

**University of California, Irvine
Institute for Mathematical Behavioral Sciences**

**2017– 2018
Annual Report**

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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 breath 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 Trogon), 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
Previous Directors:	Donald G. Saari, 2003-2017, William H. Batchelder, 1999-2003 R. Duncan Luce, Founding Director, 1989-1998
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, Doshier, 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 and 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.

Sociological/Anthropological

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 as 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 of constant mean degree scaling has been known for many decades, capturing it 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

evolving network, they still leave their mark upon it (much like the blurred out cars a long-exposure photograph can still prevent pedestrians from crossing a road). By showing how time scale separated social processes can have non-trivial effects on social network structure, this work directs attention to a large class of phenomena that have previously gone understudied. Concretely, the work also provides a principled basis for a large class of network models that can be used to study social systems across a range of demographic scales, improving our ability to make comparative statements about the factors driving social structure in different settings. Moreover, modified versions of these results are even serving as the foundation for models of interaction within physical systems, such as my and my collaborator's current work on network models for the formation of amyloid fibrils (the key mechanism behind diseases such as Alzheimer's, Lewy Body dementia, and type 2 diabetes). By looking at what might seem to be "obvious" features of social life through a mathematical lens, we are thus able to obtain insights that enable a range of new discoveries.

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\(1822K\)](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, up 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*.

Perception and Psychophysics

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-know 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 in 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:

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

Seminars presented while on visiting faculty status:

Stanford University

Brian Skyrms	Evolution of Signaling Spring	Spring 2018
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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

“Conceptual Models and Reflective Decision Making: A Conceptual Synthesis, Critical Re-View, and New Modeling Framework”

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 Postdoctoral 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**

9:00 Welcome Reception

Session I

9:20 Lucila Arroyo, MBS
Altruism and Guilt: An fMRI Study

9:45 Kirbi Joe, MBS
Extending the Standard Observer Model: An Application of Digital Micro-mirror Devices to Model Human Tetrachromacy

10:10 Maryam Gooyabadi, MBS
Surveying for Ideological Components: A Cultural Consensus Approach

10:35 Break

Session II

10:55 Joseph Nunn, MBS
Learning Agent Controllers from Emergent Behavior

11:20 Nishtha Sharma, Economics
Who Splits the Pie, and What Pie Anyway?

11:45 Erya Yang, Economics
Optimism and Pessimism in Bargaining and Contests

12:20 Lunch

Session III

1:50 Santiago Guisasola, MBS
A New Perspective into Potential Games

2:15 Nikhil Addleman, MBS
Equilibrium Miscoordination in Coordination Games Played on Metric Spaces

2:40 Break

Session IV

3:00 Aydin Mohseni, L&PS
Confirmation Bias, News, and Belief Polarization

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

Saturday, November 18, 2018

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

University of California, Irvine
Institute for Mathematical Behavioral Sciences (IMBS)
Center for Global Peace and Conflict Studies (SGPACS)
Friday and Saturday, April 13 & 14, 2018, SSPA 2112

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

Saturday, April 14, 2018

9:30AM	Jeff Kopstein, UCI, <i>Intimate Violence: Anti-Jewish Pogroms on the Eve</i>
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	<i>of the Holocaust</i>
10:10AM	Mohamed Saleh, University of Toulouse, <i>Taxing Unwanted Populations: Fiscal Policy and Conversions in Early Islam</i>
10:50AM	Break
11:10AM	Cailin O'Connor, UCI, <i>Discrimination and Collaboration in Science</i>
11:50AM	Lunch Break
1:30PM	Vicky Fouka, Stanford University, <i>From Immigrants to Americans: Race, Status and Assimilation during the Great Migration</i>
2:10PM	Mark Koyama, George Mason University, <i>Geopolitics and Asia's Little Divergence: State Building in China and Japan After 1850</i>
2:50PM	Break
3:10PM	Jean-Paul Carvalho, UCI, <i>Religious Identity</i>
3:50PM	Conference Discussion with Larry Iannaccone, Chapman University
4:30PM	Closing Remarks
4:45PM	Conference Adjourns

**The Institute for Mathematical and Behavioral Sciences, Department of Language Science,
and Center for Language Science
Friday and Saturday, May 4 and 5, 2018, SSPA 2112**

Conference on Quantitative Approaches to Language Science

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

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

Saturday, May 5, 2018

9:30AM	Morning Reception
10:00AM	Emily Morgan, UC Davis, <i>Generative and item-specific knowledge in language processing</i>
11:00AM	Timothy O'Donnell, McGill University, <i>Algorithmic program synthesis of morphophonological rules</i>
12:00PM	Discussion
12:30PM	Lunch Break
2:00PM	Judith Degen, Stanford University, <i>Rethinking 'overinformativeness' as rationally redundant reference</i>
3:00PM	Roger Levy, MIT, <i>Gender bias in preferred linguistic descriptions for expected events</i>
4:00PM	Discussion
4:30PM	Conference Adjourns

B. Conferences/Seminars Organized By IMBS Members

Jeff Barrett

Organizer, “Game Theory Conference”, LPS, February 2018, UC Irvine.

Carter Butts

Organizer for the Regular and Section sessions on Mathematical Sociology, “ASA Annual Meeting”, August 2018, Philadelphia, Pennsylvania.

Jean-Paul Carvalho

Co-organizer, “Conference on Identity, Cooperation and Conflict”, April 2018, IMBS/GPACS, UC Irvine.

David Eppstein

Program chair, “16th Scandinavian Symposium and Workshops on Algorithm Theory”, June 2018, Malmö, Sweden.

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

Co-organizer, “Conference on Invariance and Symmetry”, November 2018, IMBS, UC Irvine.

Cailin O’Connor

Organizer, “Formal Social Epistemology Workshop”, May 2018, UC Irvine.

Lisa Pearl

Co-Organizer, “Conference on Quantitative Approaches to Language Science”, May 2018, IMBS, UC Irvine.

Session Chair, “1st Annual Meeting of the Society for Computation in Linguistics”, January 2018, Salt Lake City, Utah.

Zyg Pizlo

Co-organizer, “Conference on Invariance and Symmetry”, November 2018, IMBS, UC Irvine.

“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.

“North American Computational Linguistics Olympiad” January 2018 and March 2018, UC Irvine.

Co-organizer, “Conference on Quantitative Approaches to Language Science” May 2018, IMBS, UC Irvine.

Stergios Skaperdas

Co-organizer, “Conference on Identity, Cooperation and Conflict”, April 2018, IMBS/GPACS, UC Irvine.

Brian Skyrms

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

Tom Trogdon

“Conference on the Solution of Problems in Multiply-connected Domains”, June 2018, CBMS, UC Irvine.

James Weatherall

Co-organizer, “Summer Institute: Philosophy of Cosmology,” June 2018, Ontario, Canada.

Hongkai Zhao

Program Committee for Joint International Mathematics Meeting by AMS and CMS, Shanghai, China, 6/11-6/14, 2018.

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

ZYGMUNT 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 Professor, 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 than 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:

2017-18 IMBS Budget allocation	\$ 90,000.00
2017-18 Overhead return	\$ 15,658.00
2016-17 Carry Forward	\$ 3,091.00
Total budget for 2017-18:	<u>\$108,749.00</u>

Expenditures:

Salaries & Benefits	\$ 48,624.00
Social Sciences Business Office (Admin. Sup)	\$ 7,500.00
Social Sciences Business Office (Overhead)	\$ 15,658.00
Conference/Colloquia /Seminars	\$ 15,084.00
Supplies & Expenses	\$ 4,754.00
Graduate Student Support	\$ 17,129.00
<u>Total Expenditures:</u>	<u>\$108,749.00</u>

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 hotpigment 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 hotpigment 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 revision 2018. National Science Foundation (NSF): CompCog. **“Using quantitative methods to articulate linguistic and non-linguistic components of language understanding in context.”** This research provides an integrated quantitative framework for precisely specifying the contribution of different linguistic and non-linguistic factors underlying typical language understanding behavior in children and adults. Role: PI. Amount: \$456K.

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

Robert Akerlof, (Ph.D. Economics, Harvard University). Associate Professor, Department of Economics, University of Warwick. Research areas: Applied Microeconomic Theory, Organizational Economics, Sociology and Economics.

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.

William H. Batchelder, (Ph.D. Psychology, Stanford University). Professor of Cognitive Sciences, University of California, Irvine. Research areas: Mathematical modeling and measurement methodology in the social sciences.

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.

John P. Boyd, (Ph.D. Communication Sciences, University of Michigan). Professor Emeritus of Anthropology, University of California, Irvine. Research areas: Algebraic models of social relations, quantitative methods, and sociobiology.

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

Myron (Mike) Braunstein, (Ph.D. Psychology, University of Michigan). Professor Emeritus of Psychology, University of California, Irvine. Research areas: Visual perception, especially depth and motion perception.

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.

Jan K. Brueckner, (Ph.D. Economics, Stanford University). Chancellor's Professor of Economics and Department Chair, University of California, Irvine. Research areas: Urban economics, public economics, industrial organization, housing finance.

Michael Burton, (Ph.D. Anthropology, Stanford University). Professor Emeritus of Anthropology, University of California, Irvine. Research areas: Economic and social anthropology.

Carter Butts, (Ph.D. Sociology, Carnegie Mellon University). Professor of Sociology, University of California, Irvine. Research areas: Social networks, Bayesian methods, informant accuracy and strategic behavior.

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.

Charles Chubb, (Ph.D. Experimental Psychology, New York University). Professor of Cognitive Sciences, University of California, Irvine. Research areas: Vision, perception, and information processing.

Linda Cohen, (Ph.D. Social Sciences, California Institute of Technology). Professor of Economics, University of California, Irvine. Research areas: Political economy, public choice, and government regulation of business.

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. Doshier, (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.

Michael D'Zmura, (Ph.D. Psychology, University of Rochester). Professor of Cognitive Sciences, University of California, Irvine. Research areas: Vision, color, attention, image understanding, virtual reality.

Jeffrey Ely, (Ph.D. Economics, University of California, Berkeley). Charles E. and Emma Morrison Professor of Economics, Director, Mathematical Methods in the Social Sciences Program, Northwestern University. Research areas: Pure game theory, applied microeconomics, behavioral and experimental economics.

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.

Michelle Garfinkel, (Ph.D. Economics, Brown University). Professor of Economics, University of California, Irvine. Research areas: Strategic aspects of monetary and fiscal policies.

Amihai Glazer, (Ph.D. Economics, Yale University). Professor of Economics, University of California, Irvine. Research Areas: Public choice, especially concerning commitment problems.

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, University of California, Irvine. Research areas: Probability theory; philosophy of probability, induction, decision theory, social philosophy, dynamical Systems.

Larry Iannaccone (Ph.D. Economics, University of Chicago). Professor of Economics, Director, Institute for the Study of Religion, Economics, and Society, Argyros School of Business and Economics, Chapman University. Research areas: Economics of religion.

Geoffrey Iverson, (Ph.D. Theoretical Physics, University of Adelaide, Australia, Ph.D. Experimental Psychology, New York University). Professor Emeritus of Cognitive Sciences, University of California, Irvine. Research areas: Psychophysics, vision, statistical estimation and testing of ordinal models.

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.

Natalia Komarova, (Ph.D. Applied Mathematics, University of Arizona). Professor of Mathematics, and Ecology & Evolutionary Biology, University of California, Irvine. Research areas: Mathematical modeling and biology, virus dynamics, cancer modeling.

Michael D. Lee, (Ph.D. Psychology, University of Adelaide). Professor of Cognitive Sciences, University of California, Irvine. Research Areas: Mathematical and computational models of stimulus representation, categorization, memory, decision-making and problem-solving.

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.

Louis Narens, (Ph.D. Mathematics, University of California, Los Angeles). Professor of Cognitive Sciences, and Psychiatry and Human Behavior, Graduate Advisor for IMBS, University of California, Irvine. Research areas: Measurement theory, foundations of science, decision theory.

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.

Kenneth A. Small, (Ph.D. Economics, University of California, Berkeley). Professor Emeritus of Economics, University of California, Irvine. Research areas: Urban, energy and transportation economics, econometrics.

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.

Douglas White, (Ph.D. Anthropology, Social Theory, University of Minnesota). Professor Emeritus of Anthropology, University of California, Irvine. Research areas: social networks, longitudinal social demography, cross cultural, quantitative methods.

Charles E. (Ted) Wright, (Ph.D. Psychology, University of Michigan). Associate Professor of Cognitive Sciences, University of California, Irvine. Research areas: Motor processing and control, visual search, handwriting.

Jack Xin, (Ph.D. Courant Institute, New York University). Professor of Mathematics, University of California, Irvine. Research areas: Partial Differential Equations (PDE), Asymptotic Analysis, Scientific Computation, and their Applications in Fluid Dynamics, Voice Signal Processing, Biology, Nonlinear Optics and Geoscience.

John I. Yellott, (Ph.D. Psychology, Stanford University). Professor Emeritus of Cognitive Sciences, University of California, Irvine. Research areas: Vision, probabilistic choice models.

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.

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Robert Forbes, (Ph.D. Mathematical Behavioral Sciences, University of California, Irvine). Project Scientist, University of California, Irvine. Research areas: Applied studies of decision-making under uncertainty. Development of mathematical modeling and methodologies for risk assessment and group decision-making in large corporations.

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).

Tim Satalich, (Ph.D. Mathematical Psychology, John Hopkins University). Associate Researcher, University of California, Irvine. Research areas: Mathematical modeling of human color vision processing. Development of statistical analysis methods for representing perceptual color space data.

D. SCIENTIFIC PUBLICATIONS

APPENDIX B SCIENTIFIC PUBLICATIONS OF IMBS MEMBERS, 2017 - 2018

Jeff Barrett

Skyrms, B. and J. Barrett (2018) "[Propositional Content in Signals](#)," preprint.

Barrett, J. A., B. Skyrms, and C. T. Cochran (2018) "[Hierarchical Models for the Evolution of Compositional Language](#)," draft.

Barrett, J. A. (2017) "Typical Worlds," *Studies in the History and Philosophy of Modern Physics* (58) 31-40.

Barrett, J. A., A. Mohseni, B. Skyrms (2017) "Self-Assembling Networks," forthcoming in *The British Journal for the Philosophy of Science*.

Barrett, J. A., C. T. Cochran, S. Huttegger, and N. Fujiwara (2017) "Hybrid Learning in Signaling Games," forthcoming in *Journal of Experimental & Theoretical Artificial Intelligence*.

Bill Batchelder

Batchelder, W. H., Anders, R., and Oravecz, Z. (2018). Cultural Consensus Theory. In Wagenmakers, E.-J. (Volume Editor), Wixted, J. (Editor in Chief). *Stevens Handbook of Experimental Psychology and Cognitive Neuroscience, Volume 5 Methodology*, 4th Edition. Hoboken, NJ: Wiley, pp. 201-264.

Batchelder, W. H., Colonius, H., and Dzhafarov, E. N. (Editors) (In Press, 2018). *New Handbook of Mathematical Psychology, Vol. 2 Modeling and Measurement*. Cambridge U.K.: Cambridge University Press.

Anders, R., Alario, F.-X, and Batchelder, W. H. (In Press). Consensus analysis for populations with latent subgroups: Applying multicultural consensus theory and model-based clustering with CCT pack. *Cross Cultural Research*. Online First Publications. DOI: 10.1177/1069397117727500, 1-35.

France, S. L., Vaghefi, M. S., and Batchelder, W. H. (In Press). FlexCCT: A methodological framework and software for rating analysis and Wisdom of Crowd applications. *IEEE Transactions of Computational Social Systems*.

Batchelder, W. H., Colonius, H., Dzhafarov, E. N. , Muying, J. (In Press). Preface. In W. H. Batchelder, H. Colonius, and E. N. Dzhafarov, (Editors). New Handbook of Mathematical Psychology, Volume 2 Modeling and Measurement. Cambridge U.K.: Cambridge University Press, 6pp.

Michael Birnbaum

Birnbaum, M. H., Schmidt, U., & Schneider, M. D. (2017). Testing independence conditions in the presence of errors and splitting effects. *Journal of Risk and Uncertainty*, 54(1), 61-85. DOI 10.1007/s11166-017-9251-5.

Birnbaum, M. H. (2018). Empirical evaluation of third-generation prospect theory. *Theory and Decision*, 84(1), 11-27. DOI 10.1007/s11238-017-9607-y.

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>

“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>

“A model for broad choice data” (with P. Li*), *Journal of Choice Modeling* 27, 19-36, 2018.
<https://doi.org/10.1016/j.jocm.2017.09.001>

Carter Butts

Baldesi, Luca; Butts, Carter T.; and Markopoulou, Athina. (2018). “Spectral Graph Forge: Graph Generation Targeting Modularity.” *Proceedings of the 2018 IEEE Conference on Computer Communications. (IEEE INFOCOM)*. Forthcoming.

Butts, Carter T. (2018). “A Dynamic Process Interpretation of the Sparse ERGM Reference Model.” *Journal of Mathematical Sociology*, forthcoming.

Butts, Carter T. (2018). “A Perfect Sampling Method for Exponential Family Random Graph Models.” *Journal of Mathematical Sociology*, 42(1), 17--36.

Fitzhugh, Sean M. and Butts, Carter T. (2018). “Patterns of Co-membership: Techniques for Identifying Subgraph Composition.” *Social Networks*, 55, 1--10.
<https://doi.org/10.1016/j.socnet.2018.03.006>

Lee, Francis and Butts, Carter T. (2018). “Mutual Assent or Unilateral Nomination? A Performance Comparison of Intersection and Union Rules for Integrating Self-reports of Social Relationships.” *Social Networks*, forthcoming.

Smith, Gilbert; Kelly, John E.; Macias-Muñoz, Aide; Butts, Carter; Martin, Rachel W.; and Briscoe, Adriana D. (2018). “Evolutionary and Structural Analyses Uncover a Role for Solvent Interactions in the Diversification of Cocoonases in Butterflies.” *Proceedings of the Royal Society, Series B*, 285(1870), 20172037. DOI: 10.1098/rspb.2017.2037

Sutton, Jeannette; Vos, Sarah C.; Olson, Micki K.; Woods, C. W.; Cohen, E.; Gibson, C. Ben; Phillips, Nolan; Studts, J.; Eberth, J.; and Butts, Carter T. (2018). “Lung Cancer Messages on Twitter: Content Analysis and Evaluation.” *Journal of the American College of Radiology*, 15(1B), 210-217. DOI: 10.1016/j.jacr.2017.09.043

Vos, Sarah C.; Sutton, Jeannette; Yu, Yue; Renshaw, Scott; Olson, Micki K.; Gibson, C. Ben; Butts, Carter T. (2018). “Retweeting Risk Communication: The Role of Threat and Efficacy.” *Risk Analysis*, forthcoming. DOI: 10.1111/risa.13140

Wang, Cheng; Hipp, John R.; Butts, Carter T.; and Lakon, Cynthia M. (2018). “The Interdependence of Cigarette, Alcohol, and Marijuana Use in the Context of School-Based Social Networks.” *PLoS ONE*, forthcoming.

Grazioli, Gianmarc; Butts, Carter T.; and Andricioaei, Ioan. (2017). “Automated Placement of Interfaces in Conformational Kinetics Calculations Using Machine Learning.” *Journal of Chemical Physics*, 147(15), 152727. <https://doi.org/10.1063/1.4989857>

Jean-Paul Carvalho

Advances in the Economics of Religion, co-edited with Sriya Iyer and Jared Rubin, Palgrave 2019.

Religious Clubs: The Strategic Role of Religious Identity, forthcoming in Iyer, Rubin and Carvalho (Eds.), *Advances in the Economics of Religion*, Palgrave 2019.

David Eppstein

D. Eppstein. *Forbidden Configurations in Discrete Geometry*. Cambridge University Press, 2018.

D. Eppstein. Proceedings of the 16th Scandinavian Symposium and Workshops on Algorithm Theory (SWAT2018), Malmö, Sweden, June 18–20, 2018. Leibniz International Proceedings in Informatics (LIPIcs) 101, Dagstuhl Publishing, 2018.

V. Dujmović, D. Eppstein, and D. R. Wood. Structure of graphs with locally restricted crossings. *SIAM J. Discrete Mathematics* 31(2):805–824, 2017, doi:10.1137/16M1062879.

- D. Eppstein, J. M. McCarthy, and B. E. Parrish. Rooted cycle bases. *J. Graph Algorithms & Applications* 21(4):663–686, 2017, doi:10.7155/jgaa.00434.
- D. Eppstein. Maximizing the sum of radii of disjoint balls or disks. *Journal of Computational Geometry* 8(1):316–339, 2017, doi:10.20382/jocg.v8i1a12.
- M. J. Bannister, S. Cabello Justo, and D. Eppstein. Parameterized complexity of 1-planarity. *J. Graph Algorithms & Applications* 18(1):23–49, 2018, doi:10.7155/jgaa.00457.
- D. Eppstein. The parametric closure problem. *ACM Trans. Algorithms* 14(1):2:1–2:22, 2018, doi:10.1145/3147212, arXiv:1504.04073.
- D. Eppstein, P. Kindermann, S. Kobourov, G. Liotta, A. Lubiw, A. Maignan, D. Mondal, H. Vosoughpour, S. Whitesides, and S. Wismath. On the planar split thickness of graphs. *Algorithmica* 80(3):977–994, 2018, doi:10.1007/s00453-017-0328-y. Special issue for LATIN 2016.
- Z. Abel, E. D. Demaine, M. L. Demaine, D. Eppstein, A. Lubiw, and R. Uehara. Flat foldings of plane graphs with prescribed angles and edge lengths. *Journal of Computational Geometry* 9(1):71–91, 2018, doi:10.20382/jocg.v9i1a3.
- D. Eppstein and D. S. Hirschberg. From discrepancy to majority. *Algorithmica* 80(4):1278–1297, 2018, doi:10.1007/s00453-017-0303-7.
- D. Eppstein, M. T. Goodrich, M. Mitzenmacher, and M. Torres. 2-3 cuckoo filters for faster triangle listing and set intersection. *Proc. 36th ACM SIGMOD-SIGACT-SIGAI Symposium on Principles of Database Systems (PODS 2017)*, pp. 247–260, 2017, doi:10.1145/3034786.3056115.
- Eppstein, M. T. Goodrich, and N. Mamano. Algorithms for stable matching and clustering in a grid. *Proc. 18th Int. Worksh. Combinatorial Image Analysis (IWCIA 2017)*, pp. 117–131.
- Springer-Verlag, *Lecture Notes in Computer Science* 10256, 2017, doi:10.1007/978-3-319-59108-7_10, arXiv:1704.02303.
- A. Biniarz, P. Bose, K. Crosbie, J.-L. De Carufel, D. Eppstein, A. Maheshwari, and M. Smid. Maximum plane trees in multipartite geometric graphs. *Proc. 15th Algorithms and Data Structures Symp. (WADS 2017)*, pp. 193–204. Springer-Verlag, *Lecture Notes in Computer Science* 10389, 2017, doi:10.1007/978-3-319-62127-2_17.
- D. Eppstein and M. T. Goodrich. Using multi-level parallelism and 2-3 cuckoo filters for faster set intersection queries and sparse boolean matrix multiplication. *Proc. 29th ACM Symposium on*

Parallelism in Algorithms and Architectures (SPAA 2017), pp. 137–139, 2017, doi:10.1145/3087556.3087599.

D. Eppstein and D. Kurz. K-best solutions of MSO problems on tree-decomposable graphs. Proc. 12th International Symposium on Parameterized and Exact Computation (IPEC 2017), pp. 16:1–16:13. Schloss Dagstuhl, Leibniz International Proceedings in Informatics (LIPIcs) 89, 2017, doi:10.4230/LIPIcs.IPEC.2017.16, arXiv:1703.02784.

D. Eppstein. Triangle-free penny graphs: degeneracy, choosability, and edge count. Proc. 25th Int. Symp. Graph Drawing and Network Visualization (GD 2017), pp. 506–513. Springer-Verlag, Lecture Notes in Computer Science 10692, 2017, doi:10.1007/978-3-319-73915-1_39, arXiv:1708.05152.

D. Eppstein. The effect of planarization on width. Proc. 25th Int. Symp. Graph Drawing and Network Visualization (GD 2017), pp. 560–572. Springer-Verlag, Lecture Notes in Computer Science 10692, 2017, doi:10.1007/978-3-319-73915-1_43, arXiv:1708.05155.

D. Eppstein, M. T. Goodrich, D. Korkmaz, and N. Mamano. Defining equitable geographic districts in road networks via stable matching. Proc. 25th ACM SIGSPATIAL Int. Conf. Advances in Geographic Information Systems (SIGSPATIAL 2017), pp. 52:1–52:4, 2017, doi:10.1145/3139958.3140015, arXiv:1706.09593.

D. Eppstein and S. Gupta. Crossing patterns in nonplanar road networks. Proc. 25th ACM SIGSPATIAL Int. Conf. Advances in Geographic Information Systems (SIGSPATIAL 2017), pp. 40:1–40:9, 2017, doi:10.1145/3139958.3139999, arXiv:1709.06113.

G. Da Lozza, W. E. Devanny, D. Eppstein, and T. U. Johnson. Square-contact representations of partial 2-trees and triconnected simply-nested graphs. Proc. 28th Int. Symp. Algorithms and Computation (ISAAC 2017), pp. 24:1–24:14. Schloss Dagstuhl, Leibniz International Proceedings in Informatics (LIPIcs) 92, 2017, doi:10.4230/LIPIcs.ISAAC.2017.24, arXiv:1710.00426.

J. J. Besa Vial, W. E. Devanny, D. Eppstein, M. T. Goodrich, and T. U. Johnson. Quadratic time algorithms appear to be optimal for sorting evolving data. Proc. 16th Worksh. Algorithm Engineering and Experiments (ALENEX 2018), pp. 87–96, January 2018, doi:10.1137/1.9781611975055.8.

D. Eppstein, S. Har-Peled, and G. Nivasch. Grid peeling and the affine curve-shortening flow. Proc. 16th Worksh. Algorithm Engineering and Experiments (ALENEX 2018), pp. 109–116, January 2018, doi:10.1137/1.9781611975055.10.

D. Eppstein, M. T. Goodrich, and N. Mamano. Reactive proximity data structures for graphs. Proc. 13th Latin American Theoretical Informatics Symposium (LATIN 2018), pp. 777–789. Springer-Verlag, Lecture Notes in Computer Science 10807, 2018, doi:10.1007/978-3-319-77404-6_56, arXiv:1803.04555.

Steve Frank

Frank, S. A. 2018. Homeostasis, environmental tracking and phenotypic plasticity. I. A robust control theory approach to evolutionary design tradeoffs. bioRxiv doi:10.1101/332999. (preprint)

Frank, S. A. 2018. A biochemical logarithmic sensor with broad dynamic range. F1000Research 7:200. (abstract, reprint, doi)

Frank, S. A. 2018. Control Theory Tutorial: Basic Concepts Illustrated by Software Examples. Springer, Cham, Switzerland.

Frank, S. A. 2017. Receptor uptake arrays for vitamin B12, siderophores and glycans shape bacterial communities. Ecology & Evolution 7:10175-10195.

Michelle Garfinkle

“Rules for Dividing a Disputed Resource in the Context of the Classical Liberal Argument for Peace,” PEACE ECONOMICS, PEACE SCIENCE AND PUBLIC POLICY, vol. 24 (February 2018) with Constantinos Syropoulos.

Ami Glazer

Glazer, Amihai and Stef Proost (2017) “Free riding on successors, delay, and extremism.” Social Choice and Welfare, 48(4): 887-900.

Cohen, Linda and Amihai Glazer (2017) “Bargaining within the family can generate a political gender gap.” Review of Economics of the Household, 15: 1399-1413.

De Borger, Bruno and Amihai Glazer (2017) “Support and opposition to a Pigovian tax: Road pricing with reference-dependent preferences.” Journal of Urban Economics, 99: 31-47.

Terai, Kimiko and Amihai Glazer (2017) “Rewarding successes discourages experimentation.” Finanzarchiv, 73(4): 361-381.

Glazer, Amihai, Refael Hassin, and Liron Ravner (2018) “A strategic model of job arrivals to a single machine with earliness and tardiness penalties.” IISE Transactions, 50(4): 265-278.

Glazer, Amihai, Rune Jansen Hagen, and Jorn Rattso (2018) “Help not needed? Optimal quotas for expatriate NGO workers.” *Review of International Economics*, 26: 302-321.

Blondiau, Thomas, Amihai Glazer, and Stef Proost (2018) “Air traffic control regulation with union bargaining in Europe.” *Economics of Transportation*, 13: 48-60.

Terai, Kimiko, and Amihai Glazer (forthcoming) “Rivalry among agents seeking large budgets.” Forthcoming, *Journal of Theoretical Politics*.

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

Jameson, K. A. , Browne, A. W. & M. C. Kenney. (2018) Investigating genetically based Retinal Photopigment variation and color perception measures in clinical retina research populations using Konan Medical’s ColorDx system A Preliminary Report. Collaborative research whitepaper and prospectus submitted to Konan Medical, Inc., Irvine, CA.

Jameson, K. A. (2018). ColCat: A Color Categorization Digital Archive and Research Wiki. Invited contribution to edited volume *Colour Studies: Vision, Cognition and Language*, L. MacDonald, C. P. Biggam and G. Paramei (Ed.s). John Benjamins (Amsterdam and Philadelphia).

Bochko, V. A., K. A. Jameson, T. Nakaguchi, Y. Miyake, & J. T. Alander. (revised and resubmitted manuscript). Non-negative matrix factorization using genetic algorithm for spectral colors. *IEICE TRANS. ELECTRON.*, The Institute of Electronics, Information and Communication Engineers.

Bochko, V. & Jameson, K. A. (under review/submitted). Investigating Potential Human Tetrachromacy in Individuals with Tetrachromat Genotypes Using Multispectral Techniques. *Electronic Imaging, Human Vision and Electronic Imaging*, 2016 (12), pp. 1-12. Society for Imaging Science and Technology. DOI: <https://doi.org/10.2352/ISSN.2470-1173.2016.16.HVEI-145>.

Park, J.P., Tauber, S., Jameson, K. A. & Narens, L. (under review/submitted). The Evolution of Shared Concepts in Changing Populations. Invited contribution in preparation for inclusion in Special Issue on “Perceptual Categories” for the Review of Philosophy and Psychology.

Fider, N., Narens, L., Jameson, K. A., & Komarova, N. L. (2017). Quantitative approach for defining basic color terms and color category best exemplars. *JOSA A*, 34(8), 1285-1300. <https://doi.org/10.1364/JOSAA.34.001285>.

Bochko, V. A., K. A. Jameson, T. Nakaguchi, Y. Miyake, & J. T. Alander. (2017). Non-negative matrix factorization for spectral colors using genetic algorithms: Substantially Updated Version. Technical Report Series #MBS 17-03. Institute for Mathematical Behavioral Sciences University of California at Irvine, Irvine, CA, USA.

Park, J.P., Tauber, S., Jameson, K. A. & Narens, L. (2017). The Evolution of Shared Concepts in Changing Populations. Technical Report Series #MBS 17-01. Institute for Mathematical Behavioral Sciences University of California at Irvine, Irvine, CA, USA.

Deshpande, P. S., Sean Tauber, Stephanie M. Chang, Sergio Gago, and Kimberly A. Jameson (2016). “Digitizing a Large Corpus of Handwritten Documents Using Crowdsourcing and Cultural Consensus Theory.” *International Journal of Internet Science*. December 2016.

Fider, N., Narens, L., Jameson, K. A., and N. L. Komarova. (2017). A Quantitative approach for defining basic color terms and color category best exemplars. *Journal of the Optical Society of America A Vol. 34*, Issue 8, pp. 1285-1300. <https://doi.org/10.1364/JOSAA.34.001285>.

Manuscripts submitted for publication:

Bochko, V. A., K. A. Jameson, T. Nakaguchi, Y. Miyake, and J. T. Alander. (revised and resubmitted manuscript). Non-negative matrix factorization using genetic algorithm for spectral colors. *IEICE TRANS. ELECTRON.*, The Institute of Electronics, Information and Communication Engineers.

Jameson, K. A. (under review). ColCat: A Color Categorization Digital Archive and Research Wiki. Invited contribution to proceedings for PICS2016: Progress in Colour Studies Conference.

Bochko, V. and Jameson, K. A. (under review). Investigating Potential Human Tetrachromacy in Individuals with Tetrachromat Genotypes Using Multispectral Techniques. Invited contribution to proceedings for PICS2016: Progress in Colour Studies Conference.

Park, J.P., Tauber, S., Jameson, K. A. and Narens, L. (under review). The Evolution of Shared Concepts in Changing Populations. Invited contribution in preparation for inclusion in Special Issue on “Perceptual Categories” of the journal *Review of Philosophy and Psychology*.

Manuscripts in-progress:

Atilano, S. R. Jameson, K. A. & M. C. Kenney. (in-progress). Procedures for characterizing genetic sequence variations underlying human visual phenotypes: Genotyping methods and a case-study demonstration. Manuscript in preparation.

Jameson, K. A., Guo, L., Atilano, S. R. & M. C. Kenney. (in-progress). Preliminary results associating X-linked Opsin genotype variations with risk and progression for Adult-onset Macular Degeneration (AMD). Manuscript in preparation.

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Marek Kaminski

“Spoiler Effects in Proportional Representation Systems: Evidence from Eight Polish Parliamentary Elections, 1991-2015.” *Public Choice*. Forthcoming.

“Modeling rationality: How 20th century mathematics changed the understanding and modeling of social rationality.” *Culture of Modelling in Science (special issue of Dissertationes Methodologicae)*. Forthcoming.

(2017). “Backward Induction: Merits and Flaws.” In Haman, J., Poleszczuk, J. (Eds.) *Formal Models in Social Sciences (special issue of Studies in Logic, Grammar and Rhetoric)* (Vol. 50, pp. 9-24). De Gruyter.

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JOWy i ordynacje większościowe (Single-member Districts and Majoritarian Electoral Laws). (pp. 1-200). (2016). Warsaw, Poland: Scholar. Book, 2016 (in Polish).

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The Abilene Paradox and Other Meditations on Management, 2017. Harvey, J. B., Decisions (in Polish).

Robin Keller

Designing Safety Regulations for High-Hazard Industries. National Academies of Sciences, Engineering, and Medicine. 2017. Washington, DC: The National Academies Press. <https://doi.org/10.17226/24907>. This National Academies book is authored by the Committee for a Study of Performance-Based Safety Regulation. Freely downloadable at <https://www.nap.edu/catalog/24907/designing-safety-regulations-for-high-hazard-industries>.

Newly accepted articles in 2017-18:

L. Robin Keller and Jay Simon (Tenured Associate Professor, American U., 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, <http://onlinelibrary.wiley.com/doi/10.1111/risa.12892/full>, Appeared online in early view prior to print: [http://onlinelibrary.wiley.com/journal/10.1111/\(ISSN\)1539-6924/earlyview](http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1539-6924/earlyview)
[Abstract Article](#) [PDF\(1822K\)](#)

James M. Leonhardt (Assistant Professor, University of Nevada, Reno, Merage PhD alumnus) and L. Robin Keller, “Do Pictographs Affect Probability Comprehension and Risk Perception of Multiple-Risk Communications?” *Journal of Consumer Affairs*, published in Early View <https://onlinelibrary.wiley.com/doi/abs/10.1111/joca.12185> on 4-6-2018, [Leonhardt-Keller-JOCA-Final](#).

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L. Robin Keller and Yitong Wang (Merage doctoral alumnus) “Information Presentation in Decision and Risk Analysis: Answered, Partly Answered, and Unanswered Questions,” 2017, *Risk Analysis*, 37(6): 1132–1145.

Michael Lee

Danileiko, I. & Lee, M.D. (in press). A model-based approach to the wisdom of the crowd in category learning. *Cognitive Science*. Accepted 13-Sep-2017.

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Ines Levin

R. Michael Alvarez, Thad E. Hall, and Ines Levin. "Low-Information Voting: Evidence from Instant-Runoff Elections."Forthcoming in *American Politics Research*.

Sean Ingham and Ines Levin. "Can Deliberative Minipublics Influence Public Opinion? Theory and Experimental Evidence."Forthcoming in *Political Research Quarterly*.

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Gabriel Katz and Ines Levin. 2018. "Varieties of Political Support in Emerging Democracies: A Cross-National Analysis." *Social Science Research* 70: 55-70.

R. Michael Alvarez, Ines Levin, and Lucas Nuñez. 2017. "The Four Faces of Political Participation in Argentina: Using Latent Class Analysis To Study Political Behavior." *Journal of Politics* 79(4): 1386-402.

Michael McBride

G. Ridinger, M. McBride, forthcoming, "Reciprocity in Games with Unknown Types," in M. Capra, R. Croson, M. Rigdon, T. Rosenblatt, eds., *Handbook of Experimental Game Theory*, Edward Elgar Publishing.

M. McBride, S. Skaperdas, P. Tsai, forthcoming, "Why Go to Court? Bargaining Failure under the Shadow of Trial with Complete Information," *European Journal of Political Economy* (accepted Dec 2017).

Cailin O'Connor

“The Misinformation Age: How False Beliefs Spread.” with James O. Weatherall, forthcoming with Yale University Press.

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Lisa Pearl

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Zyg Pizlo

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Don Saari

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Stergios Skaperdas

Skaperdas, Stergios and Vaidya, Samarth, “Contested Political Persuasion,” forthcoming in Congleton, R., Grofman, B. and Voigt, S. (eds), *The Oxford Handbook of Public Choice*.

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Gregory Scontras

Scontras, Gregory, and Noah D. Goodman. 2017. Resolving uncertainty in plural predication. *Cognition* 168, 294–311. doi:10.1016/j.cognition.2017.07.002

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Brian Skyrms

Ten Great Ideas About Chance [with Persi Diaconis] (Princeton University Press: Oct. 2017).

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“Accommodation Dynamics for Comparing Utilities with Others” with Louis Narens (2017) *Philosophical Studies*. DOI: 10.1007/s11098-017-0966-6

Hal Stern

Davis, E.P., Stout, S.A., Molet, J., Vegetabile, B., Glynn, L.M., Sandman, C.A., Heins, K., Stern, H., Baram, T.Z. (2017) “Exposure to unpredictable maternal sensory signals influences cognitive development across species,” *Proceedings of the National Academy of Sciences*, 114(39):10390-10395. <http://dx.doi.org/10.1073/pnas.1703444114>.

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Rein Taagepera

M.S. Shugart and R. Taagepera, 2017. *Votes from Seats: Logical Models of Electoral Systems*. Cambridge UP.

R. Taagepera, 2017. *Estonian Politics: 100 Years*. The Government Office of the Republic of Estonia and Post Factum – Eesti Meedia AAS. Official distribution only.

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Maneesh Arora and R. Taagepera, 2017. The stubborn law of female-male literacy: Why the gap may widen. *Journal of Education & Social Policy* 7, 35-46.

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R. Taagepera, 2018. Lithuania, Latvia and Estonia: 100 Years of similarities and disparities. *Diplomaatia* no. 173/174, February.

Tom Trogdon

P. Deift and T. Trogdon, “Universality in numerical computation with random data. Case studies, analytic results and some speculations”, arXiv:1703.08092 (to appear in The Abel Symposium 2016 Volume), 1–13, 2017.

P. Deift and T. Trogdon, “Universality for eigenvalue algorithms on sample covariance matrices”, arXiv:1701.01896 (to appear in SIAM J. Numer. Anal.), 1–31, 2017.

L. Sagun, T. Trogdon and Y. LeCun, “Universal halting times in optimization and machine learning”, arXiv:1511.06444 (to appear in Quarterly in Appl. Math.), 1–12, 2015.

A. Jagannath and T. Trogdon, “Random matrices and the New York City subway system”, Phys. Rev. E, 96, 030101(R), 2017.

James Weatherall

The Misinformation Age: How False Beliefs Spread, with C. O'Connor. Forthcoming from Yale University Press (2019). (Accepted Jan. 2018)

“Scientific Polarization,” with C. O'Connor. Forthcoming in *European Journal for Philosophy of Science*.

“(Information) Paradox Regained? A Brief Comment on Maudlin on Black Hole Information Loss,” with J. B. Manchak. *Foundations of Physics* **48**(6), 611--627 (2018).

“On Gravitational Energy in Newtonian Theories,” with Neil Dewar. Forthcoming in *Foundations of Physics*.

“The Peculiar Logic of the Black-Scholes Model.” Forthcoming in *Philosophy of Science*

“Are Two Dimensions World Enough for Spacetime?” with S. Fletcher, M. Schneider, and J. B. Manchak. Forthcoming in *Studies in History and Philosophy of Modern Physics*.

“A Brief Comment on Maxwell(Newton)[-Huygens] Spacetime.” Forthcoming in *Studies in History and Philosophy of Modern Physics*.

“Market Crashes as Critical Phenomena? Explanation, Idealization, and Universality in Econophysics,” with J. Jhun and P. Palacios. Forthcoming in *Synthese*.

“Conservation, Inertia, and Spacetime Geometry.” Forthcoming in *Studies in History and Philosophy of Modern Physics*.

Vijay Vazirani

Opinion Dynamics in Networks: Convergence, Stability and Lack of Explosion. In *Proc. 44th International Colloquium on Automata, Languages and Programming*, July (2017). (with T. Mai and I. Panageas).

An Incentive Compatible, Efficient Market for Air Traffic Flow Management. *Proc. 23rd. Annual Computing and Combinatorics Conference*, August (2017). To appear in Special Issue of *Theoretical Computer Science*. (with R. Mehta).

A Performance-Based Scheme for Pricing Resources in the Cloud. In *Proc. 13th Workshop on Internet and Network Economics*, Bangalore, India, December (2017). (with K. Jain and T. Mai).

A New Class of Combinatorial Markets with Covering Constraints: Algorithms and Applications. In *Proc. 28th Annual ACM-SIAM Symposium on Discrete Algorithms*, (2018). (with N. Devanur, J. Garg, R. Mehta and S. Yazdanbod).

ETR and FIXP Completeness of Decision Versions of 3-Nash. *Transactions on Economics and Computation*, 6-1 (2018). (with J. Garg, R. Mehta and S. Yazdanbod).

Nash Social Welfare for Indivisible Items under Separable, Piecewise-Linear Concave Utilities. In *Proc. 29th Annual ACM-SIAM Symposium on Discrete Algorithms*, January (2018). (with N. Anari, T. Mai and S. Oveis Gharan).

Cycles in Zero-Sum Differential Games and Biological Diversity. In *Proc. ACM Conference on Electronic Commerce, EC '18*, June (2018). (with T. Mai, M. Mihail, I. Panageas, W. Ratcliff and P. Yunker).

Finding Stable Matchings that are Robust to Errors in the Input. In *Proc. European Symposium on Algorithms* August (2018). Also submitted to *Mathematics of Operations Research*. (with T. Mai).

Planar Graph Perfect Matching is in NC. In *Proc. 59th Annual IEEE Symposium on Foundations of Computer Science*, October (2018). Also submitted to *Journal of the ACM*. (with N. Anari).

Hongkai Zhao

J. Fang, J. Qian, L. Zepeda-Nunez and H. Zhao. *An efficient hybrid method for high frequency Helmholtz equation with point source*, *J. Comp. Phys.*, to appear.

H. F. Li, H. Zhao and H. Li. *Neural Response Based Extreme Learning Machine for Image Classification*, *IEEE Transactions on Neural Networks and Learning Systems*, to appear.

B. Engquist and H. Zhao. *Approximate Separability of the Green's Functions of the Helmholtz Equation in the High Frequency Limit*, *Communications on Pure and Applied Mathematics*, to appear.

J. Fang, J. Qian, L. Zepeda-Nunez and H. Zhao. *Learning dominant wave directions for plane wave methods for high-frequency Helmholtz equations*, *Research in Mathematical Sciences*, 4(12), 2017.

L. Zepeda-Nunez and H. Zhao. *Fast alternating bi-directional preconditioner for the 2D high frequency Lippmann-Schwinger equation*, *SIAM Journal on Scientific Computing*, 38(5), 866-888, 2017.

C. Zhang, B. Shahbaba and H. Zhao. *Variational Hamiltonian Monte Carlo via score matching*, Bayesian Analysis, 13(2), 485-506, 2018.

C. Zhang, B. Shahbaba and H. Zhao. *Hamiltonian Monte Carlo Acceleration Using Surrogate Functions with Random Bases*, Statistics and Computing, 27(6), 1473-1490, 2017.

M. Wang, S. Leung and H. Zhao. *Modified virtual grid difference for discretizing Laplace-Beltrami operator on point clouds*, SIAM Journal on Scientific Computing, Vol. 40(1), 1-21, 2018.

E. TECHNICAL REPORT SERIES

APPENDIX C
IMBS TECHNICAL REPORTS, 2017 - 18

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 \approx Simplicity Principle, and Conservations Laws \approx Veridicality
Zygmunt Pizlo

F. FACULTY PRESENTATIONS

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

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

“Self-Assembling Networks”, Formal Social Epistemology Workshop, Irvine, CA, May 2018.

“Typical Quantum Worlds”, MAPS, NYU, NYC, November 2017.

“Typicality in Quantum Mechanics”, CQIN, Lake Arrowhead, CA, September 2017.

“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 in Selected Groups”, NSF Slacker Conference, September 2017.

“A Longtime Interest in Dealing with Individual Differences in Cognitive Modeling”, Invited paper for the Society of Experimental Psychologists Annual Meeting, March 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.

American Real Estate and Urban Economics Association Meetings, Philadelphia, January 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

Butts, Carter T. (2/2018). "Attention, Amplification, Resilience, and Hazard Messaging at the Organizational/Public Interface." Keynote Address, Social Web for Disaster Management 2018 Workshop. Los Angeles, CA.

Butts, Carter T. (6/2018). "Obtaining the Sparse ERGM Reference Model from Marginalized Latent Dynamics." 38th Sunbelt Network Conference (INSNA), Utrecht, Netherlands.

Phillips, Nolan and Butts, Carter T. (6/2018). "Comparing States' Emergency Operations Plans as Networks Using Exponential Family Random Graph Models." 38th Sunbelt Network Conference (INSNA), Utrecht, Netherlands.

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.

Smith, Emily J.; Buhler-Kane, Jennifer; Butts, Carter T.; Hipp, John R.; and Farshchi, Ehsan. (6/2018). "Local Social Network Ties and Prenatal Smoking." 38th Sunbelt Network Conference (INSNA), Utrecht, Netherlands.

Thomas, Loring and Butts, Carter T. (6/2018). "An Examination of Urban Ecology as a Conductor for Social Behavior in Networks of Areal Units." 38th Sunbelt Network Conference (INSNA), Utrecht, Netherlands.

Lee, Francis and Butts, Carter T. (8/2017). "On the Reliability of Friendship." ASA Meeting, Montreal, Quebec.

Phillips, Nolan and Butts, Carter T. (8/2017). "Tools for Assessing the Model Adequacy of Exponential Graph Models (ERGMs) Using Labeled Networks." ASA Meeting, Montreal, Quebec.

Smith, Emily J.; Butts, Carter T.; Hipp, John R.; and Nagle, Nicholas N. (8/2017). "The Geography and Multiplexity of Job Lead Ties." ASA Meeting, Montreal, Quebec.

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.

Lee, Francis and Butts, Carter T. (7/2017). "On the Validity of the Bayesian Network Accuracy Model." 1st North American Social Networks Meeting (NASN), Washington, DC.

Phillips, Nolan and Butts, Carter T. (7/2017). "Tools for Assessing the Model Adequacy of Exponential Graph Models (ERGMs) and Comparing Sets of Networks Using Labeled Features." 1st North American Social Networks Meeting (NASN), Washington, DC.

Smith, Emily J.; Butts, Carter T.; Hipp, John; and Nagle, Nicholas. (7/2017). "Spatial and Social Embeddedness of Emergency Contact Ties." 1st North American Social Networks Meeting (NASN), Washington, DC.

Wang, Cheng; Butts, Carter T.; Hipp, John; Jose, Rupa; and Lakon, Cynthia M. (7/2017).
“Goodness-of-Fit Testing for Behavior in Joint Dynamic Network/Behavior Models with an Extension to Two-Mode Networks.” 1st North American Social Networks Meeting (NASN), Washington, DC.

Jean-Paul Carvalho

“Elite Identity and Political Accountability: A Tale of Ten Islands”, Economic Research on Identity, Norms and Narratives (ERINN) Annual Conference, Oxford, June 2018.

“Religious Identity and Cultural Dynamics“, Religious Studies seminar, UC Irvine, June 2018.

“Elite Identity and Political Accountability: A Tale of Ten Islands”, LSE- NYU Conference on Political Science and Political Economy, London, May 2018.

“Religious Identity”, IMBS conference on Identity, Cooperation and Conflict, UC Irvine, April 2018.

“The Economics of Religious Communities: Social Integration, Discrimination and Radicalization”, ASREC Annual Conference, Chapman University, March 2018.

“The Economics of Religious Communities: Social Integration, Discrimination and Radicalization”, Economic Theory seminar, UC Riverside, January 2018.

“The Economics of Religious Communities: Social Integration, Discrimination and Radicalization”, NES Conference ‘Towards Effective and Equitable Development: the Role of Institutions and Diversity’, Moscow, December 2017.

“The Economics of Religious Communities: Social Integration, Discrimination and Radicalization”, Comparative Politics Seminar, Stanford University, November 2017:.

“Identity Economics”, Wired Japan Conference on Identity, Tokyo, October 2017.

“Religious Identity, INET Annual Conference, Edinburgh, October 2017.

David Eppstein

“Forbidden configurations in discrete geometry”, invited plenary talk, 5th International Conf. Combinatorics, Melbourne, Australia, December 2017.

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

“Forbidden configurations in discrete geometry”, Paul Erdős Memorial Lecture, Canadian Conference on Computational Geometry, Ottawa, Canada, July 2017.

Michelle Garfinkel

“Arming and Fighting as Commitment Problems”, Eighth Annual Academic Conference on Political Violence and Policy, Center for Global Collective Action, University of Texas-Dallas, May 2018.

Steve Frank

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

“Predictions of disease: somatic mosaicism, mitochondrial transmission, and pathogen dosage”, Harvard Medical School, October 2017.

“Common probability patterns arise from simple invariances”, IMBS symposium on symmetry, November 2017.

Ami Glazer

“Policy proposals when government engages in rent seeking”, S.T.E.F. conference, KU Leuven, June 2018.

“Why High-level Executives Earn Less in the Government Than in the Private Sector”, Department of Economics, UC Riverside, October 2017.

“How a Corrupt Official Can Increase His Budget”, Public Choice Society Meetings, March 2018.

“Monetizing Creative Destruction: Forward Markets to Spur Innovation”, Public Choice Society Meetings, March 2018.

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

“Learning to Take Turns in Social Interactions”, Second Annual PPE conference, New Orleans, March 2018.

“Radically Finite Probability”, Workshop on Probability in the Sciences, University of Washington, Seattle, April 2018.

Kimberly Jameson

Jameson, K. A. “A Color Categorization Resource for Cross-Cultural Research: The ColCat Digital Archive.” Department of Linguistics Colloquium, April 10, 2017, University of California, Irvine.

Jameson, K. A. Invited Keynote Presentation: “Establishing a new database resource for cross-cultural color research: The Robert E. MacLaury Color Categorization (ColCat) Digital Archive. Invited Speaker at PICS2016: Progress in Colour Studies Conference (Darwin Theater, University College London. London, UK). September 2016.

Jameson, K. A., Goldfarb, K. & Bochko, V. A. (2016). Art, interpersonal comparisons of color experience, and potential tetrachromacy. Invited Speaker at the PICS2016: Progress in Colour Studies Conference (Darwin Theater, University College London. London, UK). September 2016.

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

“Spoiler Effects in Proportional Representation Systems”, Center for the Study of Democracy, Irvine, April 2018.

“Spoiler Effects in Proportional Representation Systems”, Public Choice Society Annual Meeting, Charleston, March 2018.

“Prison subculture in communist Poland”, Victims of Communism Memorial Foundation, University of California, Irvine, October 2017.

“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.

“Some Examples of Using Bayesian Statistics in Modeling Human Cognition”. Invited presentation, UC Irvine Departments of Statistics, October 2017.

“Modeling violence in the second intifada: A Bayesian cognitive modeling approach”. Advances in Econometrics workshop, UC Irvine, June 2018.

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

“Identity and the Escalation of Conflict,” UC Irvine, IMBS Conference on Identity, Cooperation, and Conflict, April 2018.

“Dynamics of Religious Group Growth and Survival,” Association for the Study of Religion, Economics, and Culture Conference, March 2018.

“Theory-of-mind Ability and Cooperation,” UC Riverside, Department of Economics, January 2018.

“Spatial Models of Religious Market Competition: A Critical Assessment,” International Economic Association Roundtable on the Economics of Religion, Cambridge University, July 2017.

Cailin O’Connor

Discrimination and Collaboration in Science. Formal Social Epistemology Workshop, UC Irvine, Irvine, CA. (May 2018).

Discrimination and Collaboration in Science. Identity, Cooperation, and Conflict, IMBS, UC Irvine, Irvine, CA. (April 2018).

Discrimination and Collaboration in Science. Formal Epistemology and Social Networks, University of Lund, Lund, Sweden. (April 2018, Presented by co-author).

Making Science Propaganda-Proof. Politics, Philosophy, and Economics Society Meeting, New Orleans, Louisiana. (March 2018).

Evolving a Gendered Division of Labor. Politics, Philosophy, and Economics Society Meeting, New Orleans, Louisiana. (March 2018).

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).

How to Beat Science and Influence People. Mind, Technology, and Society Seminar Series, University of California, Merced, Merced, 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).

Dynamics of Inequity. Department of Philosophy, The University of Auckland, Auckland, New Zealand. (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).

“Power by Association.”Fifth Conference of the Latin American Association for Analytic Philosophy. Villa de Leyva, Colombia. (May 2018, presented by co-author).

“The Cultural Red King Effect”. The Generalized Theory of Evolution Conference. Dusseldorf, Germany. (January 2018).

“Discrimination and Collaboration in Science.”The Fifth Conference of the European Network on Social Ontology. Lund, Sweden. (August 2017, presented by co-author).

“Discrimination and Collaboration in Science.”Formal Models of Scientific Inquiry. Ruhr-University, Bochum, Germany. (July 2017, presented by co-author).

Louis Narens

“A Multiple World Approach to Contextuality”, IMBS Friday Seminar, January 13, 2018, UC Irvine.

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) 44th Annual Meeting of the Berkeley Linguistics Society, UC Berkeley, February 2018.

Exactly two things to learn from modeling scope ambiguity resolution: Developmental continuity and numeral semantics. (with K.J. Savinelli and Greg Scontras) Cognitive Modeling and Computational Linguistics, Salt Lake City, UT, January 2018.

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 Meeting of the Society for Computation in Linguistics, Salt Lake City, UT, January 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.

Small lexical learners: The development of adjective ordering preferences. (with Galia Bar-Sever, Rachael Lee, and Greg Scontras) Boston University Conference on Language Development 42, Boston, MA. November 2017.

Continuity in development of scope ambiguity resolution and the importance of numeral semantics. (with K.J. Savinelli and Greg Scontras) California Universities Semantics and Pragmatics (CUSP) 10, UC Irvine. September 2017.

Bayesian inference and linguistic parameters. Norwegian Summer Institute on Language and Mind 2017, University of Oslo, Norway. August 2017.

Computational models of syntactic acquisition. Norwegian Summer Institute on Language and Mind 2017, University of Oslo, Norway. August 2017.

Introduction to computational models of language acquisition. Norwegian Summer Institute on Language and Mind 2017, University of Oslo, Norway. August 2017.

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.

Modeling scope ambiguity resolution as pragmatic inference: Formalizing differences in child and adult behavior. (with KJ Savinelli and Greg Scontras) 39th annual meeting of the Cognitive Science Society, London, UK. July 2017.

Zyg Pizlo

Symmetry as the fundamental prior in human 3D vision. Keynote at the Workshop on Detecting symmetry in the wild. International Conference on Computer Vision, Venice, Italy. October 2017.

The role of symmetry in computational models of 3D vision. 7th Workshop of Computational and Mathematical Models in Vision. St. Pete Beach, May 2018.

Donald Saari

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

“Mathematics behind the dark matter mystery.” Colloquium, Mathematics, Michigan Tech., September 2017.

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

“Hidden symmetries inherent to decision methods”, IMBS Conference on Symmetry and invariance in the natural and behavioral & sciences, November 2017.

Greg Scontras

Savinelli, K. J., Gregory Scontras, and Lisa Pearl. 2017. Modeling scope ambiguity resolution as pragmatic inference: Formalizing differences in child and adult behavior. Poster presented at the 39th meeting of the Cognitive Science Society.

Bar-Sever, Galia, Rachael Lee, Gregory Scontras, and Lisa Pearl. 2017. Subjective little learners: Hyperarticulated input and the early development of adjective ordering preferences. Boston University Conference on Language Development 42.

Savinelli, K. J., Gregory Scontras, and Lisa Pearl. 2018. Exactly two things to learn from modeling scope ambiguity resolution: Developmental continuity and numeral semantics. Poster presented at Cognitive Modeling and Computational Linguistics 2018.

Bar-Sever, Galia, Rachael Lee, Gregory Scontras, and Lisa Pearl. 2018. Quantitatively assessing the development of adjective ordering preferences using child-directed and child-produced speech corpora. Poster presented at the 1st Annual Meeting of the Society for Computation in Linguistics.

Scontras, Gregory, K.J. Savinelli, and Lisa Pearl. 2018. The pragmatics of truth-value judgments. The 92nd Annual Meeting of the Linguistic Society of America.

“Property noise and ambiguity resolution: The case of stubborn distributivity.” September 15, 2017. Department of Linguistics, Harvard University.

“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.

“The pragmatics of truth-value judgments.” UConn Logic Group. March 30, 2018. University of Connecticut.

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

Stergios Skaperdas

“Investing in Influence: Policy Determination Under Persuasive Lobbying,” Seminar at Max Planck Institute for Tax Law and Public Finance, Munich, Germany, March 2018.

“Investing in Influence: Policy Determination Under Persuasive Lobbying,” Semina at University of California, Riverside, February 2018.

“External Intervention, Identity, and Civil War,” Conference on “Empowering Sustainability in a Fragile World,” Center for Security and Development Studies, Lomonosov Moscow State University, Moscow, December 2017.

“Guns, Lawyers, and Markets: Economic Consequences of Costly Conflict,” Seminar at Fudan University, September 2017.

“Guns, Lawyers, and Markets: Economic Consequences of Costly Conflict,” Seminar at Zhejiang University, September 2017.

“External Intervention, Identity, and Civil War,” Conference on Microeconomic Theory and Experiments, South China Normal University, Guangzhou, China, September 2017.

“Guns, Lawyers, and Markets: Economic Consequences of Costly Conflict,” Annual Meeting of the Canadian Law and Economics Association, Toronto, Canada, September 2017.

“Guns, Lawyers, and Markets: Economic Consequences of Costly Conflict,” Seminar at University of Waterloo (Ontario), September 2017.

“Investing in Influence: Policy Determination Under Persuasive Lobbying,” Society for the Advancement of Economic Theory (SAET) conference, Faro, Portugal, June 2017.

“Guns, Lawyers, and Markets: Economic Consequences of Costly Conflict,” Conference on Contests: Theory and Evidence, University of East Anglia, Norwich, UK, June 2017.

Brian Skyrms

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

Keynote: Social Evolution Groningen University, January 2018.

Emergent Communication Workshop, Neural Information Processing Systems Meeting, NIPS 2017, Long Beach, CA, December 2017.

Hal Stern

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

“Characterizing Handwriting Complexity for Forensic Evaluation”, Internal Conference on Forensic Inference and Statistics, Minneapolis, MN, September 2017.

“Why Error Rates?”, CSAFE Error Rate Symposium, Arlington, VA, January 2018.

“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.

“Getting Beyond the Mean in Predictive Inference”, Conference on Predictive Inference and its Applications, Iowa State University, Ames, IA, May 2018.

“The Likelihood Ratio and Other Paradigms for Forensic Evidence”, ABA Criminal Justice Section’s Ninth Annual Prescription for Criminal Justice Forensics Program, New York, NY, June 2018.

“Forensic Statistics and the Assessment of Probative Value”, NACDL Cardozo Law National Forensic College, New York, NY, June 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 Szegő Lecture, University of Kent, July 6, 2017: “The high oscillation of special functions”

Vijay Vazirani

“Planar Graph Perfect Matching is in NC”

- Joint ACO/ARC Seminar, College of Computing, Georgia Tech, November 2017.
- 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 Angeles, CA, February 2018.
- Computer Science Department, University of Southern California, Los Angeles, 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.
- New England Microsoft Research, Cambridge, MA, July 2018.

“Google’s AdWords Market: How Theory Influenced Practice”

- Optimization Seminar, Simons Institute for the Theory of Computing, Berkeley, CA, December 2017.
- Keynote Speaker, The 13th Conference on Web and Internet Economics, Bangalore, India, December, 2017.
- Keynote Speaker, The Southern California Symposium on Network Economics and Game Theory, Caltech, CA, January 2018.
- Invited Speaker, Workshop on Mathematical and Computational Challenges in Real- Time Decision Making, Simons Institute for the Theory of Computing, Berkeley, CA, April 2018.
- Keynote Speaker, The 13th Workshop on the Economics of Networks, Systems and Computation (NetEcon) Irvine, CA, June 2018.

“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

“The Motion of Small Bodies in Spacetime”. Mini-Workshop on the Problem of Motion and Geodesic Theorems in GR. California Institute of Technology, Pasadena, CA. June 2018.

“The Motion of Small Bodies in Spacetime”. Black Hole Initiative Colloquium. Harvard University, Cambridge, MA. March 2018.

“(Information) Paradox Regained?”. BHI Mini-Workshop on the Philosophy of Extreme Spacetimes. Black Hole Initiative. Harvard University, Cambridge, MA. March 2018.

“How to Beat Science and Influence People”. Institute for Mathematical Behavior Sciences. University of California, Irvine, CA. January 2018 [presented by co-author C. O'Connor].

“The Physics of Wall Street”. Engineering Physics Congress 2017. Universidad Iberoamericana, Mexico City, Mexico. November 2017.

“The Physics of Wall Street”. Perimeter Institute Public Lecture Series. Toronto, ON. October 2017.

“Questions”. High Desert Test Sites. 29 Palms, CA. October 2017.

“(Information) Paradox Regained”. Metro-Area Philosophy of Science Group. New York University. New York, NY. September 2017.

“The Motion of Small Bodies in Spacetime”. Max Planck Institute for Gravitational Physics. Potsdam, Germany. September 2017.

“The Motion of Small Bodies in Spacetime” (keynote lecture). Thinking about Space and Time: 100 Years of Applying and Interpreting General Relativity. Bern, Switzerland. September 2017.

“The Motion of Small Bodies in Spacetime”. Gravity: Past, Present Future. Pacific Institute of Theoretical Physics. Vancouver, BC. September 2017.

“How to Beat Science and Influence People”. School of Philosophy. Australian National University. Canberra, Australia. August 2017.

“On Stuff”. Department of Physics. University of Auckland. Auckland, New Zealand. August 2017.

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 of the Journal of Economics and Business.

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 Formal Modeling and Analysis of Color Categorization: Innovations and Insights since Berlin and Kay (1969)

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

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 Iłski, "Ordynacja większościowa (Majoritarian electoral laws)," *Wrocławskie Studia Politologiczne* (in Polish), 2017.

Polish Radio 24. Radio. <http://www.polskieradio.pl/130,PR24>. Interview on electoral reform. September 2017.

"Interview on democratization," *Polypsych*, with Anthony Lindsay. Online. polypsych.org. July 2017.

Robin Keller

Elected to UCI Council on Academic Personnel, 3 year term beginning September 2016.

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.

Session chair: Healthcare Decision Analysis session, INFORMS Annual Meeting, Houston, Oct. 2017.

First Annual ComplianceNet Conference, UCI Law School, session chair on “Good and Bad Apples in Compliance: An Ethics Approach”, June 2018.

Conference Panel: L. Robin Keller, moderator, Meet the Editors Panel, in session co-chaired by L. Robin Keller and Saurabh Bansal, INFORMS Annual Meeting, Houston, October 2017.

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.

Emerging Technology Staff. “The tricks propagandists use to beat science”, MIT Technological Review, (about ‘How to Beat Science and Influence People’), January 2018.

“The Culture of Risk in Science”, The Naked Scientist, Interview for podcast, August 2017.

Lisa Pearl

Organizer and faculty leader of the interdisciplinary discussion group “Computational Models of Language”: <http://www.socsci.uci.edu/~lpearl/colareadinggroup/>. 2010-current.

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

Keynote Speaker, Conference on “Contests: Theory and Evidence,” University of East Anglia, Norwich, UK, June 2017.

Jim Tory Law and Economics Public Lecture, 2017 Meeting of the Canadian Law and Economics Association, Toronto, Canada, September 2017.

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

SIAM Gabor Szego Prize, 2017.

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)

<u>Student</u>	<u>Advisor</u>
Nikhil Addleman	Carvalho
** Gregory Alexander	Batchelder
Dhari Aljutaili	Brownstone
Lucila Arroya	Narens
Galia Bar-Sever	Pearl
Alandi Bates	Pearl
Dennis Blew	Kaminski
Jennifer Bryson	Zhao
Alex Bower	Batchelder
Steven Brownlee	Poirier
Debapriya Chakraborty	Brownstone
Calvin Cochran	Barrett/O'Connor
John Cuffe	Uhlaner
Emma Cushman	O'Connor
Maozhu Dai	Stern
** Irina Danileiko	Lee
Archie Delshad	Kaminski
* Steve Doubleday	Lee
Ali Esmaeeli	Keller
Nikki Fider	Komarova
Rick Gardner	Butts
Ben Gibson	Butts
Marian Gilton	Weatherall
Maryam Gooyabadi	Narens
Kier Groulx	Chubb
Maime Guan	Lee
Santiago Guisasola	Saari
Sid Gupta	Eppstein
Daniel Herrmann	Huttegger
Christian Herrera	Chubb
Joselyn Ho	Chubb
Kurt Horner	McBride
Matt Inverso	Chubb
Kirbi Jo	Narens
Patrick Julius	McBride
Brian Kaiser	Kaminski
Alysha Kassam	O'Connor
Nagawa Khordagui	Brueckner

Student

Irina Kotova
Si-Yuan Kong
Travis LaCroix
Alex Luttmann
William Leibzon
Francis Lee
Gunnar Lund
** Timmi Ma
Amine Mahmassani
Tung Mai
Nil Mamano
Solena Mednikoff
** Percy Mistry
Chris Mitsch
* Byunggeor Moon
** Aydin Mohseni
Emma Nguyen
Joseph Nunn
Fulya Ozcan
Nolan Phillips
Jason Ralston
Jordan Rashid
Scott Renshaw
Alex Robinson
Gerard Rothfus
Sarita Rosenstock
K.J. Savinelli
Zachary Schaller
Mike Schneider
Pele Schramm
Galia Bar Sever
Nishtha Sharma
Linley Slipetz
Emma Smith
Pat Testa
* Loring Thomas
Brian Vegetabile
** Jamie Wang
Cole Williams
Nicole Winter
Karen Wood
Eyra Yang
Howard Yang
Sadra Yazdanbod
Fan Yin
Tim Young
Yue Yu

Advisor

McBride
McBride
Barrett/O'Connor
Brueckner
Narens
Butts
Scontras
Komarova
McBride
Vazirani
Eppstein
Chubb
Lee
Weatherall
Brueckner
Huttegger/O'Connor
Pearl
Saari
Poirier
Butts
McBride
Chubb
Butts
Keller
Huttegger/Skyrms
O'Connor/Weatherall
Scontras/Pearl
Skaperdas
O'Connor/Weatherall
Batchelder/
Scontras
Skaperdas
O'Connor
Butts
Skaperdas
Butts
Stern
Brueckner
Carvalho/Skaperdas
Chubb
Komarova
McBride/Skaperdas
Chubb
Vazirani
Butts
McBride
Butts

Student

Kai Yoshioka
Xuhong Zhang
Junying Zhao
Yuting Zhao
Shuying Zhu

Advisor

Brownstone
Butts
Saari/Skaperdas
Huttegger
Stern