
ABSTRACT

This conference convenes current and future leaders in language science who utilize mathematical methods -- implemented either analytically or through computational simulation -- for understanding natural language. Such methods serve as tools for theory specification and evaluation, allowing practitioners to make their theoretical commitments precise while delivering both qualitative and quantitative predictions that are testable against human behavior. These quantitative approaches to language science target a variety of subfields, including language use and understanding, language development, and the nature of our linguistic representations. Quantitative approaches also serve as an essential bridge to explorations of natural language in combination with computer science, including artificial intelligence and natural language processing.

Despite a good deal of recent progress, the diversity of perspectives and theoretical frameworks often goes unnoticed (or ignored) by individual practitioners, which results in missed opportunities for large-scale advances. By bringing together representatives of this diversity under one roof, we set the stage for a lively discussion aimed at increasing awareness, clarifying positions, and fostering collaboration.
# Schedule of Talks

## Friday, May 4, 2018

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>9:30AM</td>
<td>Welcome Reception</td>
</tr>
<tr>
<td>10:00AM</td>
<td>Richard Futrell, MIT/UCI, <em>Information locality: An information-theoretic principle of natural language word order</em></td>
</tr>
<tr>
<td>11:00AM</td>
<td>Masha Fedzechkina, University of Arizona, <em>Human information processing shapes language change</em></td>
</tr>
<tr>
<td>12:00PM</td>
<td>Discussion</td>
</tr>
<tr>
<td>12:30PM</td>
<td>Lunch Break</td>
</tr>
<tr>
<td>2:00PM</td>
<td>Kyle Gorman, Google Inc, <em>Linguistic insights in text normalization</em></td>
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<tr>
<td>3:00PM</td>
<td>Michael Frank, Stanford University, <em>Variability and consistency in early language learning: The Wordbank project</em></td>
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<tr>
<td>4:00PM</td>
<td>Discussion</td>
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</table>

## Saturday, May 5, 2018

<table>
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<tr>
<th>Time</th>
<th>Event</th>
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<tr>
<td>9:30AM</td>
<td>Morning Reception</td>
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<tr>
<td>10:00AM</td>
<td>Emily Morgan, UC Davis, <em>Generative and item-specific knowledge in language processing</em></td>
</tr>
<tr>
<td>11:00AM</td>
<td>Timothy O’Donnell, McGill University, <em>Algorithmic program synthesis of morphophonological rules</em></td>
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<tr>
<td>12:00PM</td>
<td>Discussion</td>
</tr>
<tr>
<td>12:30PM</td>
<td>Lunch Break</td>
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<tr>
<td>2:00PM</td>
<td>Judith Degen, Stanford University, <em>Rethinking ‘overinformativeness’ as rationally redundant reference</em></td>
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<tr>
<td>3:00PM</td>
<td>Roger Levy, MIT, <em>Gender bias in preferred linguistic descriptions for expected events</em></td>
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<tr>
<td>4:00PM</td>
<td>Discussion</td>
</tr>
<tr>
<td>4:30PM</td>
<td>Conference Adjourns</td>
</tr>
</tbody>
</table>
B. Conferences/Seminars Organized By IMBS Members

**Jeff Barrett**

**Carter Butts**

**Jean-Paul Carvalho**

**David Eppstein**

**Simon Huttegger**
Organizer, Topics in Scientific Philosophy, February 2018, LPS, UC Irvine.

**Michael Lee**
Co-organizer, “Workshop on Robust Social Science”, June 2018, Tampa, FL. Funded by NSF.

**Louis Narens**

**Cailin O’Connor**
Lisa Pearl
Session Chair, “1st Annual Meeting of the Society for Computation in Linguistics”, January 2018, Salt Lake City, Utah.

Zyg Pizlo
“Annual Interdisciplinary Conference”, February 2018, Jackson Hole WY.
“Workshop on Computational and Mathematical Models”, May 2018, St. Pete Beach, FL.

Gregory Scontras
“California Universities Semantics and Pragmatics”, October 2017, UC Irvine.

Stergios Skaperdas

Brian Skyrms
Organizer, Topics in Scientific Philosophy, February 2018, LPS, UC Irvine.

Tom Trogdon

James Weatherall
C. Visitors

IMBS hosted several visiting faculty this year, Robbei Akerlof, Bary Pradelski, Jonathan Newton, and Ulf Dietrich Reips.

Associate Researcher Tim Satalich continues work with Professor Kim Romney, and Project Scientist Robert Forbes continues work with Professor Louis Narens.

D. IMBS Colloquium Series

During the academic year the Institute conducts a weekly colloquia series with speakers from both inside as well as outside the Institute. For speakers outside California, we attempt, insofar as possible, to coordinate their visit with other travel to California and to co-sponsor joint talks with other research units. We distribute a relevant paper, when available, prior to each colloquium. Most papers are also downloadable from the IMBS web site at http://www.imbs.uci.edu/newsevents/events/colloquia.php.

The following talks were presented in the IMBS Luce Conference Room during the 2017 – 2018 academic year:

**OCTOBER 5**
**ZYG MUNT PIZLO**
Professor and Falmagne Chair of Cognitive Sciences
UC Irvine
“A New Science of Mind Based on Symmetry”

**OCTOBER 12**
**IGOR KOPYLOV**
Associate Professor of Economics
UC Irvine
“Subjective Beliefs and Confidence When Facts Are Forgotten”

**OCTOBER 19**
**ANN KANDLER**
Senior Scientist, Institute for Evolutionary Anthropology
Department of Human Behavior, Ecology and Culture
Max Planck Gesellschaft
“Inferring processes of cultural transmission from cultural frequency data”
OCTOBER 26
JASON MARDEN
Associate Professor of Electrical Engineering and Computer Engineering
UC Santa Barbara
“The Role of Information in Multiagent Coordination”

NOVEMBER 2
MIKE ALVAREZ
Professor of Political Science
CalTech
“Strategy and choice in primary elections”

NOVEMBER 9
TIM HUNTER
Assistant Professor, Department of Linguistics
UCLA
“Formally connecting linguistic competence and performance”

NOVEMBER 16
JEFF ELY
Professor of Economics
Director, Mathematical Methods in the Social Sciences Program
Northwestern University
“Moving the Goalposts”

NOVEMBER 30
MIHAI MANEA
Associate Professor
Department of Economics
MIT
“Bottleneck Links, Essential Intermediaries and Competing Paths of Diffusion in Networks”

DECEMBER 7
INES LEVIN
Assistant Professor, Political Science
UC Irvine
“Learning about The Influence of Spatial and Temporal Proximity using Regression Trees”

January 11
CAILIN O’CONNOR
Assistant Professor, Logic and Philosophy of Sciences
UC Irvine
“How to Beat Science and Influence People”
January 25
JORGE PACHECO
University of Minho, Portugal
“Testing the success of reward mechanisms in climate agreements via behavioral experiments”

February 1
TOM TROGDON
Assistant Processor, Mathematics
UC Irvine
“Universality: Algorithm runtimes and human decision making”

February 8
BARY PRADELSKI
Postdoctoral Researcher
ETH Zurich
“The assignment game: Decentralized dynamics, rate of convergence and value of information”

February 22
IGOR KOPYLOV
Associate Professor, Economics
UC Irvine
“Subjective State Spaces and Revealed Preferences”

March 1
JONATHAN NEWTON
“Agency, potential and contagion”

March 15
OMER TAMUZ
Assistant Professor, Mathematics and Economics
CalTech
“Social Learning Equilibria”

April 5
JEAN ENSMINGER
Edie and Lew Wasserman Professor of Social Science
CalTech
“Measuring Corruption: Unmasking Strategic Data Manipulation”

April 12
PETER RICHERSON
Distinguished Professor Emeritus, Department of Environmental Science and Policy
UC Davis
“Human Evolution in Pleistocene: A World Queerer that We Supposed”
April 19
PHIL RENY
Hugo F. Sonnenschein Distinguished Service Professor in Economics
University of Chicago
“Perfect Conditional Epsilon-Equilibria of Multi-Stage Games with Infinite Sets of Signals and Actions”

April 26
JOACHIM VANDEKERCKHOVE
Associate Professor, Cognitive Sciences
UC Irvine
“Robust Tests of Theory With Randomly Sampled Experiments”

May 10
ERIK SUDDERTH
Associate Professor of Computer Science
UC Irvine
“Multiscale Semi-Markov Dynamics for Brain-Computer Interfaces”

May 17
ULF-DIETRICH REIPS
Professor, Department of Psychology
University of Konstanz
“Methods of experimental and nonexperimental internet-based research”

May 24
ADAM WIERMAN
Professor, Department of Computing and Mathematical Sciences
Caltech
“Transparency and Control in Platforms & Networked Markets”

May 31
KIMBERLY JAMESON
Project Scientist, IMBS
UC Irvine
“Modeling color vision in relation to individual color perception and photopigment opsin genotypes”
VI. BUDGET

A. Appropriations and Expenditures

**Appropriations:**

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<tr>
<th>Description</th>
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<td>2017-18 IMBS Budget allocation</td>
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<td>2017-18 Overhead return</td>
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<td>2016-17 Carry Forward</td>
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<td><strong>Total budget for 2017-18:</strong></td>
<td><strong>$108,749.00</strong></td>
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**Expenditures:**

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<th>Description</th>
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<td>Social Sciences Business Office (Admin. Sup)</td>
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<tr>
<td>Social Sciences Business Office (Overhead)</td>
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</tr>
<tr>
<td>Conference/Colloquia/Seminars</td>
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<tr>
<td>Supplies &amp; Expenses</td>
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<td>Graduate Student Support</td>
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<tr>
<td><strong>Total Expenditures:</strong></td>
<td><strong>$108,749.00</strong></td>
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</tbody>
</table>

*Closed fiscally solvent*
B. Extramural Funding Activity

GRANTS AWARDED AND ACTIVE:

IMBS faculty research was supported by research grants totaling $16,338,568. The following is a detailed breakdown of the extramural funding:

William H. Batchelder

Source: NSF
Amount: $260,000
Award Period: 2015 – 2018
Title: Statistical Extensions and new Application of Cultural Consensus Theory
Role: Co-PI
Seeking no-cost extension through 2019.

Carter Butts

Source: NSF MMS
Amount: $441,705
Award Period: 2018 – 2021
Title: Statistical Models for Dynamic Networks with Endogenous Vertex Migration
Role: PI

Source: NSF CMMI
Amount: $458,876
Award Period: 2015 – 2018
Title: Collaborative Research: Online Hazard Communication in the Terse Regime: Measurement, Modeling, and Dynamics
Role: PI

Source: NSF CMMI Supplemental Award
Amount: $49,743
Award Period: 2015 – 2018
Title: Collaborative Research: Message Retransmission and Amplification in the Context of Meteorological Hazards
Role: PI
Source: NSF DMS
Amount: $1,308,441
Award Period: 2014 – 2018
Title: Bayesian Methods for Protein Fibrillization: Model Integration and Network Dynamics
Role: PI and Martin, Rachel W. (Co-PI)

Source: NSF IIS
Amount: $499,758
Award Period: 2015 – 2018
Title: III: NeTS: Small: Network Sampling and Construction Methods for Inference and Anonymization
Role: Co-PI with Markopoulou, Athina (PI)

**Steve Frank**

Source: NSF
Award Amount: $275,000
Award Period: 2013 – 2018
Title: ABR: Models of Natural Selection, Development, and Life History
Role: PI

**David Eppstein**

Source: NSF
Award Amount: $159,987
Award Period: 2016-2019
Title: Collaborative Research: Efficient Algorithms for Cycles on Surfaces
Role: Co-PI

Source: NSF
Award Amount: $415,894
Award Period: 2016-2019
Title: Sparse Geometric Graph Algorithms
Role: PI

**Ami Glazer**

Source: Troesh Family Foundation
Award Amount: $150,000
Award Period: 2017
Title: Program in Corporate Welfare Studies
Role: PI
Source: Charles Koch Foundation
Award Amount: $445,000
Award Period: 2018
Title: Program in Corporate Welfare Studies
Role: PI

Kimberly A. Jameson

Source: Competitive Award School of Medicine and School of Biological Sciences, UCI
Award Amount: $48,724
Award Period: 2017
Title: Clinical and Behavioral Investigations of Human Photopigment Opsin Gene Variations and Age-related Macular Degeneration
Role: Project Lead

Source: Private Donations
Award Amount: $20,888
Award Period: 2015-2017
Title: Clinical and Behavioral Investigations of Human Photopigment Opsin Gene Variations and Age-related Macular Degeneration
Role: PI with C.M. Kenney (Co-PI)

Source: Private Donation
Award Amount: $18,500
Award Period: 2015-2018
Title: Clinical and Behavioral Investigations of Human photopigment Opsin Gene Variations and Age-related Macular Degeneration
Role: PI with C.M. Kenney (Co-PI)

Source: NSF
Award Amount: $980,923
Award Period: 2014 – 2018
Title: IBSS: New methods for investigating the formation of individual and shared concepts and their dynamic dispersion across related societies
Role: PI with N. Komarova (Co-PI), D. Wodarz (Co-PI), L. Narens (Co-PI)
**Natalia Komarova**

Source: NSF DMS  
Award Amount: $131,525  
Award Period: 2017 - 2020  
Title: Collaborative Research: Infection multiplicity and virus evolution, from experiments to large scale multi-population stochastic computations  
Role: PI

Source: NSF  
Award Amount: $980,923 (calculated with Jameson’s award)  
Award Period: 2014 - 2017  
Title: New methods for investigating the formation of individual and shared concepts and their dynamic dispersion across related societies  
Role: Co-PI (with PI K. Jameson)

Source: NIH  
Award Amount: $2,249,999  
Award Period: 2014 – 2019  
Title: Aspirin and Cancer Prevention in Lynch Syndrome: From Cell to Population Data  
Role: Co-PI (with PIs D. Wodarz and D. Levy)

**Louis Narens**

Source: NSF  
Award Amount: $980,923.00 (calculated with Jameson’s award)  
Award Period: 2014-2018  
Title: IBSS: New methods for investigating the formation of individual and shared concepts and their dynamic dispersion across related societies  
Role: Co-PI with K. Jameson (PI), N. Komarova (Co-PI), D. Wodarz (Co-PI)

**Cailin O’Connor**

Source: (NSF) Science, Technology, and Society  
Award Amount: $305,986  
Award Period: 2015 – 2018  
Title: Dynamics and Diversity in Epistemic Communities  
Role: PI
Lisa Pearl

Source: National Institute of Child Health and Human Development
Award Amount: $435,000, UCI Amount: $176,000
Award Period: 2017
Title: Collaborative Research: An Integrated Theory of Syntactic Acquisition
Role: PI

Zyg Pizlo

Source: NIH (NEI)
Award Amount: $940,000
Award Period: 2014-2018
Title: Mechanisms responsible for veridical visual perception
Role: PI

Hal Stern

Source: National Institute of Standards and Technology (NIST)
Award Amount: $20,000,000
Award Period: June 2015 – May 2020
Title: Center of Excellence in Forensic Statistics
Role: Co-PI and PI of UC Irvine subcontract ($3,700,000); A. Carriquiry, PI

Tom Trogdon

Source: NSF DMS
Award Amount: $418,034
Award Period: 2018
Title: Career: Numerical Linear Algebra, Random Matrix Theory and Applications
Role: PI

Source: NSF DMS
Award Amount: $34,999
Award Period: 2018
Title: CBMS Conference
Role: PI
Vijay Vazirani

Source: NSF CISE
Award Amount: $500,000
Award Period: 2018-2021
Title: Algorithms for Matching, Markets, and Matching Markets
Role: PI

James Weatherall

Source: John Templeton Foundation
Award Amount: $1,369,872
Award Period: 2018-2020
Title: New Directions in Philosophy of Cosmology
Role: Co-PI with C. Smeenk, University of Western Ontario

Jack Xin

Source: NSF
Award Amount: $299,890
Award Period: 2015 – 2018
Title: Theory and Algorithms of Transformed L1 Minimization with Applications in Data Science
Role: PI

Hongkai Zhao

Project/Proposal Title: Theory and practice for exploiting the underlying structure of probability models in big data analysis
Source of Support: NSF
Total Award Amount: $249,964
Total Award Period Covered: 06/01/16-05/31/19

Project/Proposal Title: Shape and data analysis using computational differential geometry
Source of Support: NSF
Total Award Amount: $328,860
Total Award Period Covered: 07/01/14-12/31/18

Project/Proposal Title: Intrinsic complexity of random fields and its connections to random matrices and stochastic differential equations (THIS PROPOSAL)
Source of Support: NSF
Total Award Amount: $100,000
Total Award Period Covered: 07/01/2018 – 06/30/2021
PENDING

Lisa Pearl


Under review 2018. National Institute of Health: NICHD. “An integrated quantitative framework for specifying linguistic and non-linguistic sources of child language understanding difficulty”. Children’s ability to understand language in context has a prolonged developmental trajectory, and many pathologies can affect language development, leading to linguistic deficits. This research develops an integrated quantitative framework applied to large-scale naturalistic data in order to assess children’s input and output, explicitly model children’s learning trajectory based on these data, and evaluate model predictions with controlled behavioral experiments. Role: PI. Amount: $1.8 million.

Gregory Scontras

Source: NICHD
Award Amount: $1.8M
Award Period: 2018
Title: An integrated quantitative framework for specifying linguistic and non-linguistic sources of child language understanding difficulty
Role: PI

Source: NSF CompCog
Award Amount: $456,000
Award Period: 2019
Title: Using quantitative methods to articulate linguistic and non-linguistic components of language understanding in context
Role: Co-PI

Hongkai Zhao

Project/Proposal Title: NRT-HDR: Transdisciplinary and Foundational Data Science Program
Source of Support: NSF
Total Award Amount: $2,999,994
Total Award Period Covered: 07/01/2018 – 06/30/2023
APPENDICES

C. CURRENT FACULTY MEMBERS

APPENDIX A
IMBS FACULTY, 2017 - 2018


Pierre F. Baldi, (Ph.D. Mathematics, California Institute of Technology). Distinguished Professor of Computer Science; Director, Institute for Genomics & Bioinformatics, University of California, Irvine. Research areas: Bioinformatics, computational biology, probabilistic modeling, machine learning.

Jeffrey Barrett, (Ph.D. Philosophy, Columbia University). Chancellor's Fellow and Professor of Logic and Philosophy of Science, University of California, Irvine. Research areas: Philosophy of science; theory of knowledge; philosophy of physics.


Michael Birnbaum, (Ph.D. Psychology, University of California, Los Angeles). Professor of Psychology, Cal State University, Fullerton. Research areas: Human judgment, decision-making, and utility measurement.


William A. Branch, (Ph.D. Economics, University of Oregon). Chancellor’s Fellow and Professor of Economics, University of California, Irvine. Research areas: Macroeconomic dynamics.


David Brownstone, (Ph.D. Econometrics and Applied Microeconomics, University of California, Berkeley) Professor and Chair of Economics, University of California, Irvine. Research areas: Computer-intensive analysis of statistical estimation strategies and applied econometrics.


Jean-Paul Carvalho, (Ph.D. Economics, University of Oxford). Associate Professor of Economics, University of California, Irvine. Research areas: Game theory; culture, identity and institutions.


Art De Vany, (Ph.D. Economics, University of California, Los Angeles). Professor Emeritus of Economics, University of California, Irvine. Research areas: Models of industry organization, health, analysis and policy of extreme events, information processing and market institutions.

Barbara A. Dosher, (Ph.D. Experimental Psychology, University of Oregon). NAS Member, Distinguished Professor of Cognitive Sciences, School of Social Sciences, University of California, Irvine. Research areas: Memory, visual perception, depth from visual motion.


David A. Eppstein, (Ph.D. Computer Sciences, Columbia University). Chancellor’s Professor of Computer Science, University of California, Irvine. Research areas: Computational geometry and graph algorithms, including finite element meshing, minimum spanning trees, shortest paths, dynamic graph data structures, graph coloring, graph drawing, geometric optimization, computational robust statistics, and geometric optimization.

Jean-Claude Falmagne, (Ph.D. Psychological Sciences, University of Brussels). Research Professor, Cognitive Sciences, University of California, Irvine. Research areas: Assessment of knowledge, measurement theory, psychophysics, mathematical psychology.

Katherine Faust, (Ph.D. Social Science, University of California, Irvine). Professor of Sociology, University of California, Irvine. Research areas: Mathematical, computational, and conceptual models to study complex phenotypes.

Steven A. Frank, (Ph.D. Biology, University of Michigan). Donald Bren Professor of Ecology and Evolutionary Biology, University of California, Irvine. Research areas: Evolution of social behavior; design of reliability.


Bernard Grofman, (Ph.D. Political Science, University of Chicago). Jack W. Peltason Endowed Chair, Professor of Political Science; Past Director, Center for the Study of Democracy, University of California, Irvine. Research areas: Models of group decision making, models of individual choice, electoral competition.

Donald Hoffman, (Ph.D. Computational Psychology, Massachusetts Institute of Technology). Professor of Cognitive Sciences and Information and Computer Science, University of California, Irvine. Research areas: Formal theories of perception, human and machine vision, recovery of depth from images.

Simon Huttegger, (Ph.D. Universität Salzburg). Chancellor’s Fellow and Professor of Logic and Philosophy of Science Science, University of California, Irvine. Research areas: Probability theory; philosophy of probability, induction, decision theory, social philosophy, dynamical Systems.


Marek Kaminski, (Ph.D. Government and Politics, University of Maryland). Associate Professor of Political Science, University of California, Irvine. Research areas: Political systems and economics in transition, formal models of voting, political consequences of electoral laws, models of allocation and social choice.

L. Robin Keller, (Ph.D. Management Sciences, University of California, Los Angeles). Professor of Management, Paul Merage School of Business, University of California, Irvine. Research areas: Individual decision making, risk analysis, fairness, probability judgements, decision problem structuring.

Igor Kopylov, (Ph.D. University of Rochester). Associate Professor of Economics, University of California, Irvine. Research areas: Microeconomic theory, decision theory, and game theory.


Ines Levin, (Ph.D. Social Science, California Institute of Technology). Assistant Professor, Department of Political Science, University of California, Irvine. Research areas: Quantitative research methods with substantive applications in the areas of elections, public opinion, and political behavior. Statistical and computational methods for studying opinion-formation and decision-making processes.

Simon Asher Levin, (Ph.D. Mathematics, University of Maryland). NAS Member, Director, Center for BioComplexity, George M. Moffett Professor of Biology, Princeton University. Research Areas: Dynamics of populations and communities; spatial heterogeneity and problems of scale; evolutionary ecology; theoretical and mathematical ecology; biodiversity and ecosystem processes.

Mark Machina, (Ph.D. Economics, Massachusetts Institute of Technology). Professor of Economics, University of California, San Diego. Research areas: Utility, decision making, risk behavior.
Penelope Maddy, (Ph.D. Philosophy, Princeton). Distinguished Professor of Logic and Philosophy of Science, and Mathematics, University of California, Irvine. Research areas: Philosophy of mathematics, especially the philosophy of set theory.

Michael McBride, (Ph.D. Economics, Yale University). Professor of Economics, University of California, Irvine. Research areas: Microeconomics, game theory, and political economy.


Andrew Noymer, (Ph.D. Sociology, University of California, Berkeley). Associate Professor of Public Health, University of California, Irvine. Research Areas: Medical demography, mathematical sociology, quantitative methodology.

Cailin O’Connor, (Ph.D. Philosophy, University of California, Irvine) Assistant Professor of Logic and Philosophy of Science, University of California, Irvine. Research Areas: Philosophy of biology, philosophy of science, and evolutionary game theory.

Richard S. Palais, (Ph.D. Mathematics, Harvard University). Adjunct Professor of Mathematics, University of California, Irvine. Research Areas: Mathematical Visualization and more specifically to continue the development of Macintosh program 3D-Filmstrip (now called 3D-XplorMath).

Lisa Pearl, (Ph.D. Linguistics, University of Maryland at College Park). Chair and Associate Professor of Language Science, Associate Professor of Cognitive Sciences, University of California, Irvine. Research areas: Language development, linguistics, computational sociolinguistics, cognitive modeling.

Zygmunt Pizlo, (Ph.D. Psychology, University of Maryland at College Park). Professor and Falmagne Endowed Chair, Cognitive Sciences, University of California, Irvine. Research areas: Human and machine vision, 3D shape, symmetry, virtual reality, robotics, problem solving.

Dale Poirier, (Ph.D. Economics, University of Wisconsin). Professor of Economics, University of California, Irvine. Research areas: Econometrics, both theoretical and empirical, specializing in Bayesian econometrics.

A. Kimball Romney, (Ph.D. Social Anthropology, Harvard University). NAS Member, Emeritus Professor of Anthropology, University of California, Irvine. Research areas: Cognitive anthropology, cultural consensus, informant accuracy, quantitative methods.
Jeffrey Rouder, (Ph.D. Mathematical Behavioral Sciences, University of California, Irvine). Professor and Falmagne Endowed Chair, Cognitive Sciences, University of California, Irvine. Research areas: Mathematical and statistical models of perception and cognition, Bayesian mixed models, psychometrics.

Donald G. Saari, (Ph.D. Mathematics, Purdue University). NAS Member, Distinguished Research Professor of Mathematics and Economics, and Director Emeritus of the Institute for Mathematical Behavioral Sciences, University of California, Irvine. Research areas: Mathematics and application of dynamical systems to social sciences; decision theory.

Stergios Skaperdas, (Ph.D. Economics, Johns Hopkins University). Clifford S. Heinz Chair and Professor of Economics, and Director of Center for Global Peace and Conflict Studies, University of California, Irvine. Research areas: Economic theory and political economy.

Greg Scontras, (Ph.D. Linguistics, Harvard University). Assistant Professor, Language Science, University of California, Irvine. Research areas: Natural language semantics, computational models of language understanding, and heritage languages.

Brian Skyrms, (Ph.D. Philosophy, University of Pittsburgh). NAS Member, Distinguished Professor of Social Sciences, Professor of Logic and Philosophy of Science, and Professor of Economics, and Director of Salzburg Exchange Program, University of California, Irvine. Research areas: Probability, induction, causation, rational choice.


Padhraic Smyth, (Ph.D. Computer Engineering, California Institute of Technology). Professor of Computer Science, University of California, Irvine. Research areas: Statistical pattern recognition, probabilistic learning, information theory, artificial intelligence, image and time-series modeling.

George Sperling, (Ph.D. Psychology, Harvard University). NAS Member, Distinguished Professor of Cognitive Sciences, and Department of Neurobiology and Behavior, University of California, Irvine. Research areas: Human information processing, vision and visual perception, computer vision and image processing.

Ramesh Srinivasan, (Ph.D. Biomedical Engineering, Tulane University). Professor of Cognitive Sciences, University of California, Irvine. Research areas: Perception, development and cortical dynamics.

Hal Stern, (Ph.D. Statistics, University of California, Irvine). Ted and Janice Smith Family Foundation Endowed Chair in Information and Computer Science, Professor of Information and
Computer Science, University of California, Irvine. Research areas: Bayesian methods, model diagnostics, statistical computing.

Mark Steyvers, (Ph.D. Psychology, Indiana University). Professor of Cognitive Sciences, University of California, Irvine. Research areas: Computational models of memory, reasoning and perceptions.

Rein Taagepera, (Ph.D. Physics, University of Delaware). Professor Emeritus of Political Science, University of California, Irvine. Research areas: Quantitatively predictive models; electoral and party systems; Finno-Ugric area studies.

Tom Trogdon, (Ph.D. Applied Mathematics, University of Washington). Assistant Professor of Mathematics, University of California, Irvine. Research areas: Interaction between probability/random matrix theory and numerical analysis, Riemann-Hilbert problems, and applications of universality.

Carole Uhlaner, (Ph.D. Political Science, Harvard University). Professor of Political Science, University of California, Irvine. Research areas: Rational actor models and statistical analyses of political behavior, especially participation and voting; decision theory; comparative politics.

Joachim Vandekerckhove, (Ph.D. Psychology, University of Leuven, Belgium) Associate Professor of Cognitive Sciences, University of California, Irvine. Research areas: Response time modeling – Psychometrics- Computational methods – Bayesian statistics.

James Weatherall, (Ph.D. Philosophy, University of California, Irvine). Professor of Logic and Philosophy of Science, University of California, Irvine. Research areas: Philosophy of physics. Philosophy of space and time, philosophy of science, atomic, molecular, and optical physics (theory), mathematical physics.

Vijay Vazirani, (Ph.D. Computer Science, University of California, Berkeley). Distinguished Professor of Computer Science, University of California, Irvine. Research areas: Algorithmic problems in mathematical economics and game theory, design of efficient exact and approximation algorithms, computational complexity theory.


Hongkai Zhao, (Ph.D. Mathematics, University of California, Los Angeles). Professor of Mathematics, University of California, Irvine. Research areas: Applied and computational mathematics with applications in physics, engineering, imaging science and computer vision.


Kimberly A. Jameson, (Ph.D. Psychology, University of California, Irvine). Project Scientist, University of California, Irvine. Research areas: categorization behaviors; modeling concept formation for perceptual stimuli (e.g., the cognitive organization of color sensations and its relationship to linguistic classifiers); the development and breakdown of these cognitive functions; and optimum performance in tasks involving color-coding(s).

D. SCIENTIFIC PUBLICATIONS

APPENDIX B
SCIENTIFIC PUBLICATIONS OF IMBS MEMBERS, 2017 - 2018

Jeff Barrett


Bill Batchelder


**Michael Birnbaum**


**David Brownstone**

“Vehicle choice and utilization: Improving estimation with partially observed choices and hybrid pairs” (with A. Lloro*), Journal of Choice Modeling 28, 137-152, 2018. [https://doi.org/10.1016/j.jocm.2018.05.005](https://doi.org/10.1016/j.jocm.2018.05.005)

“Aggregation biases in discrete choice models” (with T. Wong* and D. Bunch), Journal of Choice Modelling, 2017. [http://dx.doi.org/10.1016/j.jocm.2018.02.001](http://dx.doi.org/10.1016/j.jocm.2018.02.001)


**Carter Butts**


Jean-Paul Carvalho


David Eppstein


Steve Frank


Michelle Garfinkle


Ami Glazer


**Bernie Grofman**

1. two singly authored chapters in the forthcoming two volume *Oxford Handbook of Public Choice*, of which I am co-editor, on the theory and applications of models of issue voting;
2. a co-authored article in *Public Choice*, on predicting outcomes in the Electoral College;
3. a forthcoming co-authored article in *Election Law Journal*, on the impact of public hearings on congressional redistricting decisions;
4. a forthcoming singly authored article in *Election Law Journal*, on constitutional standards for partisan gerrymandering;
5. a forthcoming co-authored article in the *Journal of Commonwealth and Comparative Studies*, on electoral manipulation in Singapore;
6. a forthcoming co-authored article in the *Journal on Politics*, on models of party primary competition; and
7. a co-authored research note in *PS: Political Science*, on the evidence for the existence of a “Reagan realignment.”

**Kimberly Jameson**


Manuscripts submitted for publication:


Manuscripts in-progress:


Marek Kaminski


Book Reviews:


Robin Keller


Newly accepted articles in 2017-18:


Printed during this year, accepted prior to this year:


Michael Lee


**Ines Levin**


**Michael McBride**


Cailin O’Connor


“Dynamics of Inequity.” forthcoming with Oxford University Press.


Lisa Pearl


Zyg Pizlo


Don Saari


Arrow, and unexpected consequences of his theorem, Public Choice, Online: March, 2018.

Three videoed lectures on decision analysis: NSF project, USC. March 2018.

**Stergios Skaperdas**


**Gregory Scontras**


Brian Skyrms


Simplified Chinese tr. forthcoming (CITIC Press).

Portuguese tr. forthcoming (Gradiva Publicações).

“Self-Assembling Networks” with Jeffrey Barrett and Aydin Mohseni (forthcoming) *British Journal for Philosophy of Science*.


Hal Stern


Rein Taagepera


R. Taagepera, 2018 *Sada aastat Eesti poliitikat* [One hundred years of Estonian politics]. Eesti Meedia AAS.


Tom Trogdon


James Weatherall


Vijay Vazirani


**Hongkai Zhao**


MBS 17-04
Accommodation Dynamics for Comparing Utilities with Others
Louis Narens and Brian Skyrms

MBS 18-01
Utility without Probability, Aggregation without Interpersonal Comparability: a Neo-Benthamite Approach
Brian Skyrms and Louis Narens

MBS 18-02
ColorSims 2.0: An extension to the python package for evolving linguistic color naming conventions applied to a population of agents
Maryam Gooyabadi and Kirbi Joe

MBS 18-03
Hierarchical Models for the Evolution of Compositional Language
Jeffrey A. Barrett, Brian Skyrms, Calvin Cochran

MBS 18-04
Utilitarianism from the Perspective of Modern Psychology
Louis Narens and Brian Skyrms

MBS 18-05
Further evolution of natural categorization systems: A new approach to evolving color concepts
Maryam Gooyabadi, Kirbi Joe, Louis Narens

MBS 18-06
Unifying Physics and Psychophysics on Basis of Symmetry, Least-Action ≈ Simplicity Principle, and Conservations Laws ≈ Veridicality
Zygmunt Pizlo
FACULTY PRESENTATIONS

APPENDIX D
COLLOQUIA AND CONFERENCES OF IMBS MEMBERS, 2017-18

Jeff Barrett

“Quantum Randomness”, CQIN, Lake Arrowhead, CA, June 2018.


“Quantum Records and Explanation”, Black Forest Summer School in Philosophy of Physics; Saig (Black Forest), Germany, July 2017.

“Typical Worlds”, Black Forest Summer School in Philosophy of Physics; Saig (Black Forest), Germany, July 2017.

“Probable Quantum Worlds”, University of Salzburg, Philosophy Department Colloquium, July 2017.

Bill Batchelder

“Cultural Consensus Theory (CCT): How to Measure Shared Knowledge or Beliefs ii Selected Groups”, NSF Slacker Conference, September 2017.


Michael Birnbaum

“Workshop on Internet-based research and data analysis”, (One of four instructors giving lectures and instruction to Summer workshop, University of Konstanz, Konstanz, Germany. September 2017.

“To err is human, but a human error is nothing to what a computer can do”, 56th Annual Edwards Bayesian Research Conference, Fullerton, CA. March 2018.
David Brownstone

University of Antwerp, Department of Economics. Antwerp, Belgium, May 2018.

New York University, Abu Dhabi Dept. of Civil Engineering, Abu Dhabi, United Arab Emirates, November 2017.

California State University Long Beach Department of Economics, Long Beach, CA, September 2017.

National University of Singapore, Department of Economics, Singapore, July 2017.

Jan Brueckner

Air Transport Research Society meeting, Seoul, Keynote speaker, July 2018.

ITEA Conference on Transportation Economics, Hong Kong, June 2018.


Xiamen-UC Irvine Conference on Urban Economics, Xiamen University, China, Keynote speaker, March 2018.

ITEA Conference on Transportation Economics, University of Toronto, November 2017.

American Real Estate and Urban Economics Association Meetings, New York University, October 2017.

American Real Estate and Urban Economics Association Meetings, Yale University, October 2017.

Airline Competition Conference, Georgetown University, July 2017 (panel presentation)

Carter Butts


Renshaw, Scott; Prestley, Robert; Olson, Michelle; Yu, Yue; Gibson, C. Ben; Sutton, Jeannette; and Butts, Carter T. (6/2018). “Strategic Inter-organizational Message Amplification through Online Networks: Implications from the National Weather Service.” 38th Sunbelt Network Conference (INSNA), Utrecht, Netherlands.


Butts, Carter T.; Sutton, Jeannette; Gibson, C. Ben; Li, Kevin; Olson, Michele; Phillips, Nolan E.; Renshaw, Scott; Vos, Sarah C.; and Yu, Yue. (7/2017). “HEROIC Project Update: Predictors of Message Passing, Social Media Adoption, and Social Media Use in Meteorological and Health Hazard Settings.” Natural Hazards Workshop, Broomfield, CO.


Jean-Paul Carvalho


David Eppstein


“Forbidden configurations in discrete geometry”, invited plenary talk, 20th Japan Conf. Discrete & Computational Geometry, Graphs, and Games, Tokyo, Japan, August 2017.

Michelle Garfinkel


Steve Frank

“Predictions of disease: somatic mosaicism, mitochondrial transmission, and pathogen dosage”, University of Rochester, March 2018.


Ami Glazer


Bernie Grofman

Conference Presentations and Colloquia
(1) an invited seminar presentation on models of voter turnout at the University of Malaga, Spain Department of Economics;
(2) serving as a keynote speaker at an international workshop on research methods held at the Central European University in Budapest, Hungary;
(3) chaired a panel on redistricting at the Annual Conference of the Midwest Political Science in Chicago
(4) gave an invited presentation at a conference on redistricting organized by the National Conference of State Legislatures, held at the Del Coronado Hotel in Coronado, California.
(5) co-organized and making a presentation at a conference in Germany at the University of Konstanz, on models of issue voting;
(6) co-organized a conference on “Money and Politics” with the distinguished Oxford Scholar, Desmond King, held at the University of Oxford in 2017; with a follow-up conference (also co-organized with Professor King) held in Laguna in winter 2018.

**Simon Huttegger**


**Kimberly Jameson**


Jameson, K. A. “Can we rule out the potential from Potential Human Tetrachromacy?” invited Institute for Mathematical Behavioral Sciences Colloquium. UC Irvine. Summer 2016.
Marek Kaminski


“Electoral Reform and its Potential Consequences (talk for a city mayors' club)”, dam Smith Center, Warsaw, Poland, September 2017.

Igor Kopylov

“Subjective State Spaces and Revealed Dominance”, IMBS, UCI, February 2018.

“Subjective Beliefs and Confidence When Facts Are Forgotten”, IMBS, UCI, October 2017.

Michael Lee

“Modeling step changes in cognition”. Invited presentation, National Autonomous University of Mexico (UNAM), Mexico City.

“Determining informative priors for cognitive models”. Invited presentation, National Autonomous University of Mexico (UNAM), Mexico City.

“Bayesian cognitive modeling”. Invited presentation, Max Planck Institute for Empirical Aesthetics, Frankfurt.

“Some Advantages of Bayesian Methods for Modeling Psychological Data”. Invited presentation, Max Planck Institute for Cognitive Psychiatry, Munich.


Ines Levin

Visions in Methodology (VIM), Ohio State University, Columbus, May 2018.
Annual Meeting of the Midwest Political Science Association (MPSA), Chicago, April 2018.

Southern California Political Behavior Conference, University of California, Riverside, March 2018.

IMBS Colloquium, University of California, Irvine, December 2017.

Bray Seminar, Division of the Humanities and Social Sciences, California Institute of Technology Pasadena, December 5, 2017.

LatAm PolMeth I, Instituto de Ciencia Política, Pontificia Universidad Católica de Chile, Santiago, November 2017.

Annual Meeting of the American Political Science Association (APSA), San Francisco, September 2017.

Southern California Methods Workshop, University of California, Santa Barbara, September 2017.

Society for Political Methodology Summer Meeting, Faculty Poster Session, University of Wisconsin-Madison, July 2017.

**Mike McBride**


**Cailin O’Connor**


The Dynamics of Inequity. Evolution of Social Behavior Workshop, University of Groningen, Groningen, Netherlands. (January 2018).

How to Beat Science and Influence People. IMBS Colloquium, University of California, Irvine, Irvine, CA. (January 2018).

How to Beat Science and Influence People. Department of Philosophy, University of California, San Diego, San Diego, CA. (October 2017).


The Cultural Red King Effect. Tempo and Mode Seminar Series, Center for Macroevolution and Macroecology, Australia National University, Canberra, Australia. (August 2017).


Evolving Collaborative Networks. Department of Philosophy, Australia National University, Canberra, Australia. (August 2017).

Dynamics of Inequity. Moral and Political Philosophy Seminar. Department of Philosophy, Australia National University, Canberra, Australia. (July 2017).

Dynamics of Inequity. Department of Philosophy, Monash University, Melbourne, Australia. (July 2017).

Modeling the Evolution of Moral Emotions. Awesome Workshop, Australia National University, Canberra, Australia. (July 2017).


Louis Narens


Lisa Pearl

Using Meaning Specificity to Aid Negation Handling in Lexicon-Based Sentiment Analysis. (with Doreen Hii and Alan Yuen) SoCal Natural Language Processing Symposium, UC Irvine, April 2018.


I can believe it: Quantitative evidence for closed-class category knowledge in a 20- to 24-month-old child. (with Alandi Bates and Sue Braunwald) 1st Annual California Meeting on Psycholinguistics, UCLA, December 2017.

Quantitatively assessing the development of adjective ordering preferences using child-directed and child-produced speech corpora. (with Galia Bar-Sever, Rachael Lee, and Greg Scontras) 1st Annual California Meeting on Psycholinguistics, UCLA, December 2017.

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Integrating conceptual and syntactic cues to understand the development of English verb classes. Symposium on Advances in Distributional Models of Language and Meaning, held at the joint meeting of the Society for Mathematical Psychology, and the International Conference on Cognitive Modeling. University of Warwick, UK. July 2017.


Zyg Pizlo


Donald Saari

“From deplorable decision approaches to the search for dark matter.” Kliakhandler Public Lecture, Michigan Technological University, September 2017.


“From Arrow’s social choice theorem to the compelling `dark matter’ mystery”, Colloquium, Mathematics, California State University, Long Beach, September 2017.

**Greg Scontras**


“Learning from heritage languages” (with Maria Polinsky). December 18, 2017. International Conference on Bilingualism: Language & Heritage, University of Cambridge – Chinese University of Hong Kong Joint Laboratory for Bilingualism.


“On the semantics of number morphology.” The Ohio State University Emergence of Number Conference, June 2018.

**Stergios Skaperdas**


**Brian Skyrms**

Keynote: Generalized Theory of Evolution, Dusseldorf University, January 2018.

Keynote: Social Evolution Groningen University, January 2018.


**Hal Stern**

“An Introduction to Statistical Thinking for Forensic Practitioners,” International Association for Identification Annual Meeting, Atlanta, GA (8 students), August 2017.


“Science and the Fair Administration of Justice” (discussant), AAAS Meeting, Austin, TX, February 2018.

“An Introduction to Statistical Thinking for Forensic Practitioners,” Orange County Crime Lab, Santa Ana, CA (75 students), February 2018.


**Tom Trogdon**

SIAM Conference on Nonlinear Waves and Coherent Structures, Anaheim, CA, June 2018, “Dispersive shock wave solutions of the KdV equation”

36th Annual Western States Mathematical Physics Meeting, UC Irvine, February 2018, “Universality for the Toda algorithm”

Applied Mathematics Seminar, University of Wyoming, February 16, 2018: “Riemann–Hilbert problems and the inverse scattering transform: From asymptotics to computation”

Special Seminar, Brandeis University, January 19, 2018: “Numerical analysis and random matrix theory”

Math Physics Seminar, UC Davis, November 15, 2017: “Numerical analysis and random matrix theory”

AMS Sectional Meeting, Riverside, CA, November 4–5, 2017: “Universality in numerical computations”
Fields Institute workshop on inverse scattering in one space dimension, August 8, 2017: “Riemann–Hilbert problems and the inverse scattering transform: From asymptotics to computation”

RANW 2017, University of Washington, August 1, 2017: “Oscillatory integrals and the AKNS scattering problem”

FoCM 2017, University of Barcelona, July 14, 2017: “Universality in numerical computation with random data”

SIAM OPSFA14, Gábor Szego Lecture, University of Kent, July 6, 2017: “The high oscillation of special functions”

Vijay Vazirani
“Planar Graph Perfect Matching is in NC”

- Distinguished Lecture, Department of Computer Science and Automation, Indian Institute of Science, Bangalore, December 2017.
- Computer Science Department, Indian Institute of Technology, New Delhi, India, June 2017.
- Computer Science Department, Indian Institute of Technology, Kanpur, India, June 2017.
- Computer Science Department, UCLA, Los Angles, CA, February 2018.
- Computer Science Department, University of Southern California, Los Angles, CA, March 2018.
- Computer Science Department, Columbia University, New York, NY, March 2018.
- Computer Science Department, New York University, New York, NY, March 2018.
- Computer Science Department, University of Chicago, Chicago, IL, April 2018.
- Computer Science Department, UIUC, Urbana-Champaign, IL, April 2018.
- Redmond Microsoft Research, Redmond, WA, July 2018.
“Google’s AdWords Market: How Theory Influenced Practice”


“Distributive Lattices, Stable Matchings, and Robust Solutions”

- Toyota Technology Institute at Chicago, Chicago, IL, April 2018.
- Computer Science Department, University of California, Berkeley, CA, May 2018.
- Computer Science Department, Stanford University, Stanford, CA, May 2018

James Weatherall


**Hongkai Zhao**

International Workshop on Computational Mathematics, Suzhou, China, June 2018

Workshop on Geometry, Imaging, and Computing, Harvard University, March 2018

International Conference of Applied Mathematics, Miami, January 2018.

(Plenary) The 6th ICCM CAM Conference on Geometry and Imaging, Tsinghua University, Beijing, December 2017.

Workshop on "Recent Advances in Seismic Modeling and Inversion: From Analysis to Applications", ICERM, Brown University, November 2017.

Frontiers in Computing and Data Science, Michigan State University, September 2017.

Claremont Colleges Mathematics Colloquia, The Claremont Colleges, April 2018.

Applied Mathematics Seminar, Simon Fraser University, March 2018.
G. FACULTY AWARDS AND ACHIEVEMENTS

APPENDIX E
IMBS FACULTY AWARDS AND ACHIEVEMENTS, 2017 - 18

Jeff Barrett

Chancellor’s Professor UC Irvine.

Carter Butts

Served as chair elect of the ASA Section on Mathematical Sociology.

Served on the council of the ASA Section on Methodology.

I continue to serve on the Board of Reviewing Editors for Science.

Jean-Paul Carvalho

Journal of the European Economic Association Excellence in Refereeing Award. Appointed

Faculty Affiliate of Center for Global Peace & Conflict Studies, UC Irvine. Appointed

Faculty Affiliate of Religious Studies Program, UC Irvine.

David Eppstein

Elected Fellow of the American Association for the Advancement of Science, November 2017.

Michelle Garfinkel

Editorial board of the Journal of Conflict Resolution.


Editorial board European Journal of Political Economy.

Bernie Grofman

(1) In winter 2018, the President-Elect of the U.S. Public Choice Society, Professor Roger Congleton, a co-author of mine, came back to UCI for the second half of his 2017-18 one
week visit, which had been similarly funded by the Koch Foundation last academic year. He chose to also spend a further portion of his 2018 sabbatical at UCI.

(2) I received a $5,000 grant from the Koch Foundation to fund a one week visit to UCI in winter 2018 by a distinguished Public Choice scholar. Professor Mark Crain came in Spring 2018, but the visit will be divided in two, with the second half to occur next academic year.

Kimberly A. Jameson

Ad Hoc Reviewing:

- Swiss National Science Foundation
- Journal of Cognition
- Color Research & Application
- Journal of the Optical Society of America

Media and Other activities:

During 2017-2018 news and media coverage highlighting Jameson’s research appeared in a variety of public and campus media outlets, including CBC’s The Nature of Things. (The Nature of Things is one of the most successful series in the history of Canadian television), BBC news, and others.

Jameson also begun a collaborative on Color Modeling and Color vision processing experts on the CIE, International Commission Internationale de L’Eclairage, and the University of British Columbia, CA. and University of Nevada, Reno about applications of color space modeling to applied lighting industry. Empirical investigations are ongoing.

Organizer of IMBS conference in November 2018:


The Institute for Mathematical Behavioral Sciences (IMBS) will host a two-day conference on 2-3 November 2018 titled “The Formal Modeling and Analysis of Color Categorization: Innovations and Insights since Berlin and Kay (1969)”.

The conference will transform our understanding of the cognitive and social bases for color categorization and in doing so yield broader insights into human and artificial cognition. The
The conference brings together for the first time leading researchers from a number of fields including Anthropology, Linguistics, Computer Science, Cognitive Science, Physics, Robotics, and Logic and Philosophy of Science.

The aims of the conference are to:

1. Provide a comprehensive view of the state of the art in color categorization research, taking stock of advances since Berlin and Kay’s (1969) seminal work, "Basic Color Terms: Their Universality and Evolution."

2. Establish a common research agenda in color categorization, produce new collaborations, and coordinate research efforts across a large number of diverse fields.

3. Introduce new theoretical approaches to color categorization developed at UC Irvine, including computational approaches to learning color categorization systems based on concepts/techniques from evolutionary game theory.

4. Publicize new data sources, including UC Irvine’s R.E. MacLaury Color Categorization Archive.

5. Generalize the insights from color categorization to produce new approaches to human and artificial cognition.

Among the confirmed speakers are the two developers of the field:

(1) Brent Berlin (Anthropologist, U. of Georgia), and (2) Paul Kay (Linguist, UC Berkeley), both National Academy of Sciences and American Academy members.

Other leading experts in the area who are scheduled to speak include (3) Terry Regier (Linguistics and Computer Science, UC Berkeley), (4) Richard Cook (Computer Science, UC Berkeley), (5) Galina Paramei (Color Vision Science, Hope University, UK), (6) David Bimler (Massey University, NZ). (7) Bevil R. Conway (NIH/NEI, Bethesda, MD), (8) Delwin Lindsey (Psychology, The Ohio State University), (9) Angela Brown (Ophthalmology, The Ohio State University), (10) Michael Webster (Foundation Professor in Cognitive Science, University of Reno, NV).

UC Irvine researchers expected to make presentations are (7) Kimberly A. Jameson (IMBS), (8) Louis Narens (Cognitive Sciences, IMBS), (9) Natalia Komarova (Mathematics, IMBS), (10) Sergio Gago (Computer Science), (11) Maryam Gooyabadi (IMBS), (11) Kirbi Joe (IMBS), (12) Nicole Fider (Mathematics), in addition to other invited participants from top-tier international research universities who are actively researching in the area. The conference is supported by the Institute for Mathematical Behavioral Sciences and is a product of the National Science Foundation Award (2014-2018) on the topic (#SMA-1416907, PI Jameson).
Marek Kaminski

Reviews of my book Gry Wiezienne (Games Prisoners Play) and Single-member Districts and
Majoritarian Electoral Laws - several, including:

Ernest Szum, “Bez wyroku: Postscriptum do losów Józefa Koryckiego (No trial: The ending of
Józef Korycki’s story),” Radzyński Rocznik Humanistyczny (in Polish), 2018

Bartłomiej Michalak, “Ordynacja większościowa (Majoritarian electoral laws),” Przegląd
Sejmowy (in Polish), 2017.

Zdzisław Ilski, “Ordynacja większościowa (Majoritarian electoral laws),” Wrocławskie Studia
Politologiczne (in Polish), 2017.

September 2017.

“Interview on democratization,” Polypsych, with Anthony Lindsay. Online. polypsych.org. July
2017.

Robin Keller


Decision Analysis editorial board member.

EURO Journal on Decision Processes editorial board member.

Investigación Operacional (Cuban OR journal) editorial board member, 2017.

Appointed Scientific Committee member and Planned Ramsey Medalist Panelist for Advances in
Decision Analysis conference at Bocconi University, Milan, Italy, June 19-21, 2019 sponsored by
the Decision Analysis Society of INFORMS.

Decision Analysis journal Publications Award Committee Member, 2017.

Ramsey Medal Committee Member, 2017 & 2018.

INFORMS (The Institute for Operations Research and the Management Sciences), President’s
Award Committee Member, 2017.

Program committee, 13th International Conference on Operations Research, Havana, March 6-9,
2018.


Igor Kopylov

Associate Editor: Theoretical Economics.

Cailin O’Connor

“Gender disparities and the science of women in organizations and teams”, Medium, NSF Social Media, March 2018.


Lisa Pearl


Adviser to 8 undergraduate students (among whom 6 were women and 6 were minority students) on quantitative approaches to language science.

Gregory Scontras

Visiting Assistant Professor, Department of Linguistics, Harvard University. Fall 2017.

Stergios Skaperdas


Hal Stern

2018 – Chancellor’s Professor, UC Irvine.
2018 - Interdisciplinary Team Science Award (Conte Center at UCI), ICTS, UC Irvine.
2017 – present, Chair, Section U (Statistics) of the American Association for the Advancement of Science (chair-elect 2017; chair 2018; retiring chair 2019)
2016 – present, Member, National Academy of Sciences Committee on Strengthening the Federal Motor Carrier Safety Administration Research and Technology Program.
2015 – present, Member, Board of Directors, National Institute of Statistical Science (NISS).
2014 – present, Member, Scientific Area Committee for Physics/Pattern Forensic Evidence, Organization of Scientific Area Committees, National Institute of Standards and Technology (NIST).
2012 – present, Vice-Chair, Ad Hoc Advisory Committee on Forensic Statistics, American Statistical Assn.

Rein Taagepera

Honorary citizen of the City of Tartu, Estonia, 2017.

Tom Trogdon

NSF Career Grant, 2018.

Vijay Vazirani

ACO Center created: I started a new Center, named Algorithms, Combinatorics and Optimization (ACO). It has faculty from three units, CS (mainly theory), Math (mainly combinatorics) and Business School (mainly optimization). In addition, faculty from Economics and Electrical Engineering have also expressed interest in joining.

A number of activities are planned starting Fall 2018, including the ACO Seminar Series, and an Inaugural Distinguished Lecture. Eventually, the goal is to create an ACO PhD program which will be jointly run by the three units mentioned above. This will be the third ACO program in the nation after the enormously successful ones created at CMU and Georgia Tech more than 25 years ago.
### H. FACULTY ADVISING

#### APPENDIX F
**GRADUATE STUDENTS AFFILIATED WITH IMBS**

(i) **Current Student Participants and their IMBS Advisors**  
(* advanced to Ph.D. candidacy;  ** received Ph.D. during year)

<table>
<thead>
<tr>
<th>Student</th>
<th>Advisor</th>
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<tr>
<td>Nikhil Addleman</td>
<td>Carvalho</td>
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<tr>
<td><strong>Gregory Alexander</strong></td>
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<td>Dhari Aljutaili</td>
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<td>Steven Brownlee</td>
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<td>Debapriya Chakraborty</td>
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<td><strong>Irina Danileiko</strong></td>
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<td>Nikki Fider</td>
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