

NIMBioS

National Institute for Mathematical
and Biological Synthesis

Ninth Bi-Annual Blackwell-Tapia Conference – 2016

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October 28-29, 2016

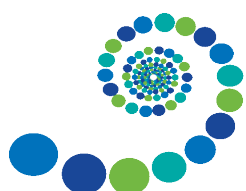
Evaluation Report

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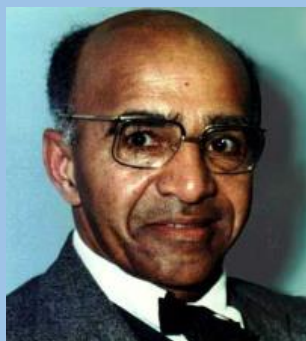
<https://www.stemeval.org/>

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NIMBioS
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David Blackwell



Richard Tapia

Introduction

The ninth bi-annual Blackwell-Tapia conference was successfully held October 28-29, 2016 at the University of Tennessee Conference Center in Knoxville, TN. The bi-annual conference was established in 2000, honoring David Blackwell and Richard Tapia for their inspiration of African-American, Native American, and Latino/Latina students to pursue careers in mathematics. The conference is intended to 1) recognize and showcase mathematical excellence by minority researchers, 2) recognize and disseminate successful efforts to address under-representation, 3) inform students and mathematicians about career opportunities in mathematics, especially outside academia, and 4) provide networking opportunities for mathematical researchers at all points in their higher education/career trajectory.

Participant feedback shows that the grant's goal to support the 2016 Blackwell-Tapia Conference in providing early-career minority mathematicians with enhanced understanding of their field, networking with peers, and interactions with senior researchers was achieved. This report summarizes the conference's success in relation to associated metrics provided by the Alfred P. Sloan Foundation. Information about this conference, including a program booklet as well as videos of the invited speakers' lectures are available at:

http://www.nimbios.org/education/blackwell_tapia.



Local organizing committee :

Kelly Sturner, PI - NIMBioS
 Suzanne Lenhart, PI - NIMBioS
 Sujit Ghosh (SAMSI and North Carolina State University),
 Abdul-Aziz Yakubu, Howard Univ.
 Carlos Castillo-Chavez, Arizona State

National Blackwell-Tapia committee:

Robert Megginson,
 Carlos Castillo-Chavez,
 David Eisenbud (MSRI Director),
 Suzanne Lenhart
 Ricardo Cortez (2014 recipient)
 Jacqueline Hughes-Oliver (2012 recipient)

Invited speakers:

Mariel Vazquez, 2016 Blackwell-Tapia Awardee, Univ. of California-Davis
 Federico Ardila, San Francisco State Univ.
 Edray Goins, Purdue Univ.
 Johnny Guzman, Brown Univ.
 Monica Jackson, American Univ.
 Overtoun Jenda, Auburn Univ.
 Carolyn Morgan, Hampton Univ.
 Jose Perea, Michigan State Univ.
 De Witt Sumners, Florida State Univ.
 Cristina Villalobos, The Univ. of Texas-Rio Grande Valley
 Abdul-Aziz Yakubu, Howard Univ.

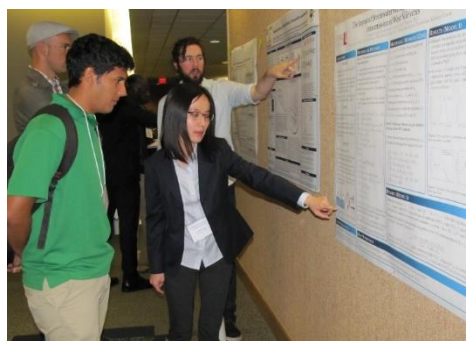
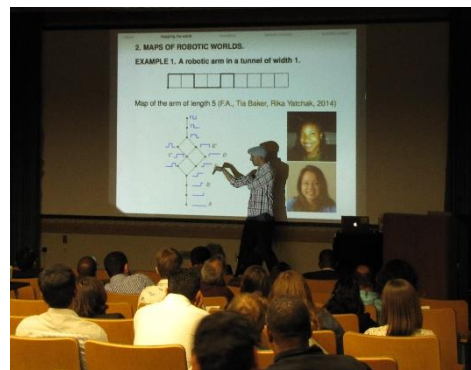


Metric 1. Hold a well-organized professional development and networking conference for 100+ participants.

The 2016 Blackwell-Tapia Conference was held on October 28-29, 2016 at the University of Tennessee Conference Center, Knoxville, TN. The conference included scientific talks, poster presentations, panel discussions, opportunities for discussion and interaction among participants, and the awarding of the Blackwell-Tapia prize to Dr. Mariel Vazquez.

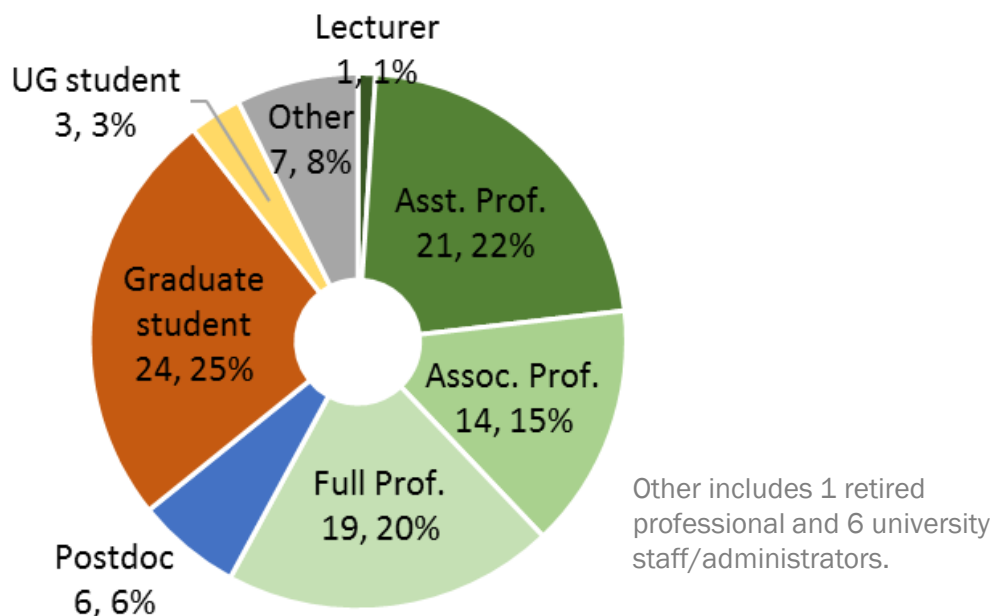
In addition to the 2-day conference, NIMBioS sponsored an event “Mathematics: It’s Not What You Think! A Virtual Math Meet-Up for Undergraduates” on October 27. For the event, Dr.’s Mariel Vazquez and Jose Perea discussed their career paths and the applications of their work in pure mathematics, medicine, computers, and engineering and more.

Appendix A includes a copy of the conference schedule with award bios.



Metric 2. Attract minority researchers at varying career stages in the mathematical sciences.

Participants of the Blackwell-Tapia conference represented a variety of researchers across different career stages. The majority of participants represented individuals who may be considered within early career stages (e.g, Assistant professors, postdoctoral researchers, graduate and undergraduate (UG) students).



Additionally 15 undergraduates from the University of Tennessee and Maryville College attended a pre-conference event.

I am currently looking for a postdoc or a faculty position. Through the conference I have obtained valuable contacts - those contacts may or may not help me achieve a desired academic position, but they will certainly be someone I will try to collaborate with.

I gained another perspective on an academic career. I saw many minorities who [are] role models. That gave me more hope in the sense that it made me realize that probably I would be able to continue my growth as a mathematician. I met a professor that geographically is close to my university with whom I can have potential collaboration. It was such a positive environment. The speakers and organizers were really encouraging. This could make my job search process smoother as I feel I have more people to ask for advice.

Exposure to this conference has shown me that there is a venue where people care about championing diversity and lifting the disadvantaged up to equality. This encourages me to go "all in" when I have the opportunity to mentor such diverse students. It is also possible that I made one or more important connections for future collaboration.

I'm old - main impact will be on new connections and people I may be able to provide advice to in the future

Metric 3. Award the Blackwell-Tapia prize

Richard Tapia presented the award to Vazquez during the banquet on Oct 29, at the closing of the Blackwell-Tapia Conference.



Dr. Mariel Vazquez, a professor in the departments of mathematics and of microbiology and molecular genetics at the University of California, Davis, was awarded the 2016 Blackwell-Tapia prize.

Vazquez is a pioneer in the emerging field, DNA topology – which applies pure math to untangle the biological mysteries of DNA. Her research has focused on cancer treatment, drug design, understanding genome rearrangements after radiation damage or in cancer, and gaining insight into how genomes package in viruses and within cells and into how viral DNA (e.g., retroviruses, such as HIV) integrates into the host genome.

Vazquez was an academic visitor at the Biochemistry Department at the University of Oxford, England, the Cancer Research Center in Salamanca, Spain, and at the molecular biology department in the Center for Research and Development in Barcelona, Spain as well as a visiting scholar at the University of California, Berkeley. Vazquez's research has been supported by grants from the National Institutes of Health and by the National Science Foundation (NSF). She received a Presidential Early Career Award for Scientists and Engineers from U.S. President Barack Obama in 2012 and was the recipient of a NSF CAREER award in 2011. f

Vazquez has worked passionately to increase diversity in the mathematical sciences at all levels. As a professor at UC Davis since 2014, Vazquez mentors graduate students, has developed an interdisciplinary course in "Analyzing DNA Structure with Mathematical and Computational Methods," and has served as co-PI on a grant from the National Security Agency to increase the mathematics and statistics components of the 2015-2016 annual conferences of the Society for Advancement of Chicanos/Hispanics and Native Americans in Science. She has also volunteered for other public outreach, including lecturing for the UC Davis Math Circle for middle and high school students. Before joining UC Davis, Vazquez was on the faculty at San Francisco State University where she mentored undergraduates and graduate students and co-founded the elementary school level component of the San Francisco Math Circles.



I am deeply honored to be selected for the 2016 Blackwell-Tapia Award. It is with great pleasure that I accept the award and join the organizing committee. Thank you all for the trust you have put in me.



I loved the conference. It was the first math conference that I attended after receiving my PhD. It's amazing that I understand the math that I heard every speaker speak about. I made some great contacts and I look to collaborate with a few people that I met there. I would love to attend again.

Metric 4. Assess the impact and evaluate the continued success of the conference, especially the opportunities for networking and mentoring.

In spring of 2016 NIMBioS evaluation staff followed up with participants of the 2014 Blackwell-Tapia Conference and gathered their feedback on the long-term effects of the conference. Forty-four of the 99 participants completed the survey. A data summary report of the survey findings was sent to the Alfred P. Sloan Foundation in May, 2016 (Appendix B). Findings from the follow-up assessment follow:

86% recommended the Conference to a student or colleague
(87% of non-faculty; 86% of faculty)

53% gained knowledge that helped advance their career
(67% of non-faculty; 46% of faculty)

51% indicated the Conference influenced their career goals
(80% of non-faculty; 36% of faculty)

42% believed the Conference was useful preparation for their career
(73% of non-faculty; 25% of faculty)



As a minority Ph.D in Mathematics, the largest impact this conference had on me was to put me in contact with role models and mentors who themselves came from diverse backgrounds and had successfully navigated the many pitfalls in academia. There's very few other ways to come in contact with minority researchers in Mathematics and as such I found this opportunity very valuable and enriching for my professional career.

35% indicated the Conference introduced them to someone who later became a mentor, advisor, employer, or collaborator in research

(47% of non-faculty; 29% of faculty)

35% felt the Conference influenced this research interests
(33% of non-faculty; 36% of faculty)

26% continue to collaborate with people they met at the Conference
(13% of non-faculty; 32% of faculty)

12% indicated the Conference led them to collaborate outside of their discipline
(13% of non-faculty; 11% of faculty)

Metric 5. Survey participants and presenters for demographics and level of satisfaction.

Participant Demographics.

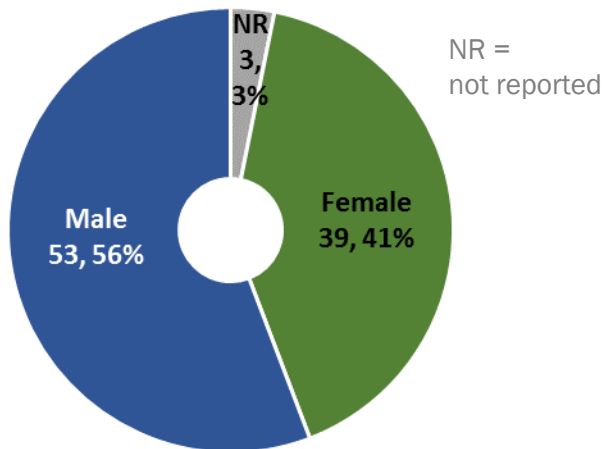
The Blackwell-Tapia Conference was attended by 107 participants; 11 presenters, 7 committee members (2 of whom were also presenters), and 91 other attendees. Demographic information for conference attendees was self-reported through a survey administered by NIMBioS staff. Of the 107 attendees, demographic data was provided by 98 (92%) participants – some demographic information may be missing for those who did not respond to certain questions on the survey.

107 total participants

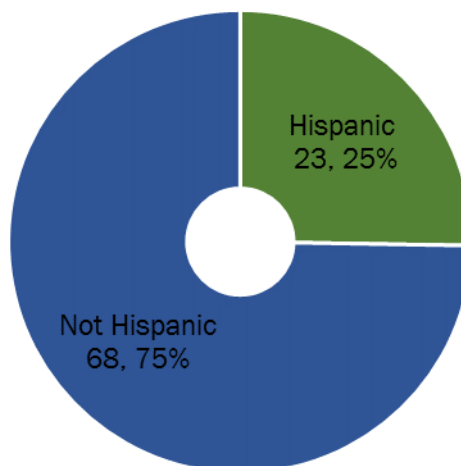
51 different institutions reported for attendees across **26** states, territories, and provinces

76 attendees had U.S. citizenship or permanent residence – **20** attendees were not U.S. citizens

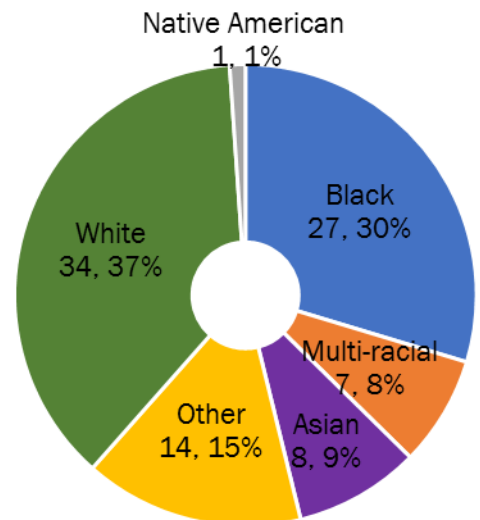
Composition of **male** and **female** attendees.



Composition of attendees by ethnicity (**Hispanic** and **not Hispanic**)



Composition of attendees by race



88% of participants indicated they learned something new at the conference.

86% of participants indicated they will recommend the Blackwell-Tapia conference to others.

78% of participants indicated they hope to attend the next Blackwell-Tapia Conference.

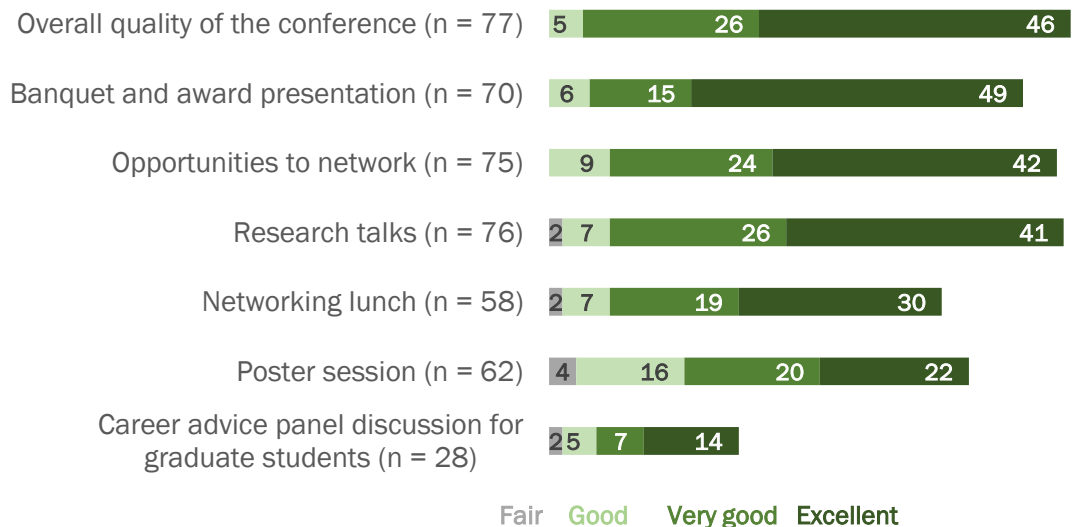
61% of participants indicated they made new scientific connections with other participants that may lead to collaborations or other opportunities.

Metric 5. Survey participants and presenters for demographics and level of satisfaction.

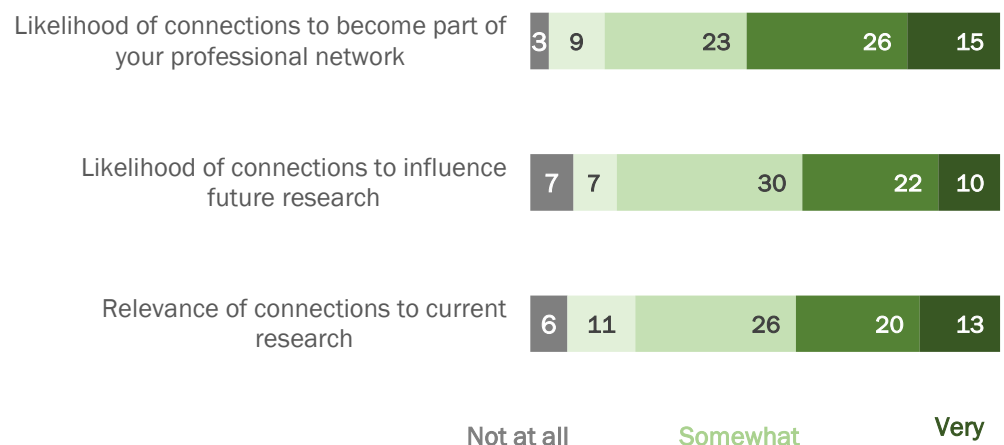
Survey results.

Christine Marshall and Dr. Helene Barcelo with the Mathematical Sciences Research Institute (MSRI) administered exit surveys for the 2016 Blackwell-Tapia conference and provided a spreadsheet of survey responses to the NIMBioS evaluation staff. The survey included both forced-choice and open-ended responses. All open-ended responses are included in Appendix C.

Satisfaction ratings for components of the 2016 Blackwell-Tapia Conference. **100%** of respondents found the overall quality of the conference, banquet and award presentation, and opportunities to network to be **good** or **better**.

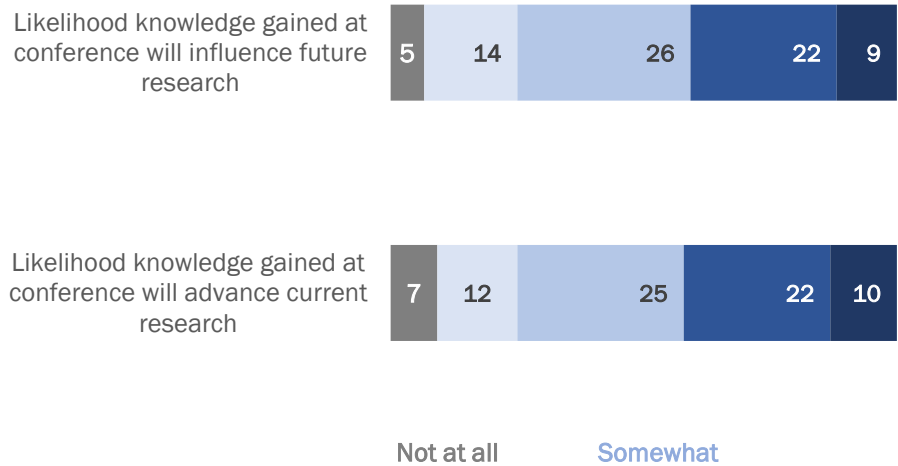


Responses for how connections made during the Blackwell-Tapia conference may impact participants.

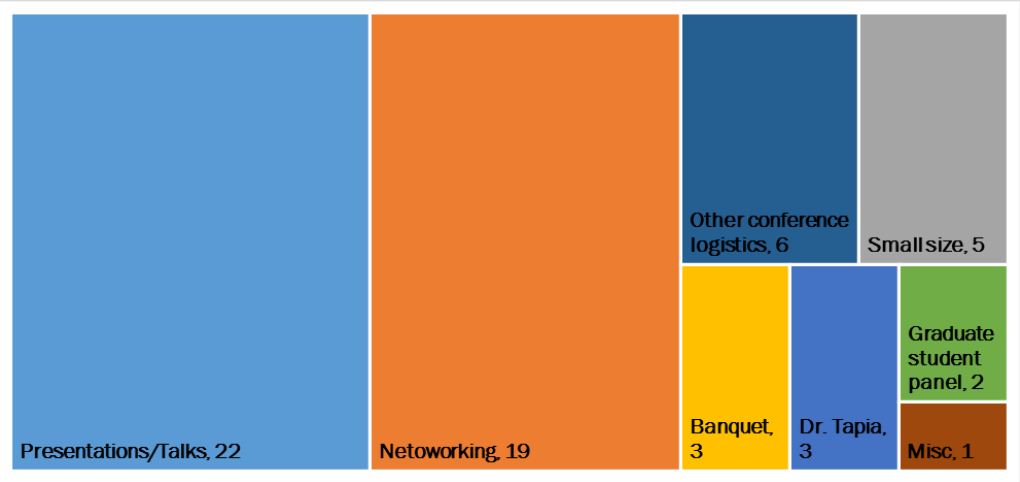


Metric 5. Survey participants and presenters for demographics and level of satisfaction.

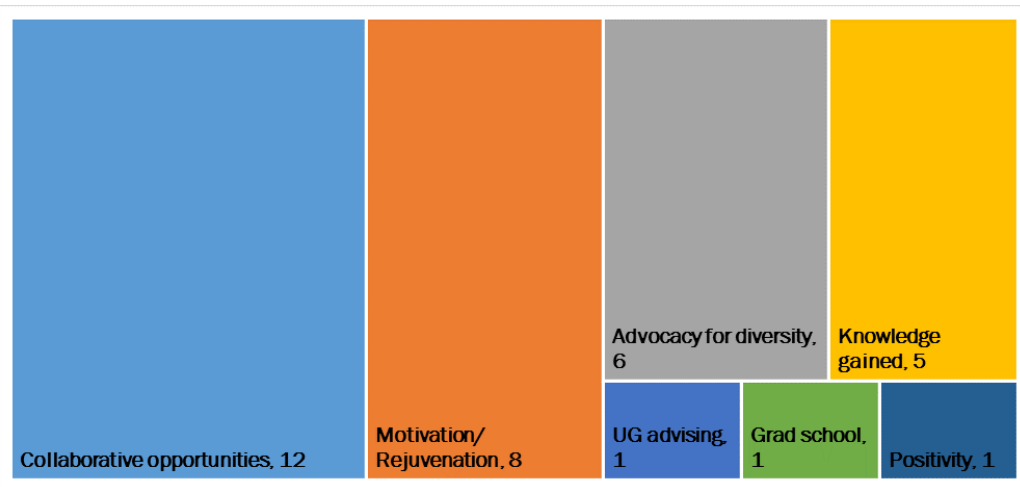
Responses for how knowledge gained during the Blackwell-Tapia conference may impact participants.



Categorization of feedback for “Aspect of conference liked most”.



Categorization of feedback for “Impact on career”.



This is very hard to pick because I loved everything about the conference. I felt the size was perfect since it allowed for interaction with as many faculty and students as possible. I think the biggest take away for me was the networking and this was possible due to size of meeting and conference venue which was conducive to interaction between people.



Exposure to this conference has shown me that there is a venue where people care about championing diversity and lifting the disadvantaged up to equality. This encourages me to go "all in" when I have the opportunity to mentor such diverse students.



The organization was impeccable. I appreciated the support given to a large number of trainees and early career mathematicians to attend the conference. I liked the diversity of attendees: professors junior and senior, students and postdocs, many members of underrepresented groups, many female mathematicians. The attendance of NSF Math institute directors is important and I acknowledge the presence of some of them. The opportunities for networking were abundant and the size of the conference facilitated interaction, especially for young attendees. The award ceremony and banquet were very nice.

Metric 6. Report on conference and evaluation to Sloan, the Mathematical Sciences Institute Diversity Committee, and the Blackwell-Tapia planning committee for program improvement and subsequent tracking of participants' career trajectories.

All reports, evaluation, and hosting guidance will be shared with the Alfred P. Sloan Foundation, the Institute for Computational & Experimental Research in Mathematics (ICERM which is the next lead hosting institute for the conference), the NSF Mathematical Sciences Institute Diversity Committee, and the Blackwell-Tapia planning committee.



Appendix A

Blackwell-Tapia Conference Agenda and Speaker Abstracts

The Blackwell-Tapia Conference and Awards Ceremony

October 28-29, 2016

**The University of Tennessee Conference Center
600 Henley Street, Knoxville, TN**

Friday, October 28, 2016

- 1:00-1:10 Welcome by Suzanne Lenhart, NIMBioS Associate Director for Education & Outreach
- 1:10-2:00 Joaquin Bustoz, Jr. Lecture: Abdul-Aziz Yakubu, Howard University
Mathematical Models for Malaria with Applications to Mali and USA
 Introduced by Suzanne Lenhart, NIMBioS
- 2:10-2:50 Federico Ardila, San Fransisco State University
Using High-Dimensional Geometry to Move Robots Quickly
 Introduced by Brendan Hassett, ICERM
- 2:50-3:10 Break
- 3:10-3:50 Cristina Villalobos, The University of Texas-Rio Grande Valley
*Becoming Agents of Change: Building Diverse Communities and Lessons Learned
from Mathematical Modelling of Eye Disease*
 Introduced by Kelly Sturner, NIMBioS
- 4:00-4:40 Edray Goins, Purdue University
Toroidal Belyi Pairs, Toroidal Graphs, and their Monodromy Groups
 Introduced by Abdul-Aziz Yakubu, Howard University
- 4:50-5:00 Introduction to NIMBioS by Colleen Jonsson, Director of NIMBioS
- 5:00-6:00 Poster session and reception
- Dinner on your own*

Saturday, October 29, 2016

- 8:45 Continental Breakfast Available at the Conference Center
- 9:15-9:55 Jose Perea, Michigan State University
The Shape of Data
 Introduced by David Eisenbud, MSRI

10:05-10:45 Overtoun Jenda, Auburn University
Generalized Baer's Criterion
Introduced by Suzanne Lenhart, NIMBioS

10:45-11:10 Group Photo & Break

11:10-11:50 Monica Jackson, American University
Correlation Induced by Missing Spatial Covariates
Introduced by Louis Gross, NIMBioS

Noon-1:30 Lunch in 404A

- Career Advice Panel Discussion for graduate students - bring your lunch to 403
 - Panelists: Joan Lind (moderator), University of Tennessee-Knoxville; Michael Kelly, Transylvania University; Johnny Guzman; and Cristina Villalobos
- Networking lunch for other participants in 404A
 - Tables:
 1. Mariel Vazquez and De Witt Sumners
 2. Abdul-Aziz Yakubu
 3. Carolyn Morgan
 4. Monica Jackson
 5. Jose Perea
 6. Edray Goins
 7. Federico Ardila
 8. David Eisenbud, Brendan Hassett, and Suzanne Lenhart
 9. Richard Tapia and Carlos Castillo-Chavez
 10. Overtoun Jenda

1:30-2:10 Johnny Guzman, Brown University
Some Numerical Methods for Steady State Interface Problems
Introduced by Arlie Petters, Duke University

2:20-3:00 Carolyn Morgan, MECK Limited LLC
Statistical Research - Industrial, Governmental, and Academic
Introduced by Louis Gross, NIMBioS

3:00-3:20 Break

- 3:20-4:00 De Witt Sumners, Florida State University
The Work of Mariel Vazquez
Introduced by Carlos Castillo-Chavez, Arizona State University
- 4:15-5:15 Prize Winner Lecture: Mariel Vazquez, University of California, Davis
Using Topology, Geometry and Computer Simulations to Understand the Molecule of Life
Introduced by Carlos Castillo-Chavez, Arizona State University

Holiday Inn - Knoxville, Downtown
Windows on the Park Pavillion - Tennessee Ballroom
525 Henley Street, Knoxville, TN

- 6:00-9:00 Reception followed by Blackwell-Tapia Banquet
- Remarks by Richard Tapia, Rice University
Introduced by Arlie Petters
- Award Presentation

Speaker Abstracts

Federico Ardila (San Francisco State University) *Using High-Dimensional Geometry to Move Robots Quickly*

How do we move a robot quickly from one position to another? To answer this question, we need to understand the “configuration space” containing all possible positions of the robot. Unfortunately, these spaces can be very high dimensional and intricate. Fortunately, combinatorialists and geometric group theorists have encountered and studied these kinds of spaces before. Thanks to the tools they’ve developed, we can build “remote controls” to navigate these configuration spaces, and move (some) robots optimally.

Edray Goins (Purdue University) *Toroidal Belyi Pairs, Toroidal Graphs, and their Monodromy Groups*

A Belyi map $\beta : \mathbb{P}^1(\mathbb{C}) \rightarrow \mathbb{P}^1(\mathbb{C})$ is a rational function with at most three critical values; we may assume these values are $\{0, 1, \infty\}$. A Dessin d’Enfant is a planar bipartite graph obtained by considering the preimage of a path between two of these critical values, usually taken to be the line segment from 0 to 1. Such graphs can be drawn on the sphere by composing the stereographic projection: $\beta^{-1}([0, 1]) \subseteq \mathbb{P}^1(\mathbb{C}) \simeq S^2(\mathbb{R})$. Replacing \mathbb{P}^1 with an elliptic curve E , there is a similar definition of a Belyi map $\beta : E(\mathbb{C}) \rightarrow \mathbb{P}^1(\mathbb{C})$. Since $E(\mathbb{C}) \simeq \mathbb{T}^2(\mathbb{R})$ is a torus, we call (E, β) a toroidal Belyi pair. The corresponding Dessin d’Enfant can be drawn on the torus by composing with an elliptic logarithm: $\beta^{-1}([0, 1]) \subseteq E(\mathbb{C}) \simeq \mathbb{T}^2(\mathbb{R})$

This project seeks to create a database of such Belyi pairs, their corresponding Dessins d’Enfant, and their monodromy groups. For each positive integer N , there are only finitely many toroidal Belyi pairs (E, β) with $\deg \beta = N$. Using Hurwitz Genus formula, we can begin this database by considering all possible degree sequences \mathcal{D} on the ramification indices as multisets on three partitions of N . For each degree sequence, we compute all possible monodromy groups $G = \text{im} [\pi_1(\mathbb{P}^1(\mathbb{C}) - \{0, 1, \infty\}) \rightarrow S_N]$; they are the “Galois closure” of the group of automorphisms of the graph. Finally, for each possible monodromy group, we compute explicit curve $E : y^2 = x^3 + Ax + B$. We will discuss some of the challenges of determining the structure of these groups, and present visualizations of group action on the torus.

This work is a part of PRiME (Purdue Research in Mathematics Experience) with Gabriel Ngwe, Caitlin Leinkaemper, Dionel Jaime, Ivan Gonzalez, and Baiming Qiao with assistance by Mark Pengitore.

Johnny Guzman (Brown University) *Some Numerical Methods for Steady State Interface Problems*

We discuss several numerical methods for simple interface problems. We show the basic principles in deriving finite element methods with high accuracy and that are stable with respect to physical constants. Numerical experiments are provided illustrating the effectiveness of the numerical methods.

Monica Jackson (American University) *Correlation Induced by Missing Spatial Covariates*

Residual spatial correlation in linear models of environmental data is often attributed to spatial patterns in related covariates omitted from the fitted model. We connect the nonunique decomposition of error in geostatistical models into trend and covariance components to the similarly non-unique decomposition of mixed models into fixed and random effects. We specify spatial correlation induced by missing spatial covariates as a function of the strength of association and (spatial) covariation of the missing covariates. The connection with variance components models provides insight into estimation procedures.

Overtoun Jenda (Auburn University) *Generalized Baer's Criterion*

In 1940, Baer proved that an R -module M is injective if and only if any homomorphism from an ideal to M can be extended to a homomorphism from the ring R to the module M . One can check that the following are equivalent,

1. M is an injective R -module
2. $\text{Ext}_R^i(N, M) = 0$ for all modules N and for all i .
3. $\text{Ext}_R^1(R/I, M) = 0$ for all ideals I of R .

In relative homological algebra, we define an analogous notion which is called a *Gorenstein Injective* module. Suppose R is n -Gorenstein (that is a ring with $\text{inj dim}(R) \leq n$), then M is called a Gorenstein injective module if there exists an exact sequence,

$$E_n \rightarrow E_{n-1} \rightarrow \cdots \rightarrow E_0 \rightarrow M \rightarrow 0$$

where each E_i is injective and the sequence is $\text{Hom}(E, -)$ exact for any choice of injective module E . It is not difficult to see that then every injective module is Gorenstein injective. Our goal has been to find a similar criterion to that of Baer's for the Gorenstein injectives. Our starting point was to look at a simple case where R is a local, Gorenstein ring where $\text{dim } R = 1$. Then we proved that M is Gorenstein injective if and only if $\text{Ext}_R^1(R/\langle r \rangle, M) = 0$ for all R -regular elements r . We want to generalize this result to n -dimensional Gorenstein rings.

Carolyn B. Morgan (MECK Limited LLC) *Statistical Research - Industrial, Governmental and Academic*

Statistics is an all-encompassing discipline. During her professional career, the author has conducted statistical research directed at a large number of real-world applications in governmental, industrial and academic settings. In this talk she will explore the extraordinary power of mathematical and statistical methods to address problems ranging from product reliability to biomedical engineering research as it relates to anterior cruciate ligament (ACL) injuries. Additionally, she will highlight how the use of the Weibull distribution and principal component analysis statistical methods were used in her research. The discussion will also emphasize the importance of interdisciplinary teams

of mathematicians, statisticians, engineers and computer scientists to solving these and other challenging technical problems.

Jose Perea (Michigan State University) *The Shape of Data*

Topology, and particularly algebraic topology, has been used for decades to study the shape of mathematical objects – from surfaces to categories and spaces of functions. Recently some of these same ideas have been adapted to the study of data. I will show in this talk how one can use algebraic topology to probe the shape of data, and provide some examples of applications to computer vision and biology.

De Witt Sumners (Florida State University) *The Work of Mariel Vazquez*

Mariel Vazquez epitomizes excellence in research, teaching and service at the interface between mathematics and biology. Mariel is strongly motivated by the biological importance of her research, and has enjoyed great success in her collaborations with experimental scientists. She is a world leader in a generation of mathematical scientists with outstanding theoretical and computational skills, matched by success in experimental research in a molecular biology laboratory. It will be a great pleasure for me to outline some of the achievements in her amazing career.

Cristina Villalobos (The University of Texas-Rio Grande Valley) *Becoming Agents of Change: Building Diverse Communities and Lessons Learned from the Mathematical Modeling of Eye Disease*

The mathematical modeling of the photoreceptor interactions in the presence of retinitis pigmentosa will be presented and discussed in this talk. Retinitis pigmentosa is an eye-disease that affects approximately 1 in 4000 individuals and can lead to blindness. Currently, there is no treatment to halt the degeneration of the photoreceptors. However, the discovery of the RdCVF protein has shed light to possible therapies to slow the degeneration. Existence of an optimal control along with numerical results will be presented that show the experimentally observed rescue effect that RdCVF has on the cones. Based on some of the lessons learned from the mathematical model, the speaker will transition and discuss her invitation to students and faculty to become agents of change in their own communities. With that purpose in mind, the presenter will share her own career path to her present position and her efforts in becoming an agent of change in mentoring faculty and students which has led to the creation of a Center of Excellence in STEM Education that has allowed her to inspire and to help Latino students to enroll and obtain PhD degrees.

Abdul-Aziz Yakubu (Howard University) *Mathematical Models of Malaria with Applications to Mali and USA*

In this talk, we will introduce a deterministic malaria model for determining the drug administration protocol that leads to the smallest first malaria episodes during the wet season. To explore the effects of administering the malaria drug on different days during the wet season while minimizing the

potential harmful effects of drug overdose, we will define 40 drug administration protocols. Our results fit well with the clinical studies of Coulibaly *et al.* at a site in Mali. In addition, we will provide protocols that lead to smaller number of first malaria episodes during the wet season than the protocol of Coulibaly *et al.* In the second part of the talk, we will use our malaria model to “capture” the 2016 Centers for Disease Control and Prevention (CDC) reported data on the 2013 number of imported malaria cases in the US. Furthermore, we will use our “fitted” malaria models for the top 20 countries of malaria acquisition by US residents to study the impact of protecting US residents from malaria infection when they travel to malaria endemic areas, the impact of protecting residents of malaria endemic regions from mosquito bites and the impact of killing mosquitoes in those endemic areas on the 2016 CDC malaria surveillance data.

Blackwell-Tapia Prize Winner Lecture

Mariel Vazquez

University of California, Davis

Using Topology, Geometry and Computer Simulations to Understand the Molecule of Life

DNA topology addresses changes in topology and geometry of DNA molecules. For the last 25 years we have studied the topological mechanism of DNA-binding enzymes and the effects of DNA packaging in highly confined environments. We use knot theory to describe the different topological forms adopted by circular DNA. The unique geometry involved in a DNA binding reaction is entrapped in a 2-string tangle and its effect on the topology of the substrate DNA is investigated using tangle calculus. Tools from low-dimensional topology are helpful to characterize the tangles involved in the reaction. We also use computer simulations and visualization tools to determine enzymatic pathways of topology simplification and assign relative probabilities to help discriminate between them. In this talk I will give an overview of the methods used in our group.

Poster Abstracts

1. **Sarder Mohammed Asaduzzaman (University of Victoria) *The Coexistence or Replacement of Two Subtypes of Influenza***

A pandemic subtype of influenza A sometimes replaces (e.g., in 1918, 1957, 1968) the previous seasonal subtype. However, the reintroduced subtype H1N1 in 1977 has been co-circulating with H3N2 since then. To understand these alternatives, we formulate a hybrid model for the dynamics of influenza A epidemics. Our model takes into account the cross-immunity between seasonal strains and the cross-immunity between seasonal and pandemic subtypes. A combination of theoretical and numerical analyses shows that for very strong cross-immunity between seasonal and pandemic subtypes, the pandemic cannot invade, whereas for strong and weak cross-immunity there is coexistence, and for intermediate levels of cross-immunity the pandemic may replace the seasonal subtype.

2. Ghanshayam Bhatt (Tennessee State University) *Incoherent Matrices for Compressed Sensing*
3. Ariel Cintron-Arias (East Tennessee State University) *Post-Secondary Enrollment: model Validation and Student Life Tables*
4. Moussa Doumbia (Howard University) *Malaria Incidence and Anopheles Mosquito Density in Irrigated and Adjacent Non-Irrigated Villages of Niono in Mali*
 In this poster, we extend the mathematical model framework of Dembele et al. (2009), and use it to study malaria disease transmission dynamics and control in irrigated and non-irrigated villages of Niono in Mali. In case studies, we use our “fitted” models to show that in support of the survey studies of Dolo et al., the female mosquito density in irrigated villages of Niono is much higher than that of the adjacent non-irrigated villages. Many parasitological surveys have observed higher incidence of malaria in non-irrigated villages than in adjacent irrigated areas. Our “fitted” models support these observations. That is, there are more malaria cases in non-irrigated areas than the adjacent irrigated villages of Niono. As in Citinis et al., we use the sensitivity analysis on R_0 to study the impact of the model parameters on malaria control in both irrigated and non-irrigated villages of Niono.
5. Kossi Edoh (North Carolina A&T University) *Encryption Schemes for Cloud Data Security*
 The emergence of cloud computing and its increasing demand in recent years incentivizes the need to study cloud data security. New cryptographic tools are needed to provide security for cloud data because of the complexity. The project analyzes cutting edge topics such as homomorphic encryption, functional encryption, multi-party computation, verifiable computation, and secure scientific computing in providing cloud data security.
6. Michelle Guinn (Belmont University) *Image Processing and Interpolations*
 The objective of my research is to design an algorithm to enhance stereoscopic imagery so that it adapts to the viewing distance of the observer, with seamless transitions among stereo and hyperstereo levels. The algorithm will use image smoothing, blending edge detection techniques to provide this enhancement.
7. David Kotval (University of Tennessee - Chattanooga) *Optimal Design of the Spectrum of a Sturm-Liouville Problem with the Spectral Parameter Appearing in the Boundary Conditions*
 Optimal forms are of great interest to many applications in engineering. This poster investigates the optimal form, with respect to cross-sectional area, of a rod of given mass such that it most efficiently resists destructive mechanical resonance. To carry out the optimization, we use the calculus of variations to maximize the principle eigenvalue of the corresponding the SturmLiouville problem with generalized boundary conditions that contain the spectral parameter.

8. **Andrew Marchese and Vasileios Maroulas (University of Tennessee - Knoxville) *Signal Classification with a Point Process Distance on the Space of Persistence Diagrams***
We consider the problem of signal classification. Through the use of delay-embedding and persistent homology, the signal classification problem is transformed into a persistence diagram classification problem. We propose a new distance on the space of persistence diagrams and introduce a classification scheme utilizing it. This distance takes into consideration the different cardinalities among persistence diagrams. Classification using this distance is benchmarked in both synthetic data and real acoustic signals, and outperforms current signal classification techniques. The work is joint with V. Maroulas.
9. **Reginald McGee (Mathematical Biosciences Institute) *Uncovering Functional Relationships in Leukemia***
Mass cytometers can record tens of features for millions of cells in a sample, and in particular, for leukemic cells. Many methods consider how to cluster or identify populations of phenotypically similar cells within cytometry data, but there has yet to be a connection between cell activity and other features and these groups or clusters. We use differential geometric ideas to consider how cell cycle and signaling features vary as a function of the cell populations. This consideration leads to a better understanding of the nonlinear relationships that exist in the cytometry data.
10. **Francis Patricia Medina (Worcester Polytechnic Institute) *Hybrid Modeling and Analysis of Multicomponent Adsorption with Applications to Coalbed Methane***
We consider non-standard models of multi-component adsorption with applications to gas adsorption processes in coalbeds. In particular we follow thermodynamically consistent approaches, both at macroscale, via the Ideal Adsorbate Solution (IAS) theory, as well as at the pore-scale. The models we consider do not have a simple algebraic form, and therefore their analyses and numerical simulation have challenges. We present several mathematical analysis results and numerical solutions to illustrate the issues
11. **Josh Mike and Vasileios Maroulas (University of Tennessee - Knoxville) *Combinatorial Hodge Theory for Equitable Kidney Paired Donation***
The problem of Kidney Paired Donation (KPD) has traditionally been approached within an integer programming framework. Here we adopt computational topology methods to find kidney exchange cycles. Employing Hodge theory, we decompose the edge flow describing the KPD pool into three parts. The curl portion of the flow represents local cycles and is trivial here. The gradient portion creates a scoring that we use to measure inequity in the kidney exchange. This scoring measures typical cases of disparity within a KPD pool, specifically that under demanded pairs and highly sensitized patients have lower scores than typical patient-donor pairs. The last portion of the decomposition is used to guide our search for kidney exchange cycles by capturing the 1-cohomology of the kidney exchange graph and investigating the tendency of the donations to occur in cycles. Further results demonstrate that PD pair score and the chance to obtain a kidney are positively correlated when using top

trading cycles and chains; in contrast, we show that our method eliminates disparity in a KPD pool, i.e. the chance to obtain a kidney through our method is independent of score. The work is joint with V. Maroulas.

12. Jami Mulgave (North Carolina State University) *Bayesian Inference in Nonparanormal Graphical Models*

13. Cheryl Murphy (Michigan State University) *Using Individual-Based Models to Combat Math Phobia in Undergraduate and Graduate Students*

14. Germaine Kamleu Ndouma (University of the Western Cape), Loma Holtman (University of the Western Cape), and Bingwen Yan (Cape Peninsula University of Technology) *Analytical Model for Assessing the Knowledge of Statistical Procedure Amongst Postgraduate Students in Western Cape Institutions*

Over the past decades, university students experienced considerable difficulties in applying the knowledge of statistical concepts that they learned in their previous courses. In this study, we work with the South African Higher Education system. In this context, many strategies were developed to redress issues of reparation and social imbalances inherited from apartheid and to reconstruct a comprehensive educational quality framework. This study proposes an analytical model to assess the knowledge of statistical procedure amongst postgraduate students in academic research environment with the new Higher Education (HE) system. The results indicate that confusion and frustration characterised the attitude of students during the selection of suitable statistical test.

15. Kamaldeen Okuney and Abba B. Gumel (Arizone State University) *Analysis of a Temperature-and Rainfall-dependent Model for Malaria Transmission Dynamics*

A new non-autonomous model is designed and used to assess the impact of variability in temperature and rainfall on the transmission dynamics of malaria in a population. In addition to adding age-structure in the host population and the dynamics of immature malaria mosquitoes, a notable feature of the new model is that recovered individuals do not revert to wholly-susceptible class (that is, recovered individuals enjoy reduced susceptibility to new malaria infection). Detailed uncertainty and sensitivity analysis, using mean monthly temperature and rainfall data from KwaZulu-Natal province of South Africa, shows that the top three parameters of the model that have the most influence on the disease transmission dynamics are the mosquito carrying capacity, transmission probability per contact for susceptible mosquitoes and human recovery rate. Numerical simulations of the model show that, for the KwaZulu-Natal province, malaria burden increases with increasing mean monthly temperature and rainfall in the ranges $[17 - 25]^{\circ}\text{C}$ and $[32 - 110]$ mm), respectively (and decreases with decreasing mean monthly temperature and rainfall values). In particular, transmission is maximized for mean monthly temperature and rainfall in the ranges $[21 - 25]^{\circ}\text{C}$ and $[95 - 125]$ mm. This occurs for a six-month period in KwaZulu-Natal (hence, this study suggests that anti-malaria control efforts should be intensified during this period). It is

shown, for the fixed mean monthly temperature of KwaZulu-Natal, that malaria burden decreases whenever the amount of rainfall exceeds a certain threshold value.

16. **Robert Stolz (University of California - Davis), Reuben Brasher (Microsoft Corporation), Koya Shimokawa (University of Saitama), and Mariel Vazquez (University of California - Davis)** *Modeling Pathways of DNA Unlinking by Site-Specific Recombination*

In *Escherichia Coli*, replication of circular chromosomes yields topologically linked DNA molecules. Topo IV, one of the type-II topoisomerases in *E. coli*, plays a major role in the decatenation of the newly replicated chromosomes. It has been shown that in the absence of Topo IV, site-specific recombinases XerC/D, in cooperation with the translocase FtsK, can also unlink the replication links. The goal of this research is to explore the possible topological pathways of stepwise unlinking by XerCD-FtsK. We use computational methods to exhibit the recombination pathways and assign transition probabilities to each recombination step. Our results give strong support to the analytically identified minimal unlinking pathway.

17. **Yiyuan Wang (York University)** *The Impact of Stormwater Management Ponds on the Transmission of the West Nile Virus*

By investigating the data from larvae surveillance program launched by Toronto and Region Conservation Authority (TRCA), Canada, we establish a basic model to study the impact of Stormwater Management Ponds (SWMP) as well as weather factors on the mosquito abundance and transmission of West Nile virus (WNV). The numerical results show that moderate temperature, rainfall and aquatic intraspecific competition of mosquito development in the SWMP will increase the basic reproduction number, consequently the risk of WNV. We further develop an improved compartmental model and study the dynamics of the transmission, including the existence of a backward bifurcation of the model which allows to develop threshold conditions to evaluate the risk of human infection of WNV in one area. This is a joint work with Pons Wendy, Jessica Fang and Huaiping Zhu.

18. **Shawn Witte (University of California - Davis)** *Randomly Sampling Grid Diagram of Knots*

Appendix B

Findings of the 2014 Blackwell-Tapia Participants

The Blackwell-Tapia conference seeks to recognize and showcase mathematical excellence by minority researchers. All 99 participants who attended the 2014 Blackwell-Tapia conference were asked to complete a survey designed to understand longitudinal impacts of the conference. A total of 44 (44%) past participants completed the survey. Of these 44 respondents, 28 identified as faculty, 11 as graduate students, and 5 as postdocs as their professional status at the time of the conference.

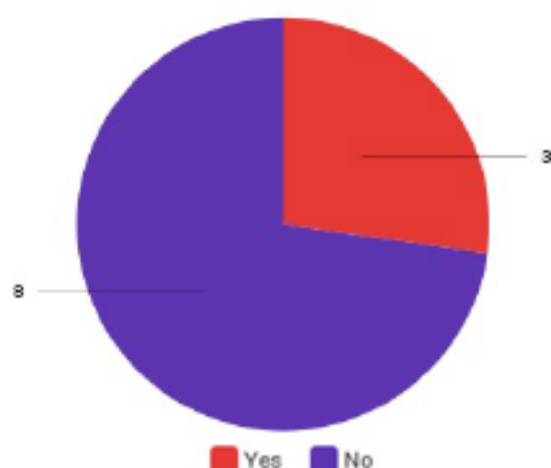
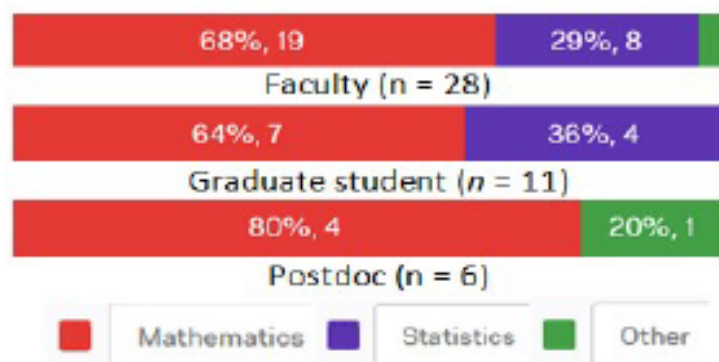


Figure (Above). Three of the 11 graduate student respondents completed the degree they were working towards (1 MS, 2 PhDs all completed in 2015).

Figure (Left) Other for faculty = mathematical physics. Other for postdoc = civil engineering.

Table. Frequency and percentage of respondent agreement with the following:

	Faculty		Non-faculty		Total	
	n	%	n	%	n	%
I have recommended the Blackwell-Tapia Conference to a colleague or student.	24	86%	13	87%	37	86%
I gained knowledge at the Blackwell-Tapia Conference that helped advance my career.	13	46%	10	67%	23	53%
The Blackwell-Tapia Conference influenced my career goals.	10	36%	12	80%	22	51%
The Blackwell-Tapia Conference was useful preparation for my career.	7	25%	11	73%	18	42%
The Blackwell-Tapia Conference introduced me to people who later became my mentor, advisor, employer or collaborators in research.	8	29%	7	47%	15	35%
The Blackwell-Tapia Conference influenced my research interests.	10	36%	5	33%	15	35%
I continue to collaborate with people I met at the Blackwell-Tapia Conference.	9	32%	2	13%	11	26%
The Blackwell-Tapia Conference led me to collaborate outside of my discipline.	3	11%	2	13%	5	12%

A high percentage of the graduate student and postdocs participants (non-faculty during the conference) indicated that attending the 2014 conference impacted their careers. Of these eight statements, participants agreed with a minimum of 1, median of 4 (IQR = 2) and maximum of 8.

Open-ended feedback for impact or influence of 2014 Blackwell-Tapia Conference had on participants' careers

Collaboration/Networking

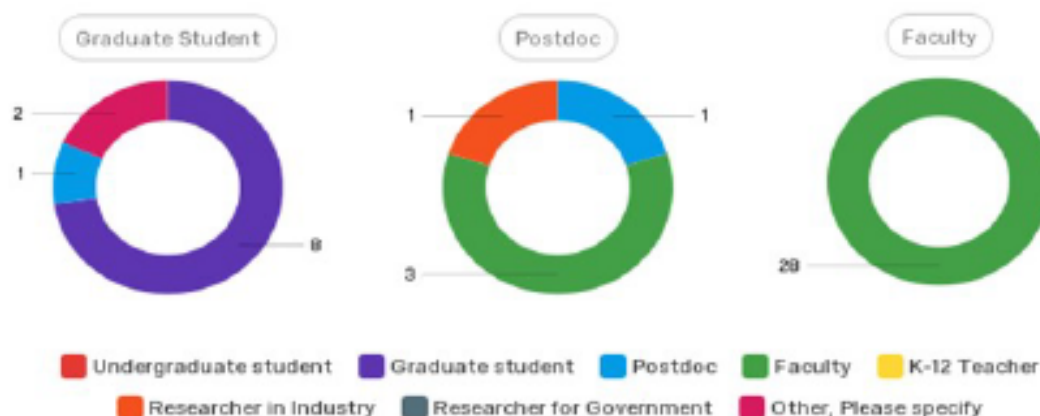
- Professional connections for possible future collaboration (but not currently).
- Networking with other researchers and learning about their research area.
- The networking opportunity
- Great conference for networking and helps to keep you motivated professionally
- I loved the conference. It was the first math conference that I attended after receiving my PhD. It's amazing that I understand the math that I heard every speaker speak about. I made some great contacts and I look to collaborate with a few people that I met there. I would love to attend again.
- It helped to increase my network, especially with people who genuinely care about my career.

Additional feedback

- It exposed me to luminaries in mathematics and allowed me to hear their stories.
- This was a place of motivation for me. Seeing how others were progressing successfully in their careers was something I needed at that time in my career as I was becoming unsure of my career choices.
- Enforcing the view that "mathematics" is a social activity ... in all aspects !

Diversity

- Connections to a more diverse group of students.
- Not the 2014 edition but an earlier one, (the last time it was UCLA IPAM) really introduced me to the idea that there were many minority mathematicians doing high quality research in applied mathematics, and encouraged me to try to do the same and to let my students know about them.
- Made me more aware of people of color in the field which is motivating. It made me proud of myself for being a Latino in STEM. It felt nice to recognize and be recognized for the strides that people are making for diversity in STEM at all levels.
- As a minority Ph.D in Mathematics, the largest impact this conference had on me was to put me in contact with role models and mentors who themselves came from diverse backgrounds and had successfully navigated the many pitfalls in academia. There's very few other ways to come in contact with minority researchers in Mathematics and as such I found this opportunity very valuable and enriching for my professional career.



One faculty participant indicated being awarded an NSF Career award since the conference.

92% of participants (34 of 36 who responded) indicated their current job is in a math-related field.

Figure. Participants' current professional status is compared to their professional status at the time of the conference. All faculty remained faculty. Three of the five post-docs are now faculty, one a researcher in industry, and one is continuing as a postdoc. Eight of the 11 graduate students are still graduate students, 1 is a postdoc, and 2 other responses include 'unemployed' and 'non-researcher in industry'.

Appendix C

2016 Qualitative Findings

What aspects of the conference did you like most?

The panel for graduate students and the research talks.

Learning more about the mathematical biology research.

research talks; awards dinner

Talk presentations

The variety of talks.

Presentation topics

The quality of the talks, the length of the event, and the location.

Speakers made an effort to communicate to all audience from different academic background

Number of talks

the talks were all 40 mins, only a few speakers, but all were excellent

The talks were very accessible to all fields and the speakers made an effort to also address the role of the conference and diversity issues in their talks.

The research talks.

The presentations were all excellent

Presentations

The research talks, and opportunities to network.

The presentations and the networking opportunities

Many opportunities were given for networking. I really enjoyed interacting with Johnny Guzman, Jose Perea, Federico Ardila and Cheryl Murphy, they gave great advice and inspiration! Also, Kelly was so nice and helpful from the beginning to the end. Thanks for the opportunity!

Some of the talks (especially Ardila and Perea) were excellent. I also liked the opportunities for networking.

The networking and open room speakers. The single speaking room brings everyone together (literally) from the get-go. This connection mixed with the message of the conference conveys a powerful message that were all in it together.

Meeting new people; poster session; banquet; the personal stories and the background provided by Dr. Tapia about the conference

Talks and opportunity for networking.

The talks and networking

I love the networking section, at lunch and dinner, also the talks

This is very hard to pick because I loved everything about the conference. I felt the size was perfect since it allowed for interaction with as many faculty and students as possible. I think the biggest take away for me was the networking and this was possible due to size of meeting and conference venue which was conducive to interaction between people.

Getting to meet a new crowd of researchers, all dedicated to diversity and representation in research at the highest levels.

Networking

Networking with participants

I enjoyed networking aspect of the conference.

The networking aspect

The opportunity to network with the diverse participants

The pre-banquet reception provided wonderful networking opportunities.

The networking lunch on Saturday

That the conference helps to link and build a bridges between Latin and African American mathematicians and others. I was able to reconnect with a Mexican mathematician that I had [not] seen in several years.

What aspects of the conference did you like most? Contd.

Its small size.

Small size. Nice banquet. Great accommodations.

Small environment to interact, it connected both biology with different areas of mathematics. It was a small number of attendees so I was able to talk to more people on a 1-1 basis. Enjoyed the short but profound speeches at dinner,

The organization was impeccable. I appreciated the support given to a large number of trainees and early career mathematicians to attend the conference. I liked the diversity of attendees: professors junior and senior, students and postdocs, many members of underrepresented groups, many female mathematicians. The attendance of NSF Math institute directors is important and I acknowledge the presence of some of them. The opportunities for networking were abundant and the size of the conference facilitated interaction, especially for young attendees. The award ceremony and banquet were very nice.

Positive supportive atmosphere

Time given to each speaker to speak. Hotel is so close to conference.

The food and snacks were really good and I liked that all of the sessions were in 1 room - making it easy to keep up. the panel for graduate students, doing Q&A was something I really needed and I appreciate the honesty and "realness" that the panel provided. I think that is what I needed to push through my PhD program

The presentation of Prof Carolyn Morgan was the backbone, all advis[ing given] by Prof Richard Tapia were so relevant and deep during award presentation.

Dr. Tapia speech at banquet

What aspects of the conference did you like least?

None except it started on thursday

Long day on Saturday

Banquet should be on Friday

It felt a bit rushed.

Not sticking to schedule

There were too little breaks to talk to people. However, I think for the time constrains they were very well managed.

The talks were a bit too technical for a broad audience and it would have been nice if selected speakers could have provided more of a 'big picture' overview of their work and how it fits into their field.

I was surprised by the relatively low attendance, as the talks were definitely accessible to a wider audience. On a different note, the food on Sat. Lunch was much better than the food at the banquet on Sat. night. I suppose this is very venue-dependent, though.

The Table set ups for the lunch network session - there were too many options and some tables had few people

I enjoyed the networking lunch but I think it would have helped the main table participant to have a list of questions and directions.

Lunch served

The lack of snacks :)

Coffee breaks Banquet catering: the food was good, and the waiters were polite, but in their efficiency they took away my drink, my desert, and coffee without asking. I was not the only one with this experience.

The coffee

Invited talks among the circle of Blackwell, Tapia and Carlos.

Few talks were not that stellar.

Leak of diversity in talks, needs more pure math talks

Tapia's talk about discrimination while he was discriminating the Asian culture himself, e.g. "they sit this side and they don't laugh with my jokes".

I wish I would have met more statistics people, I met a lot of math people which I loved, but I also would have liked to learn more about the "lay of the land" with respect to statistics

Poster session. There was nothing that motivated me to see the posters.

Not all the senior researchers got to see my poster.

I think the poster session was not at the same level as the remainder of the conference.

The poster session

Perhaps a little more time between talks, more breaks for networking

Projector screen visualization -very poor at the beginning

Freezing cold lecture room the first day

Cold in the conference room!

Difficult getting to Knoxville.

Please tell us what impact your participation in the conference may have on your career?

I am currently looking for a postdoc or a faculty position. Through the conference I have obtained valuable contacts - those contacts may or may not help me achieve a desired academic position, but they will certainly be someone I will try to collaborate with.

It is always useful to expand my network of colleagues.

new collaborators hopefully

I met many colleagues at the conference. I got new connections that might lead to potential collaborations.

I made many connections that I hope will lead to future collaborations.

I developed new collaborations and this is likely to impact me in the form of new research. Eventually this leads to more publications, future conference presentations and many other opportunities.

connecting with new network

Networking with prolific professors and the possibility of research collaboration.

I gained another perspective on an academic career. I saw many minorities who role models. That gave me more hope in the sense that it made me realize that probably I would be able to continue my growth as a mathematician. I met a professor that geographically is close to my university with whom I can have potential collaboration. It was such a positive environment. The speakers and organizers were really encouraging. This could make my job search process smoother as I feel I have more people to ask for advice.

I was able to identify individuals doing research in areas applicable to mathematical biology.

I am sure that I will get a publication soon as a result of this conference. I met someone that does research in a similar area as me.

I'm old - main impact will be on new connections and people I may be able to provide advice to in the future

Learned some new mathematical tools that may be useful

Kept me up-to-date with research in certain areas.

Learn more about NIMBioS and current topics in BioMath

It will influence the understand of ties between mathematics and biology. (I want to be a nurse)

I learned about Project Next during the panel and plan to apply for this program.

I heard advise that I needed to be able to refocus on my work and plan ahead for the future.

I learned about a new area and may pursue it in the future for research.

I would rethink the way I present my research. I will keep my eyes open for connections between more pure areas of mathematics and biology

I returned re-energized.

Improve publication in progress

The conference helps me stay motivated in my research and career. I will try to bring more students to the next conference as there are excellent student role models who attend this conference

Gave insight and connections to research areas

Ideas, connections, and insight into future paths

It has made me more aware of issues facing underrepresented minorities in mathematics and of things I can do to address these issues.

Exposure to this conference has shown me that there is a venue where people care about championing diversity and lifting the disadvantaged up to equality. This encourages me to go "all in" when I have the opportunity to mentor such diverse students. It is also possible that I made one or more important connections for future collaboration.

I know that the work as researchers and advocates for diversity in STEM is far from done. I hope to support this mission throughout my life.

Please tell us what impact your participation in the conference may have on your career? Contd.

Learned new aspects of TDA, the masamu program, thought on new ways to help my students from African origin as well as URM.

I had been through what Dr. Tapia talked about concerning UC Berkeley. I will continue to hard to make a positive in the minority community in education

It will have a huge impact on my career and has served to renew my commitment to increasing representation of women and URM in mathematics.

Towards advising undergraduate advising. It brings plenty of ideas together.

After attending the conference, I am actually considering pursuing graduate school.

Positive impact on my career.

How can we improve the quality of the conference? Your suggestions are welcome.

The presentation room was not ideal, especially with the projector in the middle of the room rather than overhead; and the lighting was not very good. It was also difficult to hear people's questions - so perhaps a portable mic or a moderator who could repeat questions and facilitate the Q&A.

A tough call... I'm not sure how, but better advertisement could be provided; I found the page on NIMBioS to be relatively lackluster and hard to navigate. Overall, I think the main point is to hold onto the unique benefits and message of this conference. The impact of the message is further reaching than the conference itself: your attendees leave empowered to act.

Continue efforts to encourage participation by people doing research in diverse areas related to mathematics and statistics.

Please invite students from African universities. Thank you.

Award minorities outside the circle of Blackwell, Tapia and Carlos, and give them the opportunity to make presentations.

A small issue: getting the speakers to stick to the allotted time would have been nice.

I get that the talks are a very natural academic tradition, but they can be exhausting when dry. Slides of mathematical definitions and symbols can just be tiresome. Overall, however, it was an excellent conference and very well executed.

Perhaps have a couple of less technical sessions - ones more related to outreach/leadership

Include opportunities for senior faculty who may want to change the direction of their current research and/or start a new research program. Opportunities seem to be available to graduate students and early-career faculty, but not so for seasoned faculty.

Add round table discussion current topics: research and social.

organize a lunch moment for graduate students and professional together

Maybe a short session of student talks?

More chocolate and fruit juice

Longer poster session, with an emphasis to established researchers of the importance of providing feedback to trainees. Established researchers who are not speakers may also be interested in presenting a poster (as is common in bio communities). A reception with bar may encourage broader participation. Keep an emphasis on the scientific quality of the talks, and the speaker's ability to reach a broad audience.

Encourage conference participants to go to the poster session.

Longer (3days) - very much enjoyed it!

The second day was too long. The last talk was terrific, but a lot of people were starting to doze off.

More Networking, more mixing to introduce different people and groups

Keep the size the same. Length of talks with breaks was great.

You did a great job. Keep up!

I thought the entire conference was well organized and ran very smoothly.

It is hard to think about what to improve. I feel that the organizers and speakers treated everybody with so much respect and dignity. The hotel was comfortable and its location was very convenient. The food was good. Everything was very well organized.

I have no suggestions for improvements, the conference was perfect! Thank you for funding my conference travel!

Keep up the work.