

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

**2016 – 2017
Annual Report**

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DIRECTOR'S MESSAGE

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

Preparing this 2016-17 annual report for the *Institute for Mathematical Behavioral Sciences* reinforced the unique international status of the IMBS. While there are groups that combine mathematics and the physical sciences, the IMBS is the only research institute devoted toward using the strengths of mathematical reasoning to analyze and resolve issues from the behavioral and social sciences. As this report indicates, strong progress is being made on a surprising variety of fronts.

Indeed, our charge of meeting new challenges by using mathematical methods---and creating new mathematical approaches when needed---means that the focus of the IMBS changes on a regular basis. Thus, the annual report allows a review of what new has happened and where we now are moving. But before indicating some of what we do, it must be mentioned that beyond our members (who come from at least five UCI schools), the IMBS provides an interdisciplinary home for interested UCI faculty and graduate students with our colloquia, conferences, study groups, and other activities. (Most of the speakers at our graduate student conference (Section IV, D), for instance, are not affiliated with our graduate program.) These pursuits have made the IMBS a UCI “center of convergence.”

Let me strongly recommend that you sample some of the recent IMBS contributions by skimming through Section II D of this report, which provides summaries of research contributions. As examples of contributions to pragmatics, a thorny topic to be considered this fall by the US Supreme Court is that of gerrymandering---earlier this academic year, our IMBS colleague B. Grofman, one of the top experts in this area, carried out the court mandated reapportionment of Virginia's congressional map and has extensively lectured on this topic. Then, M. Kaminski has been working closely with several Polish politicians on electoral reform, while R. Taagepera's developed a new way to detect, and explain, the number of parties in a country. Related is the actual practice of voting, where J. Duffy developed a mathematical analysis of the cost of acquiring information before doing so.

One annoyance of living where we do is driving on the 405, which leads to D. Brownstone and M. McBride's research of creating an experimental game theoretic platform to experimentally analyze traffic decisions with a goal of finding practical solutions. Related is J. Brueckner's mathematical analysis of airline emission charges. A. Noymer continues his work on demography with an emphasis on contemporary health concerns, and R. Keller's study of risk and decision analysis is identifying a variety of central issues that need clarification.

Considerable amount of IMBS emphasis focuses on human decision making, such as M. Komarova's mathematical study of the ability of humans to modify and create a "language" (where her math modeling, in part, explains data about a deaf child acquiring sign language) and L. Pearl's examination of linguistics to explore the creative but immature minds of children. In a series of experiments, M. Birnbaum proved that many people consistently choose the worse alternative. Why? To answer this question, he is developing a new mathematical explanation. (This work is related to Duncan Luce's seminal contributions.) Among his many activities, L. Narens has shown that although standard probability notions are excellent for the physical sciences, they are not adequate to handle issues from the social sciences, which leads to his foundational work on creating new, appropriate probability measures. M. Lee continues his analysis of how decisions are made with the mathematical use of Bayesian methods applied to individual data.

Much of human behavior is governed by social norms, where C. O'Connor, among others in the IMBS, is developing a mathematical approach to understand the emergences of these norms. In addition to his influential work on social norms, B. Skyrms also is exploring new ways to handle utility. The complexity of the social and behavioral sciences is analyzed by several, including C. Butts' analysis of complex systems, K. Romney's development of mathematical models of human color vision, and K. Jameson's continuing work on cultural differences in human color categorization. In this general category is J-P Carvalho's fascinating mathematical models of religion that are providing explanations of seemingly paradoxical religious practices,

Analysis on the theoretical side comes from S. Frank and his study of invariances, J. Yellott's mathematical analysis of eye focus, and J. Boyd and B. Batchelder's clever use of how a certain abstract algebraic tool can provide insight into data structures.

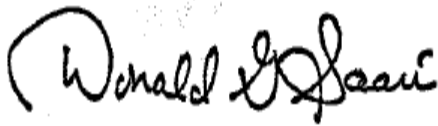
What an incredible array of valued contributions! What pulls all of this together, what allows interactions with opportunities for each of us to learn ideas from others, are the several active IMBS study groups, as well as our regular colloquia and conferences (Sections III--V).

This research is nicely funded with external grants. (See Section VI B.) But because there are absolutely no incentives to have grants go through the IMBS (e.g., the overhead that is "credited" to the IMBS is reported to us, but we never see it), we decided to encourage IMBS members to channel grant proposals through their departments. Should the incentives change, where the IMBS does receive overhead to support our research activities, the IMBS will react to aggressively encourage new grants.

While a lot is being done, what is important for our success is our Department Administrator, Joanna Kerner. Her consistent attention not only to what must be done, but also to what should or could be accomplished, is invaluable. Speaking on behalf of the IMBS, our warm thanks to Joanna!

With my retirement, this is my last annual report. The 14 years I have served as Director have been rewarding. Through the research interactions, discussions, thoughts, and contributions of so many IMBS colleagues, I have learned much that has strongly altered my own research agenda. It has been a delight working with IMBS colleagues and graduate students who have willingly cooperated on a wide range of activities. My expectation is that this strong cooperation will continue with Jean-Paul Carvalho, who was appointed the interim Director.

Sincerely,

A handwritten signature in black ink that reads "Donald G. Saari". The signature is written in a cursive style with a large, prominent initial 'D'.

Donald G. Saari
Director, IMBS

I. ORGANIZATION AND ADMINISTRATION

A. Administration

The Director of the Institute for Mathematical Behavioral Sciences is Professor Donald G. Saari. 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.

Director:	Donald G. Saari, 2003-2017
Previous Directors:	R. Duncan Luce, Founding Director, 1989-1998 William H. Batchelder, 1999-2003
Interim Director	Jean-Paul Carvalho, 2017- present
Graduate Director:	Louis Narens
Administrator:	Joanna Kerner

B. Executive Committee 2016-17

Carter Butts, Professor of Sociology
Michelle Garfinkel, Professor of Economics
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 63 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, Smyth, Steyvers, and Yellott

Economic: Brownstone, Poirier, and Saari

Sociological/Anthropological: Boyd, Butts, Faust, and White

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

Perceptions and Psychophysics:

Vision: Braunstein, Chubb, D’Zmura, Hoffman, Iverson, Palais, 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, and Skyrms

Public Choice: Carvalho, Cohen, Glazer, Grofman, Kaminski, Keller, Taagepera, and Uhlaner

Social Networks: Batchelder, Boyd, Butts, Faust, Noymer, Romney, and White

Social Dynamics and Evolution: Butts, Carvalho, Frank, Huttegger, Johnson, Narens, Romney, Saari, Skyrms, Smyth, Stern, and White

B. Publications

The members who have replied report a total of 136 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 Donald Saari. 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 145 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

Louis Narens

During the 2016-2017 Academic year my research has fallen into five areas:

- (1) Foundations of a quantum-like probability for application in behavioral science
- (2) Use new theories of probability based on intuitionistic logic for decision making
- (3) Evolution of color categorization systems
- (4) Using current ideas, mathematics, and methods to provide foundations for early economic thinking about utility

- (1) is a continuation of a long term research project of mine. It is based on the premise that context is pervasive in psychology and the behavioral sciences and there is little modeling about it except for developing methodologies that attempt to control it. I see a great part of the difficulty in modeling the effects of context as coming from the use of standard probability theory for describing the decision-like mechanisms humans use in making choices. I developed and worked out the foundations of two new kinds of probability theories for this. Both are generalizations of standard probability theory. One is described in (2). The other generalizes the mathematical structure inherent in the probability theory developed by the mathematician John von Neumann for the foundations of quantum mechanics. During this academic year I published three articles that focused on this generalization: "Probabilistic frames for non-Boolean phenomena" in *Philosophical Transactions A of the Royal Society*; "Topological and orthomodular modeling of context in behavioral science" in *Frontiers in Physics*; and "An introduction to lattice based probability theories" in the *Journal of Mathematical Psychology*.
- (2) is another aspect of this long-term research project. It develops a probability theory that is based on a logic (called intuitionistic logic) that was designed for issues in the foundations of mathematics and applies it to issues in behavioral science. Intuitionistic logic, formulated as event spaces for a generalization of Kolmogorov probability theory, is used to model rational decisions under contextual changes including emotions. Two articles about it were published during the academic year: "Multimode utility theory" in the *Journal of Mathematical Psychology*, and "Modeling decisions involving ambiguous, vague, or rare events," with IMBS member Donald Saari (Economics, Mathematics) in G. Chichilnisky and A. Rezaei (eds.), *The Economics of Global Environment, Studies in Economic Theory* 29.
- (3) concerns work on a grant on which I am Co-PI (IMBS member Kimberly Jameson PI). It is about the individual and social evolutions of concepts. During the last academic year, I have been involved in color categorization research of color categorization systems from societies that are non-industrialized and isolated. 2 articles have been recently written by our team about this, one published and one submitted. The published one is, Fider (graduate student, mathematics), Narens (IMBS, cognitive sciences), Jameson (IMBS), and

- (4) Komarova (IMBS, mathematics), “A quantitative approach for defining basic color terms and color category best exemplars,” *Journal of the Optical Society of America*. This article replaces a linguistically based core concept of “basic color term” that requires a semantic understanding of the language with a statically derived one based on a mathematical model and categorization data. This research is part of the lead author’s (Fider) PhD research. The second article, Park (undergraduate, computer science), Tauber (IMBS), Jameson (IMBS), Narens (IMBS, cognitive sciences), “The evolution of shared concepts in changing populations,” *submitted*, shows how birth-death dynamics and others that change the composition of populations can produce systematic, desirable changes that are absent in other commonly used evolutionary processes. This research was part of first author Park’s Honors Thesis that I supervised.
- (5) Recently Brian Skyrms (IMBS, LPS) and I started to collaborate of applying modern mathematical methods from measurement theory and psychophysics to issues raised by the early economist Bentham in the late Eighteenth Century concerning the economic concept of “utility.” The premise is that Bentham and the early economists did not have the appropriate mathematical and psychological theory to provide a suitable foundation for their ideas, and this lack was a principal reason for their later rejection. We have one article in submission about this, “Accommodation dynamics for comparing utilities with others,” that will be part of a larger work.

Also during the last academic year, I served as Graduate Director of the Mathematical Behavioral Sciences Graduate Program. This year we were allocated two students to recruit, which we have done successfully. This coming year, we will investigate whether we want to enlarge our graduate program, as now there appears there might be available resources for doing this.

Statistical Modeling

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 for this year have included an invited handbook chapter on the topic of Bayesian methods in cognitive modeling, and a journal paper with Wolf Vanpaemel focused on the construction of Bayesian priors in the cognitive modeling context.

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 (under review) discusses how computational and mathematical modeling are invaluable tools for scientists who want to understand the language acquisition strategies that children use. 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 linguistic phenomena and offers insights that cannot be found by using theoretical or experimental methods alone.

Savinelli, Scontras, & Pearl (in press) 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 (in prep.) 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 (in prep) 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).

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.

Both Pearl, Ho, & Detrano (in press) and Pearl (2017) also demonstrate the utility of formal modeling with a case study in English *metrical phonology*, which concerns the stress patterns that words have (e.g., *emphasis* has stress on the first syllable: *EMphasis*). While there are systematic patterns that English speakers unconsciously internalize and use, there's also a lot of “noise” — that is, English stress patterns that buck the normal trend and which English speakers effectively have to memorize. The noise in the input makes the process of acquiring English stress patterns a big challenge, and yet every typically developing English child gets it right. A current theory for why English children can manage this feat is that children come innately equipped with ideas about how human language stress systems operate. By taking this idea seriously, we can then investigate if the different proposals for the innate stress biases children have actually do make the acquisition of the English stress system possible. Both Pearl et al. (in press) and Pearl (2017) describe mathematical analyses of the input English children encounter that illuminate which innate stress representations are more helpful, when, and (most importantly) why. One interesting theoretical result is that many current proposals for the target stress knowledge of English would benefit from small changes that make this knowledge more easily learnable from the English data children actually encounter. If we don't make these changes, it's ridiculously hard to learn the “right” English stress knowledge from English data.

Pearl & Phillips (in press) 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.

Bar-Sever, Lee, Scontras, & Pearl (in prep.) use corpus 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 by Scontras and colleagues 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.) Using corpus analysis of English child-directed and child-produced speech, we found that child-directed speech hyperarticulates subjectivity-based adjective ordering preferences (similar to how child-directed speech hyperarticulates other aspects of the language to presumably make a cleaner input signal for the child). Additionally, adult-like subjectivity-based ordering preferences emerge as early as two years old. This underscores the salience of subjectivity in the development of adjective ordering preferences, which contrasts sharply with prior explanations that relied on innately available semantic classes.

Nguyen & Pearl (in press) 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.

Sociological/Anthropological

John Boyd

The chapter "Network analysis" with William H. Batchelder is now published as Chapter 4 pp. 194—273 in the *New Handbook of Mathematical Psychology Vol. 1*. Eds. William H. Batchelder, Hans Colonius, Ehtibar Dzhafarov, and Jay Myung, published by the Cambridge University Press, 2017. This chapter maintains a high level of modesty in that neither I nor my coauthors cites himself. Of course, we are very proud of this achievement.

Current project:

1. William H. Batchelder and I are exploring ways of determining the dimensionality of data using simulation studies and statistical models.
2. Again with Batchelder, we are applying an advanced algebraic techniques, Gröbner Bases, to generalize the Spearman's law of tetrads and Kelley's law of pentads. The goal here is also to determine the dimensionality of data.
3. A.K.Romney and I are using orthogonal polynomials, the so-called Jacobi polynomials, to efficiently describe color vision.

Carter Butts

One of the workhorse techniques of the physical sciences is *spectroscopy*. Spectroscopy is a broad family of techniques that exploits the fact that many phenomena have natural patterns of regular, periodic behavior that act as "fingerprints" for the underlying process: find the repeating pattern in a system's behavior, and you often have very strong evidence about what gave rise to it. Importantly, the spectral signature of a given process can often be seen in averaged, bulk signals from large and even heterogeneous systems, making spectroscopy a go-to when trying to identify the composition or behavior of a system that must be observed from a distance, or for which the components cannot be directly isolated. Familiar examples of spectroscopic applications include the absorption and emission spectra that allow us to know the composition of materials ranging from distant stars and nebula to food and medicines here on Earth, and the magnetic resonance spectra that form the basis of medical imaging techniques such as MRI and fMRI.

The success of spectroscopic methods in making sense of bulk signals from complex systems raises a question: can similar approaches be leveraged to study *social* systems? Historically, the lack of time-resolved data on human activity (with a few exceptions, such as financial time series) meant that the answer to this question was "no." This situation is now changing. Thanks to sources such as mobile device data, it is increasingly possible to obtain aggregated data on human

behavior (including movement, communication, activities, and such) with time resolution on the order of seconds to minutes. This new capability opens the potential for *social spectroscopy* as a practical scientific direction. In a recent paper, my group has demonstrated that such an approach can indeed work. In particular, we show that simple activity and environmental data from mobile devices - such as whether the device is being used to communicate, or how many other devices are in the vicinity - can be used to infer shared social contexts such as belonging to the same workgroup or even being friends. The essence of this approach (which we call *activity correlation spectroscopy*) is that shared social contexts are associated with periodic synchronization and desynchronization in the behavior of individuals. When in the same social environment as another person, our activities and environmental observations become correlated with theirs, this correlation being lost when we separate. Since many social contexts bring people together at regular intervals, this leaves a spectral fingerprint in the sequence of correlations between activity series, allowing the hidden context to be inferred. This work builds on our earlier results showing that spectral methods can likewise be used to infer the ecology of urban areas and the degree to which events in one place impact activity elsewhere, demonstrating that social spectroscopy to be employed to study social systems from the microscopic to the macroscopic level. We are excited at the prospects for these methods to unlock both new ways of studying social systems and new types of questions to investigate regarding social process, and believe that this has the potential to open up an entirely new research area.

Individual Decision-Making

Michael Birnbaum

When people are asked to make decisions between alternatives in which one option is definitely better than the other option, people often select the worse option. Further, in other tests of behavior considered "rational", people often make combinations of choices that are not compatible with the theory that people obey principles considered rational. It is also the case that when presented on more than one occasion with the same choice problem, people will often express different preferences on different occasions. Do people change their minds, or do they simply make random choices on some occasions? I have been studying why people make different decisions to the same choice problem and how we can test theories of human decision making when people are not consistent. A mathematical model has been developed that allows the researcher to find out what proportion of inconsistencies of choice are due to true violations of rational principles, what proportion is due to people changing their minds about a decision problem, and what proportion is due to random error.

Robin Keller

For the last thirty years, researchers in risk analysis, decision analysis, and economics have consistently proven that decision makers employ different processes for evaluating and combining anticipated and actual losses, gains, delays and surprises. While rational models generally prescribe a consistent response, people's heuristic processes will sometimes lead them to be

inconsistent in the way they respond to information presented in theoretically equivalent ways. Keller and Wang point out several promising future research directions by listing and detailing a series of answered, partly answered, and unanswered questions.

Perception and Psychophysics

Kimberly A. Jameson

During 2016-2017 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) 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 2016-2017 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.

Kim Romney

I am engaged with my colleagues at Irvine in ongoing research to develop models of human color appearance that have sufficient resolving power to predict individual differences in color perception. To model the color appearance of an object color requires knowledge of three variables: the reflectance spectrum of the object, the illuminant, and the sensitivity curves of the three photoreceptors (cones) in the retina. It turns out that there are considerable differences among individuals as to where the peak sensitivity of the three cones are located. Geneticists have discovered that they can predict the peak sensitivity curves of the cones from the individual's DNA. A group of Irvine researchers (including myself, Tim Satalich, Kimberly Jameson, and Louis Narens) have volunteered our DNA for examination and found differences in where our cones peak in sensitivity. We are collaborating on research to see if our models can predict differences in perceptual tests of our color appearance. We are in the process of doing pretests on the perceptual and psychophysical tasks. We hope to be the first to develop tests with enough resolving power to detect individual differences in perceptual tasks in color appearance.

Jack Yellott

In May, I reported the following findings at the Vision Sciences Society Annual Meeting. When an eye viewing incoherent monochromatic objects is out of focus by a diopter or more, the amplitude component of its optical transfer function consists entirely of rings of delta functions corresponding to the spatial frequencies made invisible by defocus. In the image domain each ring corresponds to a set of spatial sign waves that all have the same frequency, but differ in orientation and (possibly) phase. For a given frequency the sum of all such sign waves will be some zero-order Bessel function, which should be invisible regardless of its physical contrast. The entire null space of such an eye is the sum of these Bessel functions. Visual stimuli was distributed during the talk to allow the audience to visualize this in their own eyes.

Social and Economic Phenomena

David Brownstone

Professor Michael McBride and I are building an experimental platform to examine drivers' route choice behavior in a laboratory setting where we can control the information they receive. Our setup allows us to vary information about congestion on the road ahead as well as real-time toll pricing. By varying the endowments of the experimental subjects we can also control their value of time, and this allows us to test current theories about road pricing with heterogeneous values of time. We find that drivers do respond to credible information about road conditions, but their response is not optimal. This suggests that we can design information and tolling systems that

will improve the performance of our highway networks. This year we extended our experiments to include adult subjects across the U.S. using the Amazon Mechanical Turk platform. We find that the results are very similar to those obtained with UCI undergraduates in our experimental laboratory.

Jan K. Brueckner

Carbon emissions from the airline industry have gained prominence in recent years, and one policy tool for dealing with them is an emissions charge per gallon of jet fuel. While such a charge would hasten the adoption of more fuel-efficient aircraft in the long-run, it could also have short-run effects by leading to greater fuel conservation efforts in operation of the current fleets of passenger jets. This view is confirmed by results in a recently published paper of mine, which show that, holding aircraft characteristics (i.e., vintage) and operating features (stage length, load factor) of aircraft fleets constant, an optimal emissions charge of 39 cents per gallon would reduce fuel usage by 2%, with a resulting environmental benefit of \$117 per year. Although the sources of this change cannot be seen in the data, they presumably include actions such as flying at lower speeds, taxiing on one engine, carrying less reserve fuel, and installation of fuel-saving winglets.

Jean-Paul Carvalho

This year I was promoted to Associate Professor (with tenure) and received the Dean's Award for outstanding teaching in the social sciences. I had one article published, produced an NBER working paper and commenced a new project on religious communities. I delivered eight research presentations.

In terms of service, I co-organized two conferences, organized one workshop, co-organized two quarters of the Theory, History and Development Seminar, served as faculty instructor for the ASREC Economics of Religion Graduate Workshop and as a discussant at two conferences/workshops. I refereed a number of papers for leading journals. I also chaired the committee for the Jean-Claude Falmagne Dissertation Award. I supervised two students with IMBS related interests: Cole Williams and Pat Testa.

John Duffy

I have some new work on information aggregation and social learning. In one project, with S. Bhattacharya and S. Kim, we have explored incentives for individuals to obtain costly and informative private information prior to voting. Theoretically, as the number of voters gets large, voting according to majority rule should provide better information aggregation of voters' private information. At the same time, as the number of voters increases, the incentives for voters to acquire costly information prior to voting decline, as it is less likely that their vote will be pivotal to the election outcome. We test these predictions in a laboratory experiment, where we find that increases in the number of voters does indeed reduce individual's frequency of information acquisition but, due to risk aversion, subjects over-acquire information relative to theoretical predictions. This paper was recently published in *Games and Economic Behavior*, 2017.

In a second working paper on social learning, I am exploring with E. Hopkins and T. Kornienko the information that individuals choose when they try to forecast a binary state of the world that is subject to change over time. In our theory, if the state of the world is sufficiently persistent, then it is best response for individuals to look to past “social information” about others’ forecasts of the state of the world. However, if the state of the world is more erratic, then a best response is to consult one’s own more up to date “private information”. In an experiment we find that most subjects respond rationally to changes in the persistence of the state, but there is a significant fraction of people who always choose social information or private information regardless of changes in the persistence of the state they are seeking to forecast. We label such types “herd animals” and “lone wolves”. Thus we find that there is a mix of bias and rationality in social information choice settings.

Steve Frank

In a prior article from early in 2016, “Common probability patterns arise from simple invariances,” I showed that a few simple assumptions about conservation and invariance lead to a nearly complete framework for understanding the commonly observed probability patterns in nature.

This year, I published two new articles that illustrate how to apply the general invariance theory of probability patterns to widely discussed problems in biology and other disciplines. This fundamental work *should* become a primary aspect of how scientists interpret natural pattern. However, given the culture of science and the mistaken tendency to cling to historical rather than conceptual precedent, it will likely be several years before these ideas get “rediscovered.”

The first article, “Invariant death,” considers the typical form for plots of death rate versus age. Those curves of death may be associated with extreme value distributions. However, a much deeper structure provides more insight. In particular, a generalized Gompertz law follows from simple affine invariances of shift and stretch. That generalized Gompertzian form provides a simple basis for understanding the geometry and mathematical expression for nearly all commonly observed probability patterns. No other approach unifies the diverse forms of the common continuous probability distributions in such a simple and comprehensive way.

The second article, “The invariances of power law size distributions,” politely deconstructs the silly over-interpretation of commonly observed power law size distributions. More importantly, I show that a generalized notion of the variance as the average distance of fluctuations measured on the properly invariant measurement scale unifies commonly observed probability patterns by a simple transformation of the Gaussian distribution. By this view, power law size distributions are simple Gaussian patterns that can be understood by the central limit theorem, or perhaps more fundamentally, by the essential affine invariances of shift and stretch plus the additional invariance of rotation (order independence). My way of expressing these relations shows very clearly how to read the classical Gaussian form as a simple sentence about invariant properties,

and how that form connects naturally to patterns that, at first, appear very different, such as power laws.

Along these lines, I also published “Universal expressions of population change by the Price equation: natural selection, information, and maximum entropy production.” I showed that the seemingly trivial conservation of total probability provides the basis for understanding the common form of fundamental results in many different fields of study. In essence, the dynamics of probability distributions must always follow contours along conserved total probability. That constraint allows one to partition total change into, first, what can reasonably be called a response to directly applied forces, holding constant the frame of reference, and second, the changes in the inertial frame of reference. The classic expressions of evolutionary change by natural selection then relate simply to many classic expressions in physics and in other subjects, once one sees clearly the abstract geometric basis of the underlying structure.

I also published a variety of essays on key unsolved problems in biology.

Bernie Grofman

Grofman’s work has been in two areas of voting rights. On the one hand of the area of racial representation, Grofman most recently served as the Special Master in a Virginia congressional case *Personhuballah v. Alcorn*. In that case, working for the federal court, he redrew Virginia’s 3rd congressional district after it had been held to be an unconstitutional racial gerrymander. The plan he prepared reduced unnecessary packing of black voting strength in CD 3 while still allowing for the reelection of an African American incumbent. Excess black population was moved to an adjoining district that subsequently elected an African American candidate in 2016. With respect to partisan gerrymandering, Grofman has long been an opponent and has been involved in cases challenging partisan gerrymanders. Most recently, as senior author of an amicus brief in a Wisconsin US Supreme Court Case, in which a lower court overturned Wisconsin’s **legislative plan** as an unconstitutional partisan gerrymander, he proposed a new three part standard for partisan gerrymandering.

Marek Kaminski

Most of my recent work has been connected to the topic of electoral reform that has been floating in Polish politics since 2014. I have given several lectures and presentations for top Polish politicians, wrote an introductory paper, and, most recently, completed a book that was intended to provide the main source of references on electoral reform introducing single-member districts. In the book, I discuss both empirical findings on SMDs and the formal properties of voting methods in the context of Polish politics.

Igor Kopylov

This year I published a paper “Commitments and Weak Resolve” in *Economic Theory* (jointly with J. Noor from BU). In the accepted revision, we added some new testable motivation for studying weak resolve in terms self-imposed deadlines.

Second, I have completed a research project on “Framing in Expected Utility and Multiple Priors Modes” and presented it at several seminars and conferences (including North American Meeting of Econometric Society). Some new insights in that project include an axiomatic classification of several framing models under uncertainty and an endogenous definition of unframable “small worlds”.

Third, I have completed an experimental project “Subjective Beliefs and Confidence When Facts Are Forgotten” (jointly with J. Miller from Bocconi University). In addition to some novel types of overconfidence and ambiguity aversion patterns, we have developed a behavioral model of beliefs under imperfect recall.

Natalia Komarova

The fascinating ability of humans to modify the linguistic input and “create” a language has been widely discussed. In the work of Elissa Newport and colleagues, it has been demonstrated that both children and adults have some ability to process inconsistent linguistic input and “improve” it by making it more consistent. One example is the fascinating study of the performance of a 7-year deaf boy Simon, who mastered the American Sign Language (ASL) by learning it from his parents, both of whom were imperfect speakers of ASL. In a number of papers, Newport and colleagues studied artificial miniature language acquisition from an inconsistent source. It was shown that (i) children are better at language regularization than adults, and that (ii) adults can also regularize, depending on the structure of the input. Together with graduate student Timmy Ma we created a number of learning algorithms of the reinforcement-learning type, which exhibits interesting patterns consistent with those observed by Newport. Mathematical analysis of those patterns suggests a way to explain them.

In the last year Timmy Ma and I have also performed experiments on human learning, focusing on learning from an inconsistent source. We are investigating feature-label order (FLO) in the efficiency of learning and robustness against noise.

Another set of projects that I worked on with grad student Nicole Fider and in collaboration with Kimberly Jameson and Louis Narens is understanding color categorization in humans. In particular, we used the data collected in the World Color Survey to study the number of basic color terms that evolved in different cultures. We are also studying the shape of color category boundaries and investigating the role of gender in color categorization.

Over the last year I have also worked on several topics of mathematical biology. This includes stochastic dynamics of stem cells; virus dynamics, and investigating the role of spatial constraints in crossing fitness valleys in evolutionary dynamics.

Michael McBride

With a co-author, I experimentally studied the relationship between theory of mind ability and cooperativeness. We found that higher theory of mind subjects are more likely to find cooperators and more likely to avoid defectors than low theory of mind subjects. Doing so yields high payoff advantages for high theory of mind subjects.

Andrew Noymer

I work on demography, with an emphasis on health in general and mortality in particular. The human population is a complex system in constant motion among many dimensions; as such, my work fits very well in the IMBS rubric. My work in the recent past has focused on emerging and re-emerging infectious diseases, as well as cancer. I have also worked on nonlinear models of measles epidemiology recently, with a paper on this subject published during the period.

Cailin O'Connor

This year my research focused on the emergence of norms, especially those regulating bargaining and coordination, between different social groups such as men and women, and people of different races. I produced several new working papers, one modeling the interplay between discrimination and collaboration networks in academia, one modeling the dynamics of bargaining in intersectional groups, one on the cultural Red King effect, whereby minority groups can be disadvantaged by dint of their size. The manuscript of my monograph *Dynamics of Inequity: how categories like gender and race impact cultural evolution, and what it means for fairness* is now available upon request, and discusses these papers as well as a much more extensive exploration of the cultural evolution of inequitable norms.

Don Saari

Several years ago, while working on a NSF grant to identify the methodological source of difficulties in nanotechnology, I discovered that what caused the main problem in nanotechnology is that, to reduce the complexity, the field is using the commonly accepted reductionist approach. This is where a complex problem is reduced to more tractable parts, solutions for the parts are found, and then these component solutions are assembled to answer the original problem. The difficulty, as I proved, is the last part of assembling answers from the parts into a solution for the whole. A succinct way to capture the difficulty is with the well known “The whole can differ from the sum of the parts.” Namely, answers from the parts need not explain the whole.

As I also discovered, this reductionist approach with its “systems analysis” complexity, arises almost everywhere in essentially all disciplines. Part of my research this year has been to explore where this difficulty arises in totally unexpected places, and then find ways around the difficulties. Examples include the famous Arrow’s Theorem. Now, this is the commonly referenced result, which some claim asserts that “there does not exist a fair voting system for three or more alternatives.” How can this result be identified with the Reductionist method? Well, one of Arrow’s conditions is to find voting methods that are consistent with a pairwise analysis (his “independence of irrelevant alternatives, or IIA,” which is easy to prove that IIA is equivalent to the reductionist approach. Consequently, by reintroducing “information about how the parts are connected,” which is dismissed in the reductionist approach and by IIA, simple and acceptable resolutions for Arrow’s problem follow immediately.

Moving from the social science to the physical sciences, one of the most compelling scientific mysteries is the problem of dark matter in galaxies. As a quick introduction, standard methods to determine the amount of mass in a galaxy produce values that are nowhere near the amount of mass needed to keep stars from escaping and causing a galaxy to dissipate. Dark matter is the conjectured, hidden mass, that is needed to keep galaxies in a stable manner consistent with observations.

Now, how is the mass of a galaxy determined? A galaxy involves billions of stars, which corresponds to the Newtonian billion-body problem—which has not been solved. As a result, astrophysicists are forced to invent approximations. The main one is where the mass of galaxy closer to a particular star is approximated by a two-body system (this is not the derivation, but it follows from the conclusion). The two bodies are the star and the second is all of the mass (i.e., all of the stars) closer to the center of mass. But by using two-body approximations, the galactic mass question becomes using a billion two-body approximations—one for each star. This is the reductionist approach, where the parts (answers from each approximations) need not have anything to do with what happens for the whole! In this manner, I have been able to show that the current methods of predicting mass are exponentially wrong, and I am creating approaches to obtain more realistic mass values.

I also am exploring where these difficulties arise, in unexpected ways, in other mysteries.

A second theme concerns a decomposition of games into the component that captures individual objectives and the component that captures objectives achievable only by players cooperating. Consequences and extensions of this work with Dan Jessie were explored.

Rein Taagepera

Re: Shugart Taagepera, *Votes from Seats* (2017)

Take the number of seats in a representative assembly and the number of seats in districts through which this assembly is elected. From just these two numbers, the authors of *Votes from Seats* show that it is possible to 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. The ability to predict so much from so little, and to apply to countries worldwide, is an advance in the systematic analysis of a core institutional feature found in any democracy, and points the way towards making social sciences more predictive.

Re: “Science walks on two legs, but social sciences try to hop on one” (2017).

Science walks on two legs. One leg consists of asking: How things *are*? This leads to observation, measurement, graphing, and statistical description. The other leg consists of asking: How things *should be*, on logical grounds? This leads to logical models that should become quantitatively predictive. Science largely consists of such models, tested with data. Developed science establishes not only connections among individual factors but also connections among these connections. But social sciences often take the lazy road of fitting raw data with a straight line or some fashionable format, unaware of the need to *think* and build models based on logic. As expounded in my *Making Social Sciences More Scientific* (Oxford UP 2008) and *Logical Models and Basic Numeracy in Social Sciences*, http://www.psych.ut.ee/stk/Beginners_Logical_Models.pdf, I call for a major widening in social science methodology.

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:

Bill Batchelder	Mathematical Models of Cognitive Processes	Spring 2017
Carter Butts	Networks and Information Transmission	Fall 2016
Carter Butts	Network Theory	Winter 2017
Simon Huttegger	Probability and Randomness	Winter 2017
Marek Kaminski	Game Theory	Fall 2016
Marek Kaminski	Voting Theory	Winter 2017
Robin Keller	Operations Analytics	Fall 2016
Robin Keller	Decision Theory	Spring 2017
Natalia Komarova	Mathematics Graduate seminar	Spring 2017
Cailin O’Connor	Form & Empr. Approaches to Soc. Epistemology	Spring 2017
Lisa Pearl	Computational Models of Language Learning	Winter 2017
George Sperling	Seminar on Vision	Winter 2017
Narens & Skyrms	Social Dynamics	F&W 2016-17
Brian Skyrms	Chance	Spring 2017

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](#)

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 objective of the UCI Social Network Research Group is to provide an informal setting for discussion of current and ongoing network-related research at UCI (and elsewhere), facilitate the exchange of information regarding new techniques, tools, data sources, and research findings, support graduate student training in the network field, and encourage collaboration among faculty and students on network-related topics. 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.

Meets on Wednesdays from 3:30-4:30 p.m. in Calit2 3355.

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/ColorCogFALL2015.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. Others on the graduate committee who assist Professor Narens are Professors Marek Kaminski and Michael McBride. Working with the faculty of the Institute are 9 Ph.D. students, of whom 1 graduated this academic year. We are admitting 2 new MBS students fall quarter.

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

Nikhil Addleman
Calvin Cochran
Steven Doubleday
Maryam Gooyabadi
Santiago Guisasola
*Lisa Guo
Kirby Joe
William Leibzon
Junying Zhao

*Graduated in 2016-2017

Noted academic and research related achievements by our MBS graduate students include Junying Zhao's Andrew Vincent White and Florence Wales White Scholarship for the 2016-17 academic

year. The \$20,000 scholarship awarded for her work, “Hippocratic Paradox and Irrational Consensus: A Mathematical Behavioral Analysis of Medical Decision-Making.”

IMBS supported participation of Economics graduate student Cole Williams at the International Economic Association Roundtable on The Economics of Religion at Cambridge University over the summer.

B. Graduate Activities

While the formal part of our graduate program is small, the actual impact on the UCI graduate program is more extensive. This is because several graduate students from other programs participate on a regular basis with our weekly Friday lecture section and our annual graduate conference. This past year the MBS graduate students organized student meetings with weekly colloquia speakers. This gives students an opportunity to interact and network with professors. One of the goals is to gain insight into how students perceive IMBS and how to facilitate more involvement of the social science student body.

C. Friday Research Presentations

This IMBS activity was coordinated Jean-Paul Carvalho and directed by graduate student and participant Santiago Guisasola. 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. The presentations are followed by discussion periods afterwards. Below is the list of the presentations for the year:

October 7

MARK C. WILSON
Senior Lecturer, Computer Science Department
University of Auckland
Distance-based aggregation rules

October 14

AYDIN MOHSENI
LPS Graduate Student
Self-assembling Networks

October 21

Santiago Guisasola
MBS Graduate Student
Modeling and the Decomposition of Games

October 28

LISA GUO
MBS Graduate Student
Modeling Continuous Human Information Processing with Trace Conditioning

November 4

CALVIN COCHRAN
MBS Graduate Student

Probe and adjust learning dynamics in the chain game

November 18

NIKHIL ADDLEMAN
MBS Graduate Student

Invasions in Coordination Games Played on Networks

January 20

NICOLE FIDER
MBS Graduate Student

A Numerical Approach to Human Color Categorization

January 27

ETHAN GALEBACH
LPS Graduate Student

Does Perception of Spatial Layout have a Geometry?

February 10

GERARD ROTHFUS
LPS Graduate Student

Evidence, Causality, and Sequential Choice

February 17

CARL SIMON
Professor of Economics
University of Michigan

Dynamic Systems Models of Smoking Initiation, with a focus on the relative influence of peer pressure

May 5

MARYAM GOOYABADI, GRADUATE STUDENT, MBS
KIRBI JOE, GRADUATE STUDENT, MBS

*Colorsims: An agent-based model of Evolutionary color categorization for real observers using
World Color Survey*

MAY 19

JOSEPH NUNN
Fall 2017 MBS Graduate Student

*Using Probabilistic Programming to Model Language Understanding in
Context and Decision Making in Game Theory*

May 26
XUHONG ZHANG
Graduate Student, Computers, Networks, and Distributed Systems
Crossing the Boundaries: Cases for Applying Techniques across Disciplines

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 15th Annual conference were MBS graduate students Nikhil Addleman, Maryam Gooyabadi, and Santiago Guisasola. With so much interest by the graduate students to present, this year we expanded from a one-day to a two-day conference.

Luce Graduate Student Conference
Friday, June 2 & 9, 2017

Friday June 2nd
10:00am – 4:50pm

10:00 – 10:30 RECEPTION

Session I: Interdisciplinary Approaches (10:30 – 12:00)

10:30 – 11:00 Nikki Fider

Numerical Studies of Human Color Categorization

11:00 – 11:30 Ananya

Gender Bias Detector

11:30 – 12:00 Ruichen Sun

Walking down the Line: Fruit Flies' Decision-making Behavior inside a Heat-Box

12:00 – 1:00 LUNCH

Session II: Decision Making (1:00 – 3:10)

1:00 – 1:30 Percy Mistry

A Cognitive-Econometric Model of Consumption Behavior in Response to Non-Price Factors

1:30 – 2:00 Pele Schramm

A Thurstonian Investigation into the Relationship Between Probabilistic and Temporal Discounting

2:00 – 2:10 SHORT BREAK

2:10 – 2:40 **June Zhao**
Temptation, Commitment, and Weak Resolve: A Lab Experiment

2:40 – 3:10 **Gerard Rothfus**
Evidence, Causality, and Sequential Choice

3:10 – 3:20 **SHORT BREAK**

Session III: Evolution and Games (3:20 – 4:20)

3:20 – 3:50 **Travis LaCroix**
Evolving Saliency in Sender-Receiver Games

3:50 – 4:20 **Kirbi Joe**
Color category evolution: Modeling real observers using World Color Survey

4:20 – 4:50 **Lisa Guo**
An Exploration of Dual Systems via Time Pressure Manipulation in Social Cooperation Decision-making Problems

4:50 – 5:30 **RECEPTION**

Friday June 9th
10:00am – 3:40pm

10:00 – 10:30 **RECEPTION**

Session IV: Convention and Evolution (10:30 – 12:00)

10:30 – 11:00 **Calvin Cochran**
Hierarchical Models for the Evolution of Compositional Language

11:00 – 11:30 **Maryam Gooyabadi**
A Dynamical Approach to Ideology Formation

11:30 – 12:00 **Nikhil Addleman**
Toward an Evolutionary Model of Convention Entrenchment

12:00 – 1:00 **LUNCH Guest Speaker Carl Simon, University of Michigan**
Darwin and Fishing

Session V: Learning and Inference (1:00 – 2:00)

1:00 – 1:30 **Michael Shin**
Endogenous Participation and Learning in the Stock Market

1:30 – 2:00 **Joseph Nunn**
Bayesian Modeling for Level-K Reasoning in Prisoner Dilemmas

2:00 – 2:10 SHORT BREAK

Session VI: Informational Networks (2:10 – 3:10)

2:10 – 2:40 Aydin Mohseni
Truth and Conformity on Networks

2:40 – 3:10 Santiago Guisasola
Influence, Roles, and Leadership in Collaboration: Some Experiments

3:10 – 3:40 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 Michael Sacks, 2016 graduate of Economics for his dissertation, “The Economics of Collaborative Production and Consumption with Applications in Digital Technologies.”



Graduate Hannah Rubin receives this year’s IMBS Jean-Claude Falmagne Dissertation Award for her dissertation, “The Explanatory Value of Inclusive Fitness for Evolutionary Theory.” The award is given 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.

Hannah received her Bachelor's degree in philosophy and religious studies from the University of Missouri in 2011. From UC Irvine, she earned her PhD in Philosophy in 2017. Hannah is working in philosophy of science, in particular the philosophy of biology. Her dissertation is about the conceptual and formal foundations of inclusive fitness theory. Recently, she also received the 2017 Order of Merit Award for Outstanding Scholarship of the School of Social Sciences. Hannah is currently a postdoctoral fellow at the University of Groningen (Netherlands). She will start a tenure track position at the Philosophy Department of the University of Notre Dame in Fall 2018.

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.

The Formation of Beliefs

University of California, Irvine
Institute for Mathematical Behavioral Sciences
Social Science Plaza A, Room 2112
Friday, March 10, 2017, 9:15 am – 6:00 pm

9:15 – 9:30	Welcome remarks by Don Saari (UCI IMBS) and Jean-Paul Carvalho (UCI Economics)
9:30 – 10:15	Bill Branch (UCI Economics): <i>Restricted Perceptions and Endogenous Volatility</i>
10:15 – 11:00	Stergios Skaperdas (UCI Economics): <i>Beliefs and Identity</i>
11:00 – 11:30	Break
11:30 – 12:15	Elizabeth Loftus (UCI Social Ecology, Law): <i>Illusions of Belief and Memory</i>
12:15 – 2:00	Lunch Break
2:00 – 2:45	Arthur Robson (Simon Fraser): <i>Applying 'Theory of Mind': Theory and Experiments</i>
2:45 – 3:30	Michael McBride (UCI Economics): <i>Theory of Mind Ability and Cooperation in the Prisoner's Dilemma</i>

3:30 – 4:00	Break
4:00 – 4:45	Michael Birnbaum (CS Fullerton Psychology): <i>Formation of beliefs based on sources of evidence: Diagnosticity, bias, and judge’s point of view</i>
4:45 – 5:30	Cole Williams (UCI Economics): <i>Echo Chambers: Disagreement in Bayesian Learning</i>
5:30 – 6:00	Closing remarks and reception

B. Conferences/Seminars Organized By IMBS Members

Jean-Paul Carvalho

Co-organizer, International Economics Association Roundtable on The Economics of Religion, Cambridge UK, July 2017.

Organizing committee, AALIMS annual conference, Pomona College, 2017.

Organizer, Workshop on the Formation of Beliefs, IMBS, UC Irvine, 2017.

Co-organizer, *Theory, History and Development Seminar*, Department of Economics, Fall 2016 & Spring 2017.

Michelle Garfinkle

Workshop on Economic Interdependence and War (sponsored by CGPACS, with Stergios Skaperdas and Etel Solingen), UC Irvine, April 2017.

Natalia Komarova

Co-organizer (with J. Arino) of a mini-symposium on “Linear Algebra and Mathematical Biology”, at the 21st conference of the International Linear Algebra Society, Iowa State University, Summer 2017.

Co-organizer (with A. Pantano and 2 grad students) of the first Diversity in Math Festival, UC Irvine, Spring 2017.

Michael McBride

Co-organizer, UC Workshop on National Security Through Social Sciences, UC Irvine, May 2017.

Lisa Pearl

“SynLinks: Links between representation and processing in syntactic acquisition.” Organizer of the workshop: <http://linguistics.uconn.edu/events/synlinks.html>. This workshop brought together experts who use a range of techniques to build large-scale, integrative theories of syntactic acquisition that (i) draw on the insights from theoretical, experimental, and computational approaches, (ii) recognize the links between children’s developing representations and their developing processing abilities, and (iii) recognize the links between syntactic representations and other representations. University of Connecticut, Storrs, 2016.

C. Visitors

During the fall quarter IMBS hosted Mark Wilson, Director at the Centre for Mathematical Social Sciences and Senior Lecturer at the Department of Computer Science at the University of Auckland.

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

D. IMBS Colloquia 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 2016 – 2017 academic year:

OCTOBER 20

JUN ZHANG

Professor of Psychology and Mathematics
Department of Psychology and Department of Mathematics
University of Michigan, Ann Arbor

“Information Geometry: From Divergence Functions to Geometric Structures”

NOVEMBER 3

AUSTIN ROORDA

Professor of Vision Science and Optometry
UC Berkeley School of Optometry
“Seeing light and color with single cones”

NOVEMBER 17

BERNIE GROFMAN

Jack W. Peltason Endowed Chair of Democracy and
Professor of Political Science
UC Irvine
“Redrawing Virginia’s Congressional Map as a Special Master
for a Three Judge Federal Court: The Inextricable Entanglement of Social Science Research
and Methodologies and Voting Right Case Law”

DECEMBER 1

MICHAEL RAMSCAR

Senior Researcher, Department of Research
Universtät of Tübingen
“The discriminative nature of human communication”

DECEMBER 8

JEFF BARRETT

Professor, Logic and Philosophy of Science
UC Irvine
“Self-Assembling Games”

JANUARY 19

MARK SATTERTHWAITE

Professor of Strategy
Northwestern University
“Price Discovery Using a Double Auction with Correlated Signals and Interdependent Values”

JANUARY 26

JORGE PACHECO

Professor of Applied Mathematics
University of Minho
“Population Dynamics through Hierarchically Embedded Markov chains”

FEBRUARY 2

PAVEL KRIVITSKY

Lecturer in Statistics

National Institute of Applied Research Australia (NIASRA)

School of Mathematics and Applied Statistics

“Inference for Social Network Models from Egocentrically-Sampled Data”

FEBRUARY 9

JIMI ADAMS

Associate Professor

University of Colorado, Denver

“Unbounded Knowledge: Integrating Science Across Disciplines”

FEBRUARY 16

CARL SIMON

Professor of Mathematics, Economics, Public Policy and Complex Systems

University of Michigan

“A Dynamical Systems Approach to Modeling the Spread of Crime”

MARCH 9

JOE WAKANO

Associate Professor

Meiji University

“Ecocultural range-expansion scenarios for the replacement or assimilation of Neanderthals by modern humans”

MARCH 16

MICHAEL LEE

Professor of Cognitive Sciences

UC Irvine

“The relationship between individual knowledge and group agreement on accuracy in binary decisions”

APRIL 13

MARK MACHINA

Distinguished Professor of Economics

UC San Diego

“Analytical Aspects of Attitudes Toward Ambiguity”

APRIL 20

DON SAARI

Director, IMBS

Distinguished Professor of Economics and Mathematics

UC Irvine

“Using Arrow’s Theorem to investigate dark matter”

APRIL 27

MAGGIE PENN

Professor of Political Science

University of Chicago

“Does Representation Induce Polarization? A Theory of Choosing Representatives”

MAY 4

JOHN A. MEDEIROS, Ph.D.

Senior Scientist, (ret)

COLSA Corporation

“A Path to Solving the Enigmas of Color Vision: Thinking Outside the Box”

MAY 11

JEAN-CLAUDE FALMAGNE

Professor Emeritus of Cognitive Science

UC Irvine

“On a meaningful axiomatic derivation of the Doppler effect and other scientific equations”

MAY 18

HONGKAI ZHAO

Chancellor’s Professor of Mathematics

UC Irvine

“Should we interpret data using an educated or uneducated basis?”

VI. BUDGET

A. Appropriations and Expenditures

Appropriations:

2016-17 IMBS Budget allocation	\$ 90,000.00
2016-17 Overhead return	\$ 28,149.00
Total budget for 2016-17:	<u>\$118,149.00</u>

Expenditures:

Salaries & Benefits (Director & Administrator)	\$ 47,350.00
Social Sciences Business Office (Admin. Sup)	\$ 7,500.00
Social Sciences Business Office (Overhead)	\$ 28,149.00
Conference/Colloquia /Seminars	\$ 13,643.00
Supplies & Expenses	\$ 2,416.00
Graduate Student Support	\$ 16,000.00
Total Expenditures:	<u>\$115,058.00</u>

Encumbered to 2017:

Interim Director's Computer, Printer & IMBS video recorder	<u>\$ 3,091.00</u>
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Closed fiscally solvent

B. Extramural Funding Activity

GRANTS AWARDED AND ACTIVE:

IMBS faculty research was supported by research grants totaling \$39,534,654. 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

David Brownstone

Source: UCONNECT
Amount: \$66,982
Award Period: 8/1/2015 – 9/30/2106
Role: Co-PI

Source: UCONNECT
Amount: \$172,314
Award Period: 5/1/2016 – 9430/2017
Role: Co-PI

Carter Butts

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)

Source: ARO
Amount: \$448,706
Award Period: 2014 – 2017
Title: Advancing Statistical Methods for Analysis of Multiple Networks
Role: PI

Source: NSF IIS
Amount: \$746,783
Award Period: 2013 – 2016
Title: BIGDATA: Small: DA: DCM: Measurement and Learning in Large-Scale Social Networks.
Role: CO-PI

John Duffy

Source: NSF
Amount: \$79,056
Award Period: 2016-2017
Title: Experimental Evidence on Monetary Policies
Role: Co-PI (with Daniela Puzzello)

Steve Frank

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

Kimberly 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 Donations

Award Amount: \$18,500

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 Donations

Award Amount: \$65,000

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: 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: UCI Graduate Division DECADE Mentor Graduate Diversity Award

Award Amount: \$30,000

Award Period: 2016 - 2017

Title: Improving the Climate of the Mathematics Program: the Past, the Present, and the Future

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)

Michael McBride

Source: UC Connect Faculty Research Grant

Award Amount: \$172,314

Award Period: 2016-2017

Title: Experimental Studies for Traffic Incident Management with Pricing, Private Information, and Diverse Subjects

Role: Co-PI

Source: Army Research Office

Award Amount: \$68,439

Award Period: 2016-2017

Title: Instrumentation for the UC Irvine Experimental Social Science Laboratory

Role: PI

Louis Narens

Source: NSF

Award Amount: \$980,923.00 (calculated with Jameson's award)

Award Period: 2014-2017

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: National Science Foundation (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

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

Source: National Institutes of Mental Health – NIMH Conte Center

Award Amount: \$10,000

Award Period: 2013 – 2018

Title: Fragmented Early Life Environment and Cognitive and Emotional Vulnerabilities,

Role: Co-PI and Head of Biostatistics Computation and Data Management Core, T. Baram, PI

James Weatherall

Source: NEH

Award Amount: \$21,991

Award Period: 2014 – 2017

Title: What is Time? Perspectives from Physics, Philosophy, Fiction, and Film, NEH Big Questions Course Development Grant

Role: PI

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

Source: NSF

Award Amount: \$328,860

Award Period: 2014 – 2017

Title: Shape and data analysis using computational differential geometry

Role: PI

Source: NSF

Award Amount: \$249,964

Award Period: 6/1/2016 -05/31/19

Title: BIGDATA: Theory and practice for exploiting deterministic structures of probability models in big data analysis

Role: PI

PENDING

Lisa Pearl

Source: National Science Foundation (NSF)

Award Amount: \$375,000 UCI Amount: \$142,000

Award Period: 2014 – 2017

Title: Collaborative Research: An Integrated Theory of Syntactic Acquisition

Role: PI

Kimberly Jameson

Submitted Pilot Grant proposal Oct. 2016 to The Institute for Clinical and Translational Science, UCI — Proposal Title: “Clinical and Behavioral Investigations of Human Photopigment Opsin Gene Variations and Age-related Macular Degeneration.” Investigators: M. Cristina Kenney MD PhD, Kimberly A. Jameson PhD & Natalia L. Komarova PhD. Requested Budget: \$26,322. (January 2017 — Notification of No Funding Award).

Submitted collaborative Multi-Institution Grant Proposal. National Science Foundation SMA-Data Infrastructure. Project Title: “An Internet Laboratory and Database for Research into the Evolution and Communication of Signals, Concepts, and Knowledge.” Requested Budget \$1,250,246. Planned resubmission: February 2018.

VII. APPENDICES

A. CURRENT FACULTY MEMBERS

APPENDIX A IMBS FACULTY, 2016 - 2017

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: Applied 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.

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.

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.

Kent Johnson, (Ph.D. Philosophy, Rutgers University). Professor of Philosophy, University of California, Irvine. Research areas: Lexical semantics, metaphysical/epistemological relation between current linguistic theories and broader psychological processes, Methodological issues bearing on linguistic theorizing.

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.

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). Associate Professor of Cognitive Sciences, University of California, Irvine. Research areas: Language acquisition, language change, natural language processing.

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

David M. Riefer, (Ph.D. Psychology, University of California, Irvine). Professor of Psychology, California State University at San Bernardino. Research areas: Memory, cognitive science, and mathematical Psychology.

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.

Donald G. Saari, (Ph.D. Mathematics, Purdue University). NAS Member, Distinguished Professor of Mathematics and Economics, and Director 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., University of California, Irvine. Research areas: Economic theory and political economy.

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.

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.

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 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.

B. SCIENTIFIC PUBLICATIONS

APPENDIX B SCIENTIFIC PUBLICATIONS OF IMBS MEMBERS, 2016 - 2017

Bill Batchelder

Boyd, J.P. and Batchelder, W.H. (2017). Network Theory. In *New Handbook of Mathematical Psychology* (Volume 1). W. H. Batchelder, H. Colonius, E. Dzhafarov, and J. Myung (Eds.) pp.194-273. Cambridge University Press. Cambridge, England.

Batchelder, W.H. (2016). *Cognitive Psychometrics*. In *Mathematical Models of Perception and Cognition: A Festschrift for James T. Townsend First* (Volume 1). J. W. Houpt and L. M. Blaha (Eds.) pp. 245-262. Psychology Press. N.Y.

Batchelder, W.H. (2017). *Discrete State Models*. *New Handbook of Mathematical Psychology* (Volume 1). W. H. Batchelder, H. Colonius, E. Dzhafarov, and J. Myung (Eds.) pp. 454-503. Cambridge University Press. Cambridge, England.

Batchelder, W.H., Anders, R., and Oravecz, Z. In press. *Cultural Consensus Theory*. *Stevens Handbook of Experimental Psychology* (Volume 4). E.J. Wagenmakers (Ed.). John Wiley.

Batchelder, W.H., Colonius, H., Dzhafarov, E., and Myung, J. (Eds.) (2017). *New Handbook of Mathematical Psychology* (Volume 1). Cambridge University Press. Cambridge, England.

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Marek Kaminski

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Robin Keller

Newly accepted Journal articles (peer-reviewed):

L. Robin Keller and Yitong Wang (Merage doctoral alumnus) “Information Presentation in Decision and Risk Analysis: Answered, Partly Answered, and Unanswered Questions,” forthcoming, *Risk Analysis*, accepted August 7, 2016.

Appeared online in early view prior to print: [Information Presentation in Decision and Risk Analysis: Answered, Partly Answered, and Unanswered Questions](#), Version of Record online: 21 SEP 2016 | DOI: 10.1111/risa.12697 [Abstract](#) [Article](#) [PDF\(120K\)](#) [References](#)

For the last thirty years, researchers in risk analysis, decision analysis, and economics have consistently proven that decision makers employ different processes for evaluating and combining anticipated and actual losses, gains, delays and surprises. While rational models generally prescribe a consistent response, people's heuristic processes will sometimes lead them to be inconsistent in the way they respond to information presented in theoretically equivalent ways. We point out several promising future research directions by listing and detailing a series of answered, partly answered, and unanswered questions.

Luping Sun, Xiaona Zheng, Meng Su, L. Robin Keller (2017), "Intention-Behavior Discrepancy of Foreign versus Domestic Brands in Emerging Markets: The Relevance of Consumer Prior Knowledge," *Journal of International Marketing*, published by the American Marketing Association, Vol. 25, No. 1, pp. 91-109, accepted October 20, 2016. **doi:** <http://dx.doi.org/10.1509/jim.15.0123>.

Most research on the performance of foreign versus domestic brands in emerging markets examines measures of product evaluation or purchase intention. However, consumers intending to buy a product may switch to competing brands, displaying an intention-behavior discrepancy (IBD). Drawing upon literature on country associations and dual process theory, we examine the difference in IBD of foreign versus domestic brands in emerging markets and the moderating role of prior knowledge. We conducted an intention survey followed by a post-purchase survey in the Chinese automobile and smartphone industries. We found that foreign brands have an advantage on IBD relative to domestic brands, indicating that they have the dual advantage of higher evaluations and lower IBDs. Furthermore, foreign brands' advantage on IBD is smaller for consumers with inaccurate prior knowledge, as they are more likely to systematically reprocess information and discount foreign brands' favorable country associations. For these consumers, overestimating the product reduces foreign brands' advantage to a smaller degree than underestimating it due to confirmation bias. These findings provide implications for brands in emerging markets.

Printed during this year, accepted prior to this year:

Liangyan Wang (Merage alumna and Associate Professor of Marketing, Antai Management School, Shanghai Jiao Tong University), Shijian Wang (just graduated student of marketing), L. Robin Keller, Jie Li (Assoc. Prof. of Market., Shanghai Jiao Tong Antai Mgt Sch.), "Thinking Styles Affect Reactions to Brand Crisis Apologies," *European Journal of Marketing*, 50(Issue 7/8), Sept. 2016, pp. 1263-1289. abstract: <http://www.emeraldinsight.com/doi/abs/10.1108/EJM-07-2014-0457>, accepted in March 2016. Permanent link: <http://dx.doi.org/10.1108/EJM-07-2014-0457>.

Purpose – This article examines how a person's thinking style, specifically holistic versus analytic, and a firm's crisis apology with the remedial solution framed in "why" (vs. "how") terms can interactively impact consumers' perceived efficacy of the firm to respond to the crisis and their impression or evaluation of the brand.

Design/methodology/approach – Hypotheses were tested through three experimental studies involving 308 participants recruited in China. Participants answered survey questions investigating the interactive effects from consumers’ thinking style (culture as a proxy in study 1, measured in study 2 or primed in study 3) and a brand’s crisis apology with the remedial solution framed in “why” (vs. “how”) terms on consumers’ perceived efficacy and evaluation of the firm.

Findings –The frame of the remedial solution resulting in a higher evaluation improvement depended on a consumer’s thinking style. For holistic thinkers, a “why” (vs. “how”) framed remedial solution resulted in a higher evaluation improvement; however, for analytic thinkers, a “how” (vs. “why”) framed remedial solution resulted in a higher evaluation improvement. Additionally, the results showed that a consumer’s perceived efficacy of the brand being able to successfully respond to the crisis mediated the interactive effects of the remedial solution framing and thinking styles on the evaluation improvement.

Research limitations/implications – Different ways of framing the remedial solution in a firm’s apology will have different impacts on people with different thinking styles. Participants in studies 2 and 3 were recruited from samples on campus in China. Additionally, the automobile brand used in this study is fictional to avoid prior brand name or brand commitment impact.

Practical implications – Our findings provide evidence that framing of the remedial solution can be leveraged as a tool to reduce negative impact resulting from a brand crisis. Specifically, our results suggest that companies may do well to employ a “why” framed remedial solution, particularly in cases where consumers are likely to process information holistically. Conversely, a “how” framed remedial solution may be effective in situations where consumers are likely to process information analytically.

Originality/value – This research contributes to the literature, being among the first to consider how the remedial solution framing in a firm’s apology can enhance people’s evaluation of the brand and decrease the perceived negative impact resulting from the brand crisis.

This research was funded by the National Natural Science Foundation of China Grant (71072059) and Shanghai Shuguang Program Grant (13SG16) to Liangyan Wang.

Jiaru Bai (Merage PhD student), Cristina del Campo (Universidad Complutense de Madrid and UCI visitor in 2016), L. Robin Keller, “Markov Chain Models in Practice: A Review of Low Cost Software Options,” Publication in English, Spanish version also available: “Modelos de Cadenas de Markov en la Práctica: Una Revisión de Opciones de Software de Bajo Coste,” *Investigación Operacional*, 2017, Volume 38 (Issue 1), pp. 56-62, accepted May 30, 2016. <http://rev-inv-ope.univ-paris1.fr/spip.php?article64>.

This paper was written in Spanish (and English) to facilitate communication with Spanish-speaking scholars in Cuba and elsewhere, who aim to conduct Markov cost effectiveness analyses

and would benefit from low cost software alternatives. The working paper is in English and Spanish versions: [investigacion_operacional_2016_06_28_Bai_delCampo_Keller_English](#), [investigacion_operacional_2016_Bai_delCampo_Keller](#)

Markov processes (or Markov chains) are used for modeling a phenomenon in which changes over time of a random variable comprise a sequence of values in the future, each of which depends only on the immediately preceding state, not on other past states. A Markov process (PM) is completely characterized by specifying the finite set S of possible states and the stationary probabilities (i.e. time-invariant) of transition between these states. The software most used in medical applications is produced by TreeAge, since it offers many advantages to the user. But, the cost of the TreeAge software is relatively high. Therefore in this article two software alternatives are presented: Sto Tree and the zero cost add-in program "markovchain" implemented in R. An example of a cost-effectiveness analysis of two possible treatments for advanced cervical cancer, previously conducted with the Treeage software, is re-analyzed with these two low cost software packages.

Natalia Komarova

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Saari, D.G. "From Paired Comparisons and Cycles to Arrow's Theorem." To appear in Oxford University press, ed. B. Grofman.

Brian Skyrms

Barrett, J.A. and Skyrms, B. "Self-Assembling Games" *British Journal for Philosophy of Science*, vol. 68, no 2, Dec. 2015, pp 329-353., doi:10.1093/bjps/axv043.

Skyrms, B. "Evolution, Norms and the Social Contract" (2017) *Arizona State University Law Journal*.

Barrett, J., Mohseni, A. and Skyrms, B. "Self-Assembling Networks" (forthcoming) *British Journal for Philosophy of Science*. Accepted.

Hal Stern

Saks, M.J., Albright, T., Bohan, T.L., Bierer, B.E., Bowers, C.M., Bush, M.A., Bush, P.J., Casadevall, A., Cole, S. A., Denton, M. B., Diamond, S.S., Dioso-Villa, R., Epstein, J., Faigman, D., Faigman, L., Fienberg, S.E., Garrett, B.L., Giannelli, P.C., Greely, H.T., Imwinkelried, E., Jamieson, A., Kafadar, K., Kassirer, J.P., Koehler, J., Korn, D., Mnookin, J., Morrison, A.B., Murphy, E., Peerwani, N., Peterson, J.L., Risinger, D.M., Sensabaugh, G.F., Spiegelman, C., Stern, H., Thompson, W.C., Wayman, J.L., Zabell, S., Zumwalt, R.E. (2016). "Forensic bitemark identification: weak foundations, exaggerated claims," *Journal of Law and the Biosciences*, 1-38. <http://dx.doi.org/10.1093/jlb/lsw045>

Stern, H. S. (2017). "Statistical Issues in Forensic Science," *Annual Review of Statistics and Its Applications*, 4:1-22. <http://dx.doi.org/10.1146/annurev-statistics-041715-033554>

Glickman, M.E. and Stern, H. S. (2017). "Chapter 5: Estimating Team Strength in the NFL" in J. Albert, M.E. Glickman, T. B. Swartz, R. H. Koning (eds.) *Handbook of Statistical Methods and Analyses in Sports*, 113-135. Chapman & Hall / CRC: Boca Raton. ISBN 9781498737364

Rein Taagepera

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

Taagepera, R. (2016). *Armastuse keemia: Mare Taagepera pärand* The Chemistry of Love: Mare Taagepera's Legacy. Tartu: Metsaülikool.

Taagepera, R. (2018). *Sada aastat Eesti poliitikat* (One hundred years of Estonian politics), forthcoming.

Taagepera, R. (2017). "Science Walks on Two Legs, but Social Sciences Try to Hop on One". *International Political Science Review*.

Allen, T.J. and Taagepera, R. (2017). "Seat Allocation in Federal Second Chambers: Logical Models in Canada and Germany". *Mathematical Social Sciences* 87, 22-30.

Arora M. and Taagepera, R. (2017). "The Stubborn Law of Female-Male Literacy: Why the Gap May Widen". *Journal of Education & Policy* 87, 22-30.

Previously unreported: Taagepera, R. (2015). "La balanza inclinada: Probando la 'ley' de Duverger en el Nivel Nacional" (Tilted equilibrium: Testing Duverger's 'law' at the National Level), *De Politica* (Mexico) 3, No. 4/5, 9-19.

C. TECHNICAL REPORT SERIES

APPENDIX C
IMBS TECHNICAL REPORTS, 2016 - 17

MBS 16-02

A Numerical Approach for Defining Basic Color Terms and Color Category Best Exemplars
Nicole Fider, Louis Narens, Kimberly A. Jameson, Natalia Komarova

MBS 16-03

Non-negative matrix factorization using genetic algorithm for spectral colors
Vladimir A. Bochko, Kimberly A. Jameson, Toshiya Nakaguchi, and Yoichi Miyake, and Jarmo T. Alander

MBS 16-04

Investigating Potential Human Tetrachromacy in Individuals with Tetrachromat Genotypes Using Multispectral Techniques
Vladimir A. Bochko, Department of Electrical Engineering and Energy Technology, University of Vaasa, FIN-65101 Vaasa, Finland; Kimberly A. Jameson, Institute for Mathematical Behavioral Sciences, University of California, Irvine, CA, USA

MBS 17-01

The Evolution of Shared Concepts in Changing Populations
Jungkyu Park , Sean Tauber , Kimberly A. Jameson , Louis Narens

MBS 17-02

On a meaningful axiomatic derivation of the Doppler effect and other scientific equations
Jean-Claude Falmagne

MBS 17-03

Non-negative matrix factorization for spectral colors using genetic algorithms: Substantially Updated Version
Vladimir A. Bochko, Kimberly A. Jameson, Toshiya Nakaguchi, and Yoichi Miyake, and Jarmo T. Alander

D. FACULTY PRESENTATIONS

APPENDIX D COLLOQUIA AND CONFERENCES OF IMBS MEMBERS, 2016-17

Bill Batchelder

William H. Batchelder (2016). *Cognitive Psychometrics: History and Nature*. Invited Keynote Talk. Association for Psychological Science. Chicago.

William H. Batchelder, Pele Schramm (2016). *Cultural Consensus Theory Models for Paired-Comparisons*. Society for Mathematical Psychology 49th Annual Meeting. New Brunswick NJ.

Stephen L. France, William H. Batchelder (2017). *FlexCCT: Theory and Software for Flexible Rating Analysis*. Classification Society Conference. Santa Cruz, CA.

Manuel Alvarado, William Batchelder. Using Cultural Consensus Theory to Study Morality Beliefs of UCI Undergraduate Students. Western Psychology Association Poster Presentation , Sacramento, CA April 2017.

Gui, Baokun & Batchelder, W.H. (2017). Extracting the Truth from Influenced Eyewitness Memory: Misinformation Effect and Cultural Consensus Theory. Poster session presented at the 26th Annual Psychology Undergraduate Research Conference, Los Angeles, CA.

Michael Birnbaum

Birnbaum, M. H. (2016). To err is human; to model is divine. *54th Edwards Bayesian Research Conference*, Fullerton, CA.

Birnbaum, M. H. (2016). True and error models for analysis of choice studies. *The Press Lecture* (Statistics program) University of California, Riverside, CA.

Birnbaum, M. H. (2016). What does it mean to say we are tracing a process? *35th Meeting of the European Group of Process Tracing Studies (EGPROC)*. Max Planck Institute, Bonn, Germany.

Birnbaum, M. H. (2016). True and error models of response variability. *Foundations of Utility and Risk (FUR Conference)*, Warwick, UK.

Birnbaum, M. H. (2016). Sources of variability in choice tasks and criteria for evaluation of error models. *Foundations of Utility and Risk: Round Table (FUR Conference)*, Warwick, UK.

Birnbaum, M. H. (2017). Bond: Do you expect me to talk? Goldfinger: No, Mr. Bond; I expect you to buy. *55th Edwards Bayesian Research Conference*, Fullerton, CA.

Birnbaum, M. H. (2017). Forming beliefs by combining information from sources. *Workshop on Belief Formation*, UC Irvine, Irvine, CA.

David Brownstone

“Aggregation Bias in Discrete Choice Models.” (with Timothy Wong and David Bunch), International Choice Modelling Conference in Capetown, South Africa. 4/5/2017.

“Incorporating External Information into Discrete Choice Models with Incomplete Choice Data.” (with Phillip Li), International Choice Modelling Conference in Capetown, South Africa. 4/5/2017.

“The Neglected Impacted of Measurement Error in Applied Microeconomics with Applications to Automobile Type Choice and Utilization.” Department of Economics, UCSB. 5/17/17.

“Aggregation Bias in Discrete Choice Models.” (with Timothy Wong and David Bunch), International Association of Applied Econometrics Conference in Sapporo, Japan. 6/28/2017.

Jan Brueckner

International:

ITEA Conference on Transportation Economics, Barcelona, June 2017.

University of Chile, Santiago, March 2017.

Singapore Management University, March 2017.

National University of Singapore, February-March 2017

OECD conference on “Urban Green Growth, Spatial Planning, and Land-Use”, Paris, November 2016 (keynote speaker).ETH Zurich, July 2016.

Ifo Institute, Munich, July 2016.

Domestic:

California State University, Fullerton, January 2017.

UC San Diego, November 2016.

San Diego State University, October 2016.

University of Missouri, Columbia, November 2016.

Property and Environment Research Center workshop on “Bringing Free Market Environmentalism to the Urban Environment,” Atlanta, November 2016.

Carter Butts

Invited Talks:

Butts, Carter T. (5/2017). “From Conversation to Plant Carnivory: Using Data Science to Tackle Complex Problems.” Invited Presentation, Data Science Initiative Colloquium, University of California, Davis. Davis, CA.

Butts, Carter T. (10/2016). “Leveraging Computational Advances to Approach Hard Problems.” Invited Keynote Presentation, Informatics Institute, University of Georgia. Athens, GA.

Butts, Carter T. (8/2016). “Some Applications of Graph Mixtures for Social Network Analysis.” Invited Panel Presentation, Joint Statistical Meeting. Chicago, IL.

Conference Presentations (partial list):

Butts, Carter T.; Smith, Emily J.; Hipp, John R.; Nagle, Nicholas N.; Boessen, Adam; Acton, Ryan M. Marcum, Christopher S.; and Almquist, Zack W. (8/2016). “Large-scale Geographical Structure in Interpersonal Networks within the Western United States.” ASA Meeting, Seattle, WA.

Gibson, C. Ben and Butts, Carter T. (8/2016). “Relational Event Modeling of Emergency Management Organizations’ Communications during the Boston Marathon Bombing.” ASA Meeting, Seattle, WA.

Lee, Francis and Butts, Carter T. (8/2016). “A Tale of Two LASes: Comparative Performance Between the Union and Intersection Rules in Network Inference.” ASA Meeting, Seattle, WA.

Smith, Emily J.; Butts, Carter T.; Hipp, John R.; and Nagle, Nicholas N. (8/2016). “Predicting Respondent Precision of Geographic Location.” ASA Meeting, Seattle, WA.

Jean-Paul Carvalho

“Elite Identity and Political Accountability: A Tale of Ten Islands”, Theory, History, Development Seminar, UC Irvine. October 2016.

“Elite Identity and Political Accountability: A Tale of Ten Islands”, Social interactions, Norms and Development Conference, New Economics School Moscow. October 2016.

“Resisting Education”, Economic Theory Seminar, University of Warwick. November 2016.

“Resisting Education”, Department of Economics Seminar, USC. November 2016.

“Elite Identity and Political Accountability: A Tale of Ten Islands”, ASREC Annual Conference., Boston MA. February 2017.

“The Economics of Religious Communities: Integration, Discrimination and”, AALIMS Annual Conference, Pomona College.

“The Economics of Religious Communities: Integration, Discrimination and Radicalization”, Economic Research on Identity, Norms and Narratives (ERINN) inaugural conference, Georgetown 2017. April 2017.

“Elite Identity and Political Accountability: A Tale of Ten Islands”, London Summer Colloquium on Identity Economics. June 2017.

Charlie Chubb

Groulx K, Chubb C (Poster presented by K Groulx at the annual meeting of the Psychonomics Society, Boston, MA, Nov. 18, 2016) *Analyzing Preattentive Visual Mechanisms via the Superthreshold Contrast Paradigm.*

Rodriguez LM, Wright CE, Chubb C (Poster presented by LM Rodriguez at the annual meeting of the Psychonomics Society, Boston, MA, Nov. 18, 2016) *Problems Using Size Judgements to Study Statistical Summary Representations.*

Lu V, Wright CE, Chubb C (Poster presented by V Lu at the annual meeting of the Psychonomics Society, Boston, MA, Nov. 18, 2016) *Target-Item Heterogeneity Undermines Performance in Estimating Centroids.*

Winter AN, Chubb C, Wright CE, Sperling G (Poster presented by AN Winter at the annual meeting of the Psychonomics Society, Boston, MA, Nov. 18, 2016) *Target-Distractor Similarity in Feature and Conjunctive Centroid Judgments.*

Inverso M, Chubb C, Wright CE, Sperling G (Poster presented by M Inverso at the annual meeting of the Vision Sciences Society, St Petersburg, FL, May 20, 2017) *Using angles as features.*

Yang H, Chubb C, Sperling G (Poster presented by H Yang at the annual meeting of the Vision Sciences Society, St Petersburg, FL, May 20, 2017) *Does feature-based attention for grayscale vary across visual tasks with identical stimuli?*

RodriguezCintron L, Wright CE, Chubb C (Poster presented by L RodriguezCintron at the annual meeting of the Vision Sciences Society, St Petersburg, FL, May 20, 2017) *Is mean size a good example of a statistical summary representation? centroid versus mean size judgments.*

Winter AN, Chubb C, Wright CE, Sperling G (Poster presented by AN Winter at the annual meeting of the Vision Sciences Society, St Petersburg, FL, May 20, 2017) *Conjunctive targets are better than or equal to both constituent feature targets in the centroid paradigm.*

Rashid J, Chubb C (Poster presented by J Rashid at the annual meeting of the Vision Sciences Society, St Petersburg, FL, May 22, 2017) *The density effect in centroid computation.*

Chubb C (Talk presented at Al-apalooza: A celebration of the life, work and play of Albert Jil Ahumada, May 24, 2017, St. Petersburg, FL) *New paradigms inspired by classification images.*

Michelle Garfinkel

"Trading with the Enemy," at the Workshop on Economic Interdependence and War. April 2017.

Steve Frank

"Three conjectures on organismal design, UCLA, February 2017.

"Predictions of disease: somatic mosaicism," mitochondrial transmission, and pathogen dosage, UCLA, February 2017.

"Three conjectures on organismal design," Washington University, March 2017.

"Cancer: somatic mosaicism and the age-incidence curves of death," Washington University, March 2017.

"Workshop on emerging directions in cancer research in which I was the primary discussant," Washington University, March 2017.

Bernie Grofman

Trompounis, Orestis, Dimitrios Xeferis, and Bernard Grofman. "Downsian Competition with Primaries and Valence Asymmetries" Presented at the Joint Conference of the [European Economic Association](#) and the [Econometric Society](#) (EEAESEM). Geneva, Switzerland, August 22-26, 2016.

Brunell, Thomas, Bernard Grofman and Samuel Merrill III. “Puzzles and Paradoxes in Understanding Models of Legislative Voting: Comparing Party and Chamber Medians.” Presented at the Annual Meeting of the American Political Science Association, Philadelphia, August, 2016.

Bochsler, Daniel and Bernard Grofman. “The Effects of Ethnic Fragmentation on Party Proliferation Revisited: The Intermediating Role of Ethnic Parties” Prepared for delivery at the Annual Meeting of the European Political Science Association, Milan, June 22-24, 2017.

Grofman, Bernard and Scott L. Feld. “Graph Theory Perspectives on Collective Representation and Potential for Computational Social Choice .” Prepared for delivery at the Conference on Voting Rules to Select Multiple Winners, Schloss Dagstuhl, Germany, June 25-29, 2017.

Saari, Donald and Bernard Grofman. “A Problem for Computational Social Choice: Reconciling Quota and House Monotonicity in Proportional Methods for Apportionment.” Prepared for delivery at the Conference on Voting Rules to Select Multiple Winners, Schloss Dagstuhl, Germany, June 25-29, 2017.

Grofman, Bernard. “Electoral Rules and Ethnic and Gender Representation in Global Perspective.” Prepared for delivery at the Conference on Democracy and Inclusion, University of Zurich, June 14-16, 2017.

Simon Huttegger

Schnorr Randomness and the Lévy Martingale Convergence Theorem”, Workshop on Learning and Probability, Columbia University, April 2017.

“The Probabilistic Foundations of Rational Learning” Department of Philosophy, University of Michigan, March 2017.

“Schnorr Randomness and the Lévy Martingale Convergence Theorem”, Second Salzburg-Irvine-Munich (SIM) Workshop in Scientific Philosophy, UC Irvine. March 2017.

“The Probabilistic Foundations of Rational Learning” Munich Center for Mathematical Philosophy, LMU Munich, February 2017.

“Foundations of (Boundedly) Rational Learning”, Center for Mathematical Economics, University of Bielefeld, January 2017.

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

“Non-standard game-theoretic models of collective action,” Public Choice Annual Conference, Ft. Lauderdale, March 2016.

“Voting methods for single-member districts and their properties,”

- Adam Smith Center, Warsaw, June 24, 2015.
- Institute of Sociology, Warsaw University, June 26, 2015.
- Polish Academy of Sciences, Warsaw, May 12, 2016.
- Kraków Economic University, Kraków, Poland, May 17, 2016.
- Koźmiński Academy Business School, Warsaw, May 18, 2016.
- Dept. of Economics, Warsaw University, May 18, 2016.
- Single-member Districts Movement, Wrocław, Poland, May 21, 2016.

Robin Keller

Juliet Elizabeth Wolford (Poster presenter), Jiaru Bai, Ramez Hasef Eskander, L. Robin Keller, Lindsey E Minion, John K. Chan, Bradley J. Monk, Krishnansu Sujata Tewari, “Evaluating the cost-effectiveness of current FDA-approved PARP inhibitors for the treatment of recurrent ovarian cancer”, American Society of Clinical Oncology (ASCO) conference, June 3, 2017, Chicago, Poster abstract published in J Clin Oncol 35, 2017 (suppl; abstr 5516), http://abstracts.asco.org/199/AbstView_199_193762.html

Background: Unlike approved IV administered therapies, Medicare is under no obligation to cover prescription medicines. We sought to evaluate the cost-effectiveness of the two FDA-

approved orally administered PARP inhibitors (PARPi), olaparib and rucaparib. **Methods:** A Markov model was created in TreeAge Pro 2015 with nodes in the chain allowing patients to transition through response, hematological complications, non-hematological complications, progression, and death. Separately, the PARP inhibitors were compared with IV administered drugs approved for recurrent ovarian cancers including platinum-based, non-platinum, and bevacizumab-based regimens. Toxicity and mean PFS rates for the different agents were obtained from registration trial data. Costs of IV chemotherapy, managing toxicities, infusions, and supportive care were estimated using 2015 Medicare data. Incremental cost-effectiveness ratios (ICER) were calculated and survival was reported in quality adjusted life months. **Results:** Platinum-based combinations were the most cost-effective at \$1,672/PFS mo as compared to non-platinum agents (\$6,688/mo), bevacizumab-containing regimens (\$12,482/mo), olaparib (\$13,3731/mo), and rucaparib (\$14,034/mo). Considering a cost of \$114,478 for olaparib and \$137,068 for rucaparib prior to progression, costs associated with PARPi were 7.1 to 8.3X more than platinum combinations. To better compare the registration trial data to PARPi data, probability was adjusted to 2nd line for rucaparib, revealing it's ICERs' of per month of life added to be \$26,997 for bevacizumab, \$17,757 for non-platinum, and \$79,585 for platinum. Using the adjusted-to-2nd-line probabilities for olaparib, exhibited ICERs were \$16,549 for bevacizumab, \$25,637 for non-platinums and \$72,083 for platinum. **Conclusions:** The high costs of PARPi were not balanced by costs of infusion and managing toxicities of IV drugs typically associated with lower response rates and shorter PFS in the recurrent space. Balancing incremental clinical benefit with novel therapies remains problematic and could widen disparities among those with limited access to care.

Jiaru Bai (presenter and session chair), Cristina Del Campo and L. Robin Keller, "Challenges In Markov Modeling of Cancer Treatment," invited talk in cluster on Computational Decision Analysis under cluster chair Jay Simon, INFORMS Computing Society ICS2017 conference, January 2017, Austin, Texas.

Jay Simon (presenter), L. Robin Keller, "Spatial preference functions for risk analysis," invited talk in Spatial Multicriteria Analysis session, INFORMS Annual Meeting, Nashville, Nov. 2016.

When 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.

L. Robin Keller, Invited Panelist on "Advice from Award Winning Researchers" in Decision Analysis Society Cluster, joint with Junior Faculty Interest Group, INFORMS Annual Meeting, Nashville, Nov. 2016.

Robin Keller is the 2016 INFORMS Past President and an INFORMS Fellow. She was the 2015 Ramsey Medalist and the Editor-in-Chief of *Decision Analysis* (2007-2012). Hints: Read widely,

make small commitments at first to new co-authors, and figure out how to not procrastinate on revisions.

Jiaru Bai (presenter), L. Robin Keller, “Challenges in Markov modeling of cancer treatment,” invited talk in Models in Medical Decision Making session, INFORMS Annual Meeting, Nashville, Nov. 2016.

We present a way to build a Markov decision tree to model cancer progression and cost-effectiveness analysis for two or more cancer treatments. We propose several problems researchers can encounter in this kind of research and provide possible solutions.

Ali Esmaeeli (presenter), L. Robin Keller, “Geographically weighted multi-attribute decision making for taxi assignment,” invited talk in Spatial Multicriteria Analysis session, INFORMS Annual Meeting, Nashville, Nov. 2016.

The taxi assignment problem is usually considered as one part of the more general vehicle routing problem (VRP) with a known value function. In this work, we extend this viewpoint to match the problem more with the real world conditions. We consider a map with weighted regions and propose a method to find the best option for each taxi request based on two different attributes. These attributes are the average response time for each region and the rate of accepted requests for each region. We show how to combine these attributes and how to include the region weights into the main value function. Moreover, we present a method for finding the best assignment option based on our defined value function.

Natalia Komarova

Mini-symposium on Linear Algebra and Mathematical Biology at International Linear Algebra Society (ILAS) 2017, Des Moines, Iowa. July 2016.

“Computational Mathematical Biology with emphasis on the Genome” workshop at the next Foundations of Computational Mathematics (FoCM 2017) conference. Barcelona, Spain. July 2016.

Plenary speaker at Southern California Applied Mathematics Symposium (SOCAMS), UC Irvine. June 2017.

Northwestern Institute on Complex Systems Speaker Series. May 2017.

Workshop on Mathematical Oncology at the University of Maryland. April 2017.

Igor Kopylov

Framing in Expected Utility and Multiple Priors Models. North American Meeting of the Econometric Society. June 2017.

Michael Lee

“Modeling the Structure of People and Items in Ranking Data”. Society for Mathematical Psychology, New Brunswick, NJ, August 2016.

“Cognitive Modeling and the Wisdom of the Crowd”, Department of Cognitive Science, University of California San Diego, February 2017.

“Bayesian methods in cognitive modeling”, Center for Cognitive Science, Rutgers, February 2017.

“Using JAGS to Implement Cognitive Models”, Data on the Mind Symposium, University of California Berkeley, March 2017.

“The Relationship Between Individual Knowledge and Group Agreement on Accuracy in Binary Decisions”, Institute for Mathematical and Behavioral Science, University of California Irvine, March 2017.

“Cognitive Modeling Explorations with Crowd-Sourced Predictions and Opinions”, Crowd Sourcing Seminar, Carnegie Mellon, March 2017.

“Applying Cognitive Models to Behavioral Memory Tests”, Memory and Meaning Conference, University of California Irvine, April 2017.

Mike McBride

M. McBride, “Identity and the Escalation of Conflict,” Yale University, Political Science, Discussion Group in Political Economy, Sep 2016.

M. McBride, “Theory-of-mind Ability and Cooperation,” Yale University, Economics, Micro theory workshop, Nov 2016.

M. McBride, "An Experimental Study of Theory of Mind and Cooperation," Association for the Study of Religion, Economics, and Culture Conference, February 2017.

M. McBride, "Theory-of-Mind Ability and Cooperation in the Prisoners Dilemma", Institution for Mathematical Behavioral Sciences Conference on "The Formation of Beliefs," March 2017.

M. McBride, “Theory-of-mind Ability and Cooperation,” University of Southern California, Department of Economics, March 2017.

Andrew Noymer

PAA 2017, Chicago • Replication and data sharing in demography: Opportunities and challenges for researchers. Session 248. [by invitation].

NBER Cohort Studies Meeting 2017, Los Angeles • The geometry of mortality change: Convex hulls for demographic analysis. With Audrey Lai and Tsuio Tai.

The geometry of mortality change: Convex hulls for demographic analysis
Labor/Public Seminar, UCI Economics Department, 4 April 2017.

Optimal measles vaccination schedules in developing countries: Insights from mathematical modeling Center for Virus Research, UCI, 14 October 2016. Rocky Mountain Laboratories, NIAID, Hamilton, Montana, 13 December 2016.

‘I’m going to Disneyland’, Or: What levels of vaccination are necessary for measles control and eradication? A mathematical model of measles transmission in developing countries.
Centre interuniversitaire québécois de statistiques sociales (CIQSS)/Quebec Inter-University Centre for Social Statistics (QICSS), Montréal, 29 September 2016.

Summertime, and the livin’ is easy—respiratory viruses’ effect on all-cause mortality: Winter and summer pseudoseasonal life expectancy in the United States
Département de démographie, Université de Montréal, 30 September 2016

Cailin O’Connor

Writing Op-Eds: How and Why?, Pacific American Philosophical Association Meeting, Seattle, Washington. (April 2017).

Risk and Collaboration. Risk and the Culture of Science - Do We Need a Maverick Room?, Center for the Study of Existential Risk, Cambridge, England. (April 2017).

Games and Kinds. 10th Logos Barcelona Workshop of Naturalistic Theories of Intentionality, University of Barcelona, Barcelona, Spain. (December 2016).

Games and Kinds. Department of Philosophy, University of Salzburg, Salzburg, Austria. (October 2016).

Panel Participant. Women in Science Forum, London School of Economics, London, England. (September 2016).

Games and Kinds. Popper Seminar, Department of Philosophy, Logic, and Scientific Method, London School of Economics, London, England. (September 2016).

The Emergence of Bargaining Inequity. Choice Group, London School of Economics, London, England. (September 2016).

The Emergence of Bargaining Inequity. Department of History and Philosophy of Science, University of Cambridge, Cambridge, England. (September 2016).

“Evolutionary Behavioral Modeling” [lecture series]. MCMP Summer School on Mathematical Philosophy for Female Students. Munich Center for Mathematical Philosophy. Ludwig-Maximilians Universität, Munich, Germany. (July 2016).

“Discrimination and Collaboration” Formal Epistemology Workshop. University of Washington, Seattle, Washington. (May 2017).

“Games, Evolution, and Intersectionality.” Philosophy of Science Association 2016 Biennial Meeting. Symposium: “Formal Methods and Social Epistemology.” Atlanta, GA. (November 2016, symposium contribution).

“The Evolution of Discriminatory Norms in Scientific Disciplines.” The Science of Evolution and the Evolution of the Sciences. Leuven, Belgium. (October 2016).

“Games and Kinds.” 8th Quadrennial Fellows Conference. Lund, Sweden. (August 2016).

“Cooperation Without the Cooperative Principle.” Decisions, Games, and Logic. Ann Arbor, MI (July 2016, presented by co-author).

Lisa Pearl

Lectures on 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.

The development of verb classes: A computational adventure with implications for linguistic theory. Language Science Colloquium, University of California, Irvine. June 2017.

Computational models of language acquisition: Why, how, and what we can learn. Keynote Address, Cognitive Science Workshop. Simon Fraser University, Vancouver. June 2017.

Linking lexical semantic profiles and the age of acquisition for the English passive. (with Emma Nguyen) 53rd Meeting of the Chicago Linguistic Society, University of Chicago. May 2017.

Do you really mean it? Linking lexical semantic profiles and the age of acquisition for the English passive. (with Emma Nguyen) West Coast Conference on Formal Linguistics, Calgary, Alberta. April 2017.

Context management vs. grammatical processing in children's scope ambiguity resolution. (with K.J. Savinelli and Greg Scontras). 30th Annual CUNY Conference on Human Sentence Processing, MIT. April 2017.

Case studies in eliciting the Spanish subjunctive in heritage bilingual children. (with Margarita Rodriguez and Julio Torres) 4th National Symposium on Spanish as a Heritage Language, UC Irvine. February 2017.

The development of scope ambiguity resolution: New frontiers in the RSA framework. (with K.J. Savinelli and Greg Scontras) CSLI workshop on *Bridging computational and psycholinguistic approaches to the study of meaning*, Stanford. February 2017.

Do you really mean it? Linking lexical semantic profiles and the age of acquisition for the English passive. (with Emma Nguyen) Linguistic Society of America Annual Meeting, Austin. January 2017.

Computational Model Building for Language Acquisition: An Introduction. Child Language Acquisition Lecture. CSU Fullerton. November 2016.

Integrating conceptual and structural cues: Theories for syntactic acquisition. SynLinks: Links between representation and processing in syntactic acquisition. University of Connecticut, Storrs. September 2016.

Donald Saari

Dept of Mathematics, April 2017, "From voting theory to the dark matter mystery."

IMBS Colloquium, April 2017, "Using Arrow's Theorem to investigate dark matter."

Brian Skyrms

NASSLI Summer School Rutgers University (5 lectures). July 2016.

"Learning to Compare Utilities" APA Central Division. March 2017.

“Dynamics in the State of Nature” APA Pacific Division. April 2017.

Hal Stern

“Strengthening the Science in Forensic Science”, Joint Statistical Meetings, Chicago, IL. August 2016.

Participant, Panel on 2016 NASEM Report “Commercial Motor Vehicle Driver Fatigue, Long-Term Health and Highway Safety”, 10th International Conference on Managing Fatigue, San Diego, CA. March 2017.

“An Introduction to Statistical Thinking for Forensic Practitioners,” Virginia Department of Forensic Science, Roanoke, VA (24 students). April 2017.

“An Introduction to Statistical Thinking for Forensic Practitioners,” Bellevue WA Police Department (40 students – King County, Seattle, Bellevue, Tacoma and other locations). April 2017.

Jack Yellott

Visualizing the null space of a defocused eye. Vision Society Annual Meeting. May 2017.

E. FACULTY AWARDS AND ACHIEVEMENTS

**APPENDIX E
IMBS FACULTY AWARDS AND ACHIEVEMENTS, 2016 - 17**

Carter Butts

Elected Offices:

Chair-elect, ASA Section on Mathematical Sociology.

Council Member, ASA Section on Methodology.

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

David Brownstone

I organized the Econometrics Seminar during the academic year. This involved coordinating 15 outside speakers visiting UC Irvine.

I was asked to serve on an expert panel to evaluate the California Energy Commission's transportation demand models. This work is ongoing.

Jean- Paul Carvalho

Promoted to Associate Professor of Economics (with tenure).

Dean's Award for Outstanding Teaching in the Social Sciences.

Co-organizer, International Economics Association Roundtable on The Economics of Religion, Cambridge UK, July 2017.

Faculty instructor, ASREC Economics of Religion Graduate Workshop, 2016.

Organizing committee, AALIMS annual conference, Pomona College, 2017.

Organizer, Workshop on the Formation of Beliefs, IMBS, 2017.

Co-organizer, *Theory, History and Development Seminar*, Department of Economics, Fall 2016, Spring 2017.

Faculty discussant, IRES Graduate Workshop, Chapman University, June 2017.

Discussant, ASREC Annual Conference, February 2017.

Chair, Jean-Claude Falmagne Dissertation Award Committee, June 2017.

Michelle Garfinkel

Journal of Conflict Resolution.

Journal of Economics and Business.

European Journal of Political Economy.

Kimberly A. Jameson

Ad Hoc Reviewing:

Journal of Cognition

Color Research & Application

Journal of the Optical Society of America

PNAS

Media and Other activities:

During 2015-2016 news and media coverage highlighting Jameson's research (sketched as (1), (3) and (6) above) appeared in a variety of public and campus media outlets, including BBC news, Canal+ and others.

(a.) Two days filming for BBC science tetrachromacy segment. Consulted with Kate Pringle and Alexis Smith. Filmed in Jameson's Color Cognition Laboratory at UCI on Sept. 8th 2016.

(b.) Interviewed and filmed research featured in "THE FIVE SENSES - The view from all point of Sight". For Canal+ / Planète+ / TV5Monde / RTBF / ODISEA / TV5 Québec program.

(c.) Interviewed, freely consulted and corresponded with inquiring scientists and media, as well as general public inquiries from prospective "tetrachromats".

(d.) Cultivated interest and established collaborative contacts with the color materials experts, e.g., a senior researcher at the University of East Anglia, School of Computing Sciences; and a senior researcher specializing in nano technology and color at KolorMondo in Trosa, Sweden.

(e.) Consulted with three separate adaptive optics experts at UC Berkeley, University of Penn, and University of Nevada, Reno about future imaging of living retina to determine the presence ratios of cone classes in CA's retina. Plans for study are pending.

Marek Kaminski

Television appearances (for Polish Television)

- lecture and discussion on single-member districts, for BRJ TV (August 2015),
<https://www.youtube.com/watch?v=b8bqKq4WhOU&list=PLjrbjoslcLm7qTZCFura8MU1je1ksA>
- interview on electoral methods, for TV Republika (December 2015)
<https://www.youtube.com/watch?v=GbHVu2AhXrg&index=2&list=PLjrbjoslcLm7qTZCFura8MUSy1je1ksA>
- lecture and discussion on single-member districts, for BRJ TV (August 2015),
<https://www.youtube.com/watch?v=b8bqKq4WhOU&list=PLjrbjoslcLm7qTZCFura8MU1je1ksA>
- interview on electoral methods, for TV Republika (December 2015)
<https://www.youtube.com/watch?v=GbHVu2AhXrg&index=2&list=PLjrbjoslcLm7qTZCFura8MUSy1je1ksA>

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<https://www.youtube.com/watch?v=b8bqKq4WhOU&list=PLjrbjoslcLm7qTZCFura8MU1je1ksA>
- interview on electoral methods, for TV Republika (December 2015)
<https://www.youtube.com/watch?v=GbHVu2AhXrg&index=2&list=PLjrbjoslcLm7qTZCFura8MUSy1je1ksA>

Robin Keller

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

Decision Analysis editorial board member.

EURO Journal on Decision Processes editorial board member.

INFORMS (The Institute for Operations Research and the Management Sciences, www.informs.org)

-Past-President- 2016

-Board Liaison to INFORMS History and Traditions Committee, 2016 (as Past President)

-Co-chair of INFORMS Strategic Planning Committee, 2016

-President's Award Committee, Chair, 2015; Member 2016 and 2017

-Nominations Committee, Chair for 2017 election- 2016

-Committee on the Board, Member, 2016

-Ad Hoc Committee on Diversity, Member, 2016

Appointment to **Committee for a Study of Performance-Based Safety Regulation,**

Transportation Research Board, National Research Council of the National Academies, 2/2/2016-8/31/2017

“Many countries, including the United States, use forms of performance-based regulation to promote safety and reduce risk in high-hazard industries. The term “performance-based” is often used to refer to (a) standards that mandate outcomes and give firms flexibility in how to meet them, or (b) requirements for firms to use management systems consisting of internal plans and practices for promoting safety and reducing risk. Performance-based regulation is usually contrasted with “prescriptive” regulation – sometimes called specification, design, or technology standards – that requires firms to adopt specific means to promote safety and reduce risks. This study will compare the advantages and disadvantages of prescriptive- and performance-based forms of safety regulation and identify possible opportunities for, and constraints on, making greater use of the latter. The study will be informed by experiences of performance-based safety regulation in the U.S. and abroad and will make recommendations about the application of this regulatory approach in high-hazard industries, such as off-shore oil and gas, pipelines, and other modes of transportation.”

Book in progress (late 2017, expected publication date), Committee for a Study of Performance-Based Safety Regulation, Transportation Research Board, National Research Council of the National Academies

Book is authored by the “Committee”

<https://www8.nationalacademies.org/cp/CommitteeView.aspx?key=49767>

DETLOF VON WINTERFELDT, University of Southern California, chair; KENNETH ARNOLD, WorleyParsons;

CARY COGLIANESE, University of Pennsylvania; LOUIS ANTHONY (Tony) COX, Cox Associates, LLC; ROBIN L. DILLON-MERRILL, Georgetown University; LOIS EPSTEIN, The Wildlife Society; ORVILLE HARRIS, O.B. Harris, LLC; L. ROBIN KELLER, University of California, Irvine; ALLISON MACFARLANE, George Washington University; RACHEL McCANN, Health and Safety Executive, UK; ARTHUR MEYER, Enbridge Pipeline (retired); DONALD MOYNIHAN, University of Wisconsin, Madison; SUSAN SILBEY, Massachusetts Institute of Technology; JAMES WATSON, American Bureau of Shipping

Igor Kopylov

Associate Editor: Theoretical Economics.

Cailin O’Connor

My work on bargaining in epistemic communities was written about in Nautilus Magazine.

Lisa Pearl

2016-2017 *North American Computational Linguistics Olympiad*. Member of committee coordinating the UCI branch of this NSF-funded program, which is aimed at introducing high school and middle school students to language science and computation (<http://www.linguistics.uci.edu/naclo.php>). Inaugural UCI session attracted a group that was over 80% women, and represents successful outreach to women in STEM.

Don Saari

Elected to receive an honorary PhD from the Russian Academy of Sciences. The selection was in Nov. 2016; the presentation will be in October 2017.

Elected as a foreign member of the Russian Academy of Sciences.

Chair or past chair of the following organizations (with my retirement, I am stepping down from most of these positions): Chair of NAS Section 32 (Applied Mathematics), Past Chair, Conference Board of Mathematical Sciences, Chair of NRC Board on Mathematical Sciences and their Applications, Chair, NAS National Member Organization of International Institute for Applied Systems Analysis, Chair, governing council of International Institute for Applied Systems Analysis (in Vienna).

Member of US National Committee on Mathematics, NRC Board on International Scientific Organizations, NAS selection committee for “Sackler Prize in Convergence Research,” and Fields Institute (Toronto) “Keyfitz Lectureship Committee”.

Brian Skyrms

Elected as Fellow of the Game Theory Society, 2017.

Recipient of the Carl G. Hempel Award Philosophy of Science Association, 2016.

Hal Stern

Fellow, American Association for the Advancement of Science (AAAS). 2016.

Member, National Academy of Sciences Committee on Strengthening the Federal Motor Carrier Safety Administration Research and Technology Program. 2016 – present.

Chair, American Statistical Association (ASA) Committee on Publications. 2015 – present.

Member, Board of Directors, National Institute of Statistical Science (NISS). 2015 – present.

Member, Scientific Area Committee for Physics/Pattern Forensic Evidence, Organization of Scientific Area Committees, National Institute of Standards and Technology (NIST), 2014-present.

Member, Advisory Committee for AAAS / Arnold Foundation “Quality and Gap Analysis of the Forensic Science Literature”. 2014 – present .

Vice-Chair, Ad Hoc Advisory Committee on Forensic Statistics, American Statistical Association 2012 – present.

Rein Taagepera

Honorary citizen of the City of Tartu, Estonia, as of 2017. Every spring semester, Taagepera is lecturing in Tartu in the very building where he was born, turned meanwhile from women’s hospital to the Skytte Institute of Political Studies.

F. 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>AdvisorS</u>
	Narens
* Gregory Alexander	Batchelder
* Jerrod Anderson	Carvalho/McBride
** Brian Asquith	Brueckner
Galia Bar-Sever	Pearl
Alandi Bates	Pearl
Michael J. Bannister	Eppstein
Zach Becker	Eppstein
Dennis Blew	Kaminski
Alex Bower	Batchelder
Steven Brownlee	Poirier
Debapriya Chakraborty	Brownstone
Elliott Chen	Weatherall
Mayuri Chaturvedi	Skaperdas
Calvin Cochran	Barrett
Andrew Colopy	Skaperdas
John Cuffe	Uhlener
Irina Danileiko	Lee
Archie Delshad	Kaminski
* Steve Doubleday	Lee
Nikki Fider	Komarova
** Katelyn Finley	Kaminski
Ben Gibson	Butts
Marian Gilton	Weatherall
Maryam Gooyabadi	Narens
Kier Groulx	Chubb
Maime Guan	Lee
Michael Guggisberg	Brownstone
Santiago Guisasola	Saari
** Lisa Guo	Trueblood
Christian Herrera	Chubb
Joselyn Ho	Chubb
Kurt Horner	McBride
Matt Inverso	Chubb
Brian Kaiser	Kaminski
Si-Yuan Kong	Brownstone
Alex Keena	Kaminski
Irina Kotova	McBride

Student

Alex Luttman
William Leibzon
Francis Lee
Timmi Ma
Amine Mahmassani
Solena Mednikoff
Percy Mistry
Chris Mitsch
* Byunggeor Moon
Aydin Mohseni
Emma Nguyen
Fulya Ozcan
Lawrence Phillips
Nolan Phillips
Jason Ralston
Jordan Rashid
Scott Renshaw
Gerard Rothfus
Sarita Rosenstock
** Hannah Rubin
K.J. Savinelli
Mike Schneider
Pele Schramm
Linley Slipetz
Emma Smith
Kyle Sneed
Pat Testa
* Brian Vegetabile
Jamie Wang
Cole Williams
Nicole Winter
Karen Wood
Howard Yang
Fan Yin
Tim Young
Junying Zhao

Advisor

Brueckner
Narens
Butts
Komarova
Brownstone/McBride
Chubb
Lee
Weatherall
Brueckner
O'Connor
Pearl
Poirier
Pearl
Butts
McBride
Chubb
Butts
Brian Skyrms
O'Connor
O'Connor
Pearl
O'Connor
Batchelder/
O'Connor
Butts
McBride
Carvalho/Skaperdas
Stern
Brueckner
Carvalho/McBride/Skaperdas
Chubb
Komarova
Chubb
Butts
McBride
Saari