IUB Innovation Conference

Thursday, April 6, 2017
Indiana Memorial Union, Frangipani Room
Bloomington, IN
LIGHTNING ROUND I

Cheng Kao
Hannah Block
David Landy
Richard Hardy
Matt Anderson
In partnership with
The Johnson Center for Innovation and Translational Research

Keith R. Davis, Ph.D.
Director
(812) 856-4805
keirdavi@indiana.edu

Bill Brizzard, PhD
Director of Technology Commercialization, IURTC
(812) 855-3597
bbrizzar@iu.edu

Johanna E. Salazar
Assistant Director
(812) 855-3133
jsalazar@indiana.edu
A tablet-based tool for accurate measurement of hand proprioception after stroke

Hannah J. Block, PhD
April 6, 2017

DEPARTMENT OF KINESIOLOGY
INDIANA UNIVERSITY
School of Public Health
Bloomington
Proprioception:
sense of position or movement

- The brain can’t plan movement without it.

- Impaired in many clinical populations.
  - Stroke, MS, Parkinson’s...

- Current clinical measurement techniques are poorly standardized, coarse, and subjective.
New tablet-based tool

- Tablet app with 3D-printed stand for accurate hand positioning.
- We recently validated in healthy adults, finding better
  - Test-retest and interrater reliability
  - Construct validity
  Than current clinical techniques.
Validating the tool in stroke survivors

Can the tool discriminate between the affected and unaffected side?

- Bias: 77% worse
- Sensitivity: 44% worse
Tablet tool more likely to detect difference between hands in patients after stroke.

40% of patients performed worse with their affected hand on the tablet test, but received the same clinical score on each hand.
Conclusions

• The tablet-based tool shows promise as a clinical measure of proprioception.
  - Portable, mostly automated, fast (2-3 min) and easy to apply.
  - Eliminates the subjectivity of current clinical methods.
  - Much lower in cost than equipment used in research labs.

• Manuscript on stroke data in prep.

Acknowledgments

• JCITR 2015 Translational Research Pilot Grant Program
• Dr. Crystal Massie, OTR, PhD (IUPUI)
• Jasmine Mirdamadi, Sydney Ryckman, Divya Udayan, Reid Wilson, Anna Lynch
A Novel and Rational Approach to the Development of an Attenuated Chikungunya Virus Vaccine
Arboviruses

- **Arthropod-borne viruses**
- **Multiple hosts**
- **Transmission strategy**
- **Necessary for maintenance**
- **Flaviviruses**
- **Bunyaviruses**
- **Alphaviruses**
Most of the world’s population is at risk ≥ 1 alphavirus
>1.9 million cases in 45 countries/territories throughout the Americas since beginning of 2014

Chikungunya virus transmission
Chikungunya virus

Aedes spp.

Primates

80% of infections result in clinical disease
Polyarthritis, fever, rash
Joint pain is frequently severe
Symptoms frequently persist for months
Instances of neurological and cardiac symptoms
Significant economic impact for regions with high disease burden

Recovery results in life-long immunity
The Alphavirus Replication Cycle

- Receptor Mediated Endocytosis & Particle Entry
- Nucleocapsid Release / Disassembly
- Viral Gene Expression & RNA Synthesis
- Nucleocapsid / Particle Assembly
We decided to target processes involving capsid interaction with RNA.
Identification of CHIKV Capsid:RNA (C:R) Interaction Sites

Crosslinking in infected cells

CLIP-Seq using anti-capsid antibody
Generation of C:R mutations

**CHIKV**

nt3400: 3403-3445
5’-TTTACAAAAGGAAAGTGGAAACATCAACAAGCAGATCTGGTGACT-3’
5’-TTCCACGACGACCAATTGGAATATATAAATAAATAACAAATATGTGTGACA-3’

nt6900: 6962-6986
5’-TTCTACTACTTCTGTTTCTCAACACG-3’
5’-TTTCAGCTCCTTGTAAATACT-3’

nt9900: 9894-9940
5’-CTGATTTGTCCCTATGCAACTGTCTGAGACTCTTACCATGCTTTTGT-3’
5’-CTCACTGCTCCTATTCTGCTCCACGGTATTGCCCTGGTTTCCTGC-3’
Phenotypic changes associated with C:R mutations

CHIKV.WT  CHIKV.nt3400  CHIKV.nt6900  CHIKV.nt9900

Plaque morphology

WT  3400  6900  9900
RNA synthesis and protein synthesis are not compromised in mutants.

Particle and therefore antigen production remains high but particles produced are not infectious.
The Alphavirus Replication Cycle

Receptor Mediated Endocytosis & Particle Entry

Nucleocapsid Release / Disassembly

Viral Gene Expression & RNA Synthesis

Nucleocapsid / Particle Assembly

Replication defect in mutant viruses is early in infection and results in decreased genome stability
C:R mutants stimulate type-I interferon response.
Mutation of the C:R sites results in enhanced interferon response and decrease in pathogenicity.
Model for attenuation

Nucleocapsid Disassembly → Genomic RNA C:R Interaction → Efficient Genomic RNA Function / Translation → Increased Viral Growth Kinetics, Reduced IFN Induction, Increased Virulence

Nucleocapsid Disassembly → Ablated C:R Interaction → Inefficient Genomic RNA Function / Instability → Decreased Viral Growth Kinetics, Increased IFN Induction, Decreased Virulence
Desirable characteristics for vaccine

- High particle (antigen) production
- Attenuation of infection
- Decreased pathogenicity
- Increased stimulation of innate immune response

Protective?
Indiana University

Hardy Lab:
   Kevin Sokoloski (U. Louisville)
   Lauren Nease
   Natasha Gebhart

Center for Genomics and Bioinformatics:
   James Ford

Funding

Johnson Center for Innovation & Translational Research Pilot Grant

NIH/NIAID  R21 AI121450

University of Colorado, Denver

   Tem Morrison
   Nicholas May
## The Challenge

- The many 2-D and 3-D face recognition solutions that exist that are easily tricked by makeup and sunglasses.
- In industrial face recognition applications on large groups of people, faces frequently occlude one another giving conventional techniques a high false-negative rate.
- For security applications, the most important metric is the false-negative rate, ensuring that specific flagged individuals will almost never be misidentified.
- Achieving a low false-negative rate in face recognition with partially occluded faces requires 3-D face recognition and high performance computing resources.

## Target Application Usages

- Private security applications requiring false negative rates of <0.001
  - casinos
  - subways
  - high profile tourist locations
  - Malls
  - airports
- Government security applications requiring false negative rates of < 0.000001
  - Law enforcement booking data acquisition
  - Human trafficking data acquisition

## The Solution

- A Novel 3-D Point Cloud Extraction Algorithm using High Performance Computing for Photogrammetry
- Novel Middleware and Technology for driving hundreds of DSLR’s and light field cameras simultaneously
- A new high Performance computing algorithm for implicit surface generation of faces with smooth derivatives that interpolates face point clouds in under 10 seconds on a small beowulf cluster.

## Solution Dataflow

- An array of off-the-shelf DSLR’s captures an image. The array configuration is site specific.
- A 3-D point cloud is extracted from the multiple images using a proprietary high performance computing algorithm developed at CREST.
- The 3-D point cloud is interpolated using radial basis function interpolation to produce an analytic implicit function of the face in the form of \( f(x,y,z) = 0 \) that is easily stored and accurately reproduces smooth derivatives on the face, even if partially occluded.
- Includes expression independent elements (i.e. nose derivatives)
Maps & Macroscopes: Envisioning Science, Technology, and Education

Katy Börner

Victor H. Yngve Distinguished Professor of Intelligent Systems Engineering & Information Science
Director, Cyberinfrastructure for Network Science Center
School of Informatics and Computing
Indiana University Network Science Institute
Indiana University, USA

Third Annual Innovation Conference by JCITR
Memorial Union, Indiana University, Bloomington
Thursday, April 6, 2017
EARTH
FROM ABOVE
Yann Arthus-Bertrand
How can we communicate the beauty, structure, and dynamics of science to a general audience?
The Structure of Science

The Social Sciences are the smallest and most diffuse of all the sciences. Psychology serves as the link between Medical Sciences (Psychiatry) and the Social Sciences. Statistics serves as the link with Computer Science and Mathematics.

Mathematics is our starting point, the purest of all sciences. It lies at the outer edge of the map. Computer Science, Electrical Engineering, and Physics are applied sciences that draw upon knowledge in Mathematics and Physics. These three disciplines provide a good example of a linear progression from pure science (Mathematics) to another (Physics) through multiple disciplines. Although applied, these disciplines are highly distinct with bands of research communities that link them. Bands indicate interdisciplinary research.

Research is highly concentrated in Physics and Chemistry. There are distinct, highly distinct, bands of research communities that link them. The boundaries of these bands indicate an extensive amount of interdisciplinary research, which suggests that the boundaries between physics and chemistry are not as distinct as one might assume.

The Life Sciences, including Biology and Biochemistry, are less concentrated than Chemistry or Physics. Bands of linking research can be seen between the larger areas in the Life Sciences. For instance, the area between Biology and Microbiology, and between Biology and Environmental Science. Bioinformatics is very interesting in that it is a large discipline that has visible links to disciplines in many areas of the map, including Biology, Chemistry, Neurobiology, and General Medicine. It is perhaps the most interdisciplinary of the sciences.

We are all familiar with traditional maps that show the relationships between countries, provinces, states, and cities. Similar relationships exist between the various disciplines and research topics in science. This allows us to map the structure of science.

One of the first maps of science was developed at the Institute for Scientific Information over 50 years ago. It identified 41 areas of science from the citation patterns in 17,000 scientific papers.

That early map was intriguing, but it didn't cover enough of science to adequately define its structure.

Things are different today. We have enormous computing power and advanced visualization software that make mapping of the structure of science possible. This galaxy-like map of science (left) was generated at Seidell National Laboratories using an advanced graph layout routine (Voro) from the citation patterns in 800,000 scientific papers published in 2002. Each dot in the galaxy represents one of the 96,000 research communities active in science in 2002. A research community is a group of papers (on average) that are written on the same research topic in a given year. Over time, communities can be born, continue, split, merge, or die.

The map of science can be used as a tool for science strategy. This is the terrain in which organizations and institutions locate their scientific capabilities. Additional information about the scientific and economic impact of each research community allows policy makers to decide which areas to explore, expand, diminish, or ignore.

We also envision the map as an educational tool. For children, the theoretical relationship between areas of science can be explored with a more concrete map showing how math, physics, chemistry, biology, and social sciences interact. For advanced students, areas of interest can be located and neighboring areas can be explored.

Nanotechnology
Most research communities in nanotechnology are concentrated in Physical Chemistry and Nanoscience. However, many disciplines in the Life and Medical Sciences also have nanotechnology applications.

Proteomics
Research communities in proteomics are centered in Biochemistry. In addition, there is a heavy focus in the tools section of chemistry, such as Chromatography. The balance of the proteomics communities are widely dispersed among the Life and Medical Sciences.

Pharmacogenomics
Pharmacogenomics is a relatively new field, with much of its activity in Medicine. It also has many communities in the Life Sciences and two communities in the Social Sciences.
Debut of 5th Iteration of the Mapping Science Exhibit at MEDIA X in 2009 at Wallenberg Hall, Stanford University.
Science Maps in “Expedition Zukunft” science train visited 62 cities in 7 months. Opening on April 23rd, 2009 by German Chancellor Merkel
Ingo Gunther's Worldprocessor globe design on display at the Museum of Emerging Science and Innovation in Tokyo, Japan.
Places & Spaces Digital Display in North Carolina State’s Immersion Theater
Exhibit Advisors and Ambassadors
Places & Spaces at Northwestern University
May 14 - September 23, 2015

Kristi Holmes @kristiholmes · Apr 30
Excited for @cnscnter Places&Spaces at @galterlibrary! @katycns @NUCATSInstitute #unpackingcrates #viz
Places & Spaces Exhibit at the David J. Sencer CDC Museum, Atlanta, GA

CDC Opening Event: Maps of Health
Tutorial and Symposium
February 4-5, 2016
Places & Spaces Exhibit at Vanderbilt University, Nashville, TN.
January 23-April 23, 2017  http://scimaps.org/vanderbilt
10 iterations over 10 years

equal

$10 \times 10 = 100$ maps!
Maps that show STRUCTURE

scimaps.org
A New Map of the Whole World with Trade Winds According to the Latest and Most Exact Observations - Herman Moll - 1736
In Terms of Geography - Andre Skupin - 2005
Maps that show FLOWS

scimaps.org
Impact of Air Travel on Global Spread of Infectious Diseases - Vittoria Colizza, Alessandro Vespignani - 2007

Epidemic spreading pattern changed dramatically after the development of modern transportation systems.

The SARS outbreak on the other hand was characterized by a patchy and heterogeneous spatio-temporal pattern, mainly due to the air transportation network identified as the major channel of epidemic diffusion and ability to connect far apart regions in a short time period. The SARS maps are obtained with a data-driven stochastic computational model aimed at the study of the SARS epidemic pattern and analysis of the accuracy of the model's predictions. Simulation results describe a spatio-temporal evolution of the disease (color coded countries) in agreement with the historical data. Analysis on the robustness of the model's forecasts leads to the emergence and identification of epidemic pathways as the most probable routes of propagation of the disease. Only few preferential channels are selected (arrows) which indicates the probability of propagation along that path out of the huge number of possible paths the infection could take by following the complex nature of airline connections (light grey, source: IATA).

The central map represents the cumulative number of cases in the world after the first year from the start of a pandemic influenza with $R_0 = 1.9$ originating in Hanoi (Vietnam) in the Spring.

The US maps focus on the situation in the US after one year, and show the effect of changes in the original scenario analyzed. Different color coding is used for the sake of visualization.

Forecasts of the Next Pandemic Influenza

Seasonal

Geographical

Chicaco

Bucharest

Reproductive Number ($R_0$)

Intervention

UNCOOPERATIVE

COOPERATIVE

Impact of Air Travel on Global Spread of Infectious Diseases - Vittoria Colizza, Alessandro Vespignani - 2007
This map is designed to show the interconnected ‘trails of thought’ in a computer science thesis.

*“A. M. Nesbitt” Computing Multidisciplinary: Design for Abstract Data maps

Thesis, University of Sydney, Sydney, Australia 2003

Ph.D. Thesis Map - Keith B. Nesbitt - 2004
Tracing of Key Events in the Development of the Video Tape Recorder - Mr. G. Benn, Francis Narin - 1968
Maps that show TRENDS
Pulse of the Nation: U.S. Mood Variations Inferred From Twitter

Mood Variations
A number of interesting trends can be observed in the data. A few overall daily variations can be seen from the graph and include the early morning and late evening highest levels of happiness. Second, geographic variations can be observed, with west coasts being more blue, and east coast happier.

Weekly Variations
Weekly trends can be observed as well, with weekdays being more blue than weekends.

About the Data and Visualization
The postings were collected using a Twitter search tool. The data taken from the U.S. Census Bureau data taken from the U.S. Census Bureau. The U.S. map was taken from Wonders of Geography.

About Cartograms
A cartogram is a map in which the masses are transferred to the final area. As such, the number of tweets is distributed as the final area. Thus, the accuracy of the actual map is altered to the shape of cartography. The number of tweets is maintained as much as possible, but the area is scaled so as to be proportional to the number of tweets that include or exclude.

Northeastern University
College of Computer and Information Science
Center for Complex Network Research
http://www.cs.northeastern.edu/alan/alan.p/create/mood

Harvard University

Pulse of the Nation - Alan Mislove, Sune Lehmann, Yong-Yeol Ahn, Jukka-Pekka Onnela, and James Niels Rosenquist - 2010
The EMERGENCE of NANOTECHNOLOGY

MAPPING THE NANO REVOLUTION
The emergence of nanotechnology has been one of the major scientific-technical revolutions in the last decade and it led to a structural reorganization of major fields of science. Price (1965) showed that fields of science and their development can be mapped using aggregated citations among the journals in the fields and their relevant environments. The frames to the right show the evolving journal-citation network for the years 1998-2003. Distances are proportional to cosine values between the citation patterns of the respective journals. Textual descriptions of key events during the development of Nanotechnology are given below each frame. Note notably, leading papers in Science and Nature catalyzed the breakthrough around 2000.

CHANGING ROLES OF DIFFERENT JOURNALS
The disciplinarity of a journal can be measured using betweenness centrality (BC). Journals that score on many shortest paths between other journals in a network have higher BC value than those that do not. In the map, sizes of nodes are proportional to the betweenness centrality of the respective journal in the citation network.

From being a specialist journal in applied physics, the journal Nanotechnology obtains a high BC value in the years of the transition, ca. 2001. This is preceded by the "intervention" of Science. After the transition, the new field of nanotechnology is established, new journals such as Nano Letters published by the influential American Chemical Society join the lead, and a new specialty structure with low BC value journals results.

LEGEND
Science Nature Nanotechnology Nano Letters

An animated sequence of this evolution is at: http://www.leydesdorff.net/journals/nanotech.

REFERENCES

MAPS

vs.

MACROSCOPES
Microscopes & Telescopes vs. MACROSCOPES
Iteration XI (2015): Macroscopes for Interacting with Science
http://scimaps.org/iteration/11
earth ≡

Earth – Cameron Beccario
AcademyScope – National Academy of the Sciences & CNS
The News Co-occurrence Globe
An interactive visualization of how countries are mentioned together in the world's news media

2.92K COOCCUR%

UNITED KINGDOM
cooccurrences in: 2,922%
cooccurrences out: 80%

Mapping Global Society – Kalev Leetaru
Iteration XII (2016): Macrosopes for Making Sense of Science
http://scimaps.org/iteration/12
Four new macrosopes debut at Vanderbilt University:

1. **Smelly Maps**: Features a “smellscape” of 12 cities mapped by smell using social media.
2. **HathiTrust**: Highlights the diversity of publications collected in digital form by HathiTrust.
3. **Excellence Networks**: Compares how research institutions, such as Indiana and Vanderbilt universities, collaborate with one another.
4. **FleetMon**: Shows how the amount of shipping traffic that navigates the Strait of Malacca compared to other major shipping lanes of the world.

[http://scimaps.org/vanderbilt](http://scimaps.org/vanderbilt)

Background and Goals

The Places & Spaces: Mapping Science exhibit is designed to open people’s hearts and minds to the value, complexity, and beauty of maps of science and technology.

Drawing from across cultures and across scholarly disciplines, the Places & Spaces: Mapping Science exhibit demonstrates the power of maps to address critical questions about the nature and value of scientific knowledge. Created by 38 (the Los Angeles County Museum of Art and the Public University of Munich) and 25 (the University of California, Berkeley), the exhibit is an exhibit to be in every museum, with an emphasis on digital and interactive exhibits. A visitor explores the macroscope kiosk at the Eskenazi Museum of Art at Indiana University.
Figure 1: Analysis types vs. user needs, taken from Emmons, Light, and Börner. "MOOC Visual Analytics: Empowering Teachers, Students, Researchers, and Developers of Massively Open Online Courses". Journal of the Association for Information Science and Technology (in press).
Students’ Countries

Legend

<table>
<thead>
<tr>
<th>Year</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>780</td>
<td>390</td>
</tr>
<tr>
<td>2014</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Top 5 Countries

<table>
<thead>
<tr>
<th>2013</th>
<th>U.S. (33.4%)</th>
<th>India (6.8%)</th>
<th>U.K. (4.6%)</th>
<th>Canada (3.7%)</th>
<th>Netherlands (3.5%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>U.S. (39.5%)</td>
<td>India (8.7%)</td>
<td>U.K. (5.1%)</td>
<td>Canada (3.3%)</td>
<td>Spain (2.7%)</td>
</tr>
</tbody>
</table>

253 students did not identify a country in 2013
110 students did not identify a country in 2014

Proportional symbol map of the world showing the location of IVMOOC students from 2013 (blue) and 2014 (orange). Circles are area size coded by the number of students per country.
Scores vs. time invested watching course videos for students who took the 2013 (blue) and 2014 (orange) IVMOOCC midterm (left) and final exam (right) and got at least 50% correct.
Exam Scores by Question

Student scores per question for midterm (left) and final exam (right) for IVMOOC 2014.
IVMOOC video views in 2013 (blue) and 2014 (orange)
Student Client Projects: All Interactions
Custom interactive visualizations of 2015 IVMOOC student engagement and performance data, explore functionality online at [http://goo.gl/TYixCn](http://goo.gl/TYixCn)

Interactive web site: [http://demo.cns.iu.edu/client/stem](http://demo.cns.iu.edu/client/stem)
Forecasting S&T

scimaps.org
Government, academic, and industry leaders discussed challenges and opportunities associated with using big data, visual analytics, and computational models in STI decision-making.

Conference slides, recordings, and report are available via http://modsti.cns.iu.edu/report
Upcoming Colloquia

Unless otherwise indicated, most Sackler colloquia are held at the Arnold and Mabel Beckman Center, in Irvine, California.

Reproducibility of Research: Issues and Proposed Remedies

March 8-10, 2017; Washington, D.C.
Organized by David B. Allison, Richard Shiffrin and Victoria Stodden
Registration now open

Science of Science Communication III

November 15-16, 2017; Washington, D.C.
Organized by Karen Cook, Baruch Fischhoff, Alan I. Leshner and Dietram A. Scheufele
Registration will open May 2017

Modelling and Visualizing Science and Technology Developments

December 4-5, 2017; Irvine, CA
Organized by Katy Börner, William Rouse and H. Eugene Stanley
Registration will open August 2017

http://www.nasonline.org/programs/sackler-colloquia/upcoming-colloquia


All papers, maps, tools, talks, press are linked from [http://cns.iu.edu](http://cns.iu.edu)

These slides are at [http://cns.iu.edu/presentations.html](http://cns.iu.edu/presentations.html)

CNS Facebook: [http://www.facebook.com/cnscenter](http://www.facebook.com/cnscenter)

Mapping Science Exhibit Facebook: [http://www.facebook.com/mappingscience](http://www.facebook.com/mappingscience)
The Virtual Reality of Evolving Biotech

Lee D. Arnold
Entrepreneur in Residence, Johnson Center for Innovation and Translational Research,
President & CEO, DiscoverElucidations, LLC
Virtual Companies and Teams

• Group of Individuals, Resources, and Contractors that work across time, space and organizational boundaries with links strengthened by webs of communication technology
  • With Internet, high-speed network, and long distance communication technologies we are no longer bound to a physical work location
  • Minimal development of infrastructure
Why do the Majority of New Biotechs Now Start Off as Highly Virtual Companies?

• Balance of speed & cost-effectiveness with quality & flexibility
  • Low overhead, minimal fixed costs
    • Reduced long-term capital commitment
    • Unencumbers scientists to focus on science rather than organizational issues
  • Nimble and flexible, utilizing your capital efficiently
    • More rapid launch & ability to maintain momentum from discovery through development
  • Timely access to most competent talent & experience around world that would be difficult to hire & relocate full time
    • Downsizing of Pharma research has created pools of experienced talent & expertise
    • Cost effective CROs brought online as efforts progress – only paying for capability when needed
    • CRO resources can readily be scaled up or down to adjust pace

Virtual companies offer cleaner exit strategies for VCs, pharma ...or shut down
Virtualization has become an expectation of investors funding start-ups
What Degree of Virtualization is Appropriate?

• **Fully Virtual companies** are most viable when they are discovering and developing drugs for an established molecular target
  - Familiar techniques, allowing outsourcing of most activities
  - “Fast-follower” approaches, “me too” drugs, biosimilars
• Most biotechs are built around unique know-how, bespoke biology, or technology
  - Patented intellectual property (IP) or trade secret combined with related scientific expertise
  - In-house staff exploit distinctive know-how for competitive advantage, differentiation
  - Often preference to keep generation of new IP internal for strategic, security, ownership reasons
• **Semi-virtual approach** - in-house scientific operations centered around your distinctive know-how while relying on external partners for the rest
  - Be very disciplined about defining which in-house know-how truly confers real strategic advantage
  - Every time you add a person in-house, there is a penalty in increased capital utilization and decreased flexibility that must be outweighed by the incremental benefits
“Internal” Team – The Most Important Resource

Competence, Character, Communication, Collaboration

- Well-seasoned R&D professionals that can design, and then manage, science at a distance
  - Complementary, Non-redundant skills
  - May need to wear several hats, avoiding recruits for niche roles
  - Ideally not in need of significant training in field
  - Self confident, proactive, independent, creative - High IQ & High EQ
- Strong individual contributors that have a collaborative spirit and can motivate through influence rather than direct reporting relationships
- All motivated by the same Common purpose with Interdependent performance goals
- High accessibility to teammates, management, advisors and CROs
- Comfort and Familiarity with teammates essential
“Internal Team” – The Most Important Resource

• Ideally, “Dream team” contributors who might not otherwise be able to work together due to time, travel, cost restrictions, cultures, languages

• Often full-time commitment NOT required – Some may be intermittent consulting roles

• Asynchronous Workday is now 24/7

• Effective Time-Management and Impeccable Work Ethic are critical
  • Availability versus task focus
  • Numerous potential Distractions
    • Home environment – Chores, children, pets, hobbies
    • Social media, Internet, Personal email
    • Other interests

• Goal-directed self discipline - encouraged by making them stake holders

• Rewarded by Quality of life
  • Often work from home office. Focus on science & discovery, not commuting, travel
  • Flexibility to time shift some tasks
  • Able to pursue other interests, semi-retirement
“Internal Team” – The Most Important Resource

“The entire team roll up their sleeves and regularly 'helicopter' from high-level strategy to the details of experimental design. Most scientists have been trained to trouble shoot experiments that they can touch and feel. The distributed model places the control of execution in the hands of others, often many time zones away and it takes a significant time commitment to manage these external relationships.”
Leadership in Virtual Biotech is Crucial

• Must combine pharma discovery and development expertise with management experience, scientific acumen and vision of future
  • “You need to have somebody who has a 30,000-foot view of the whole process of drug development ...to look at the next step and say, 'This is what I'm going to need in 18 months’”
  • Conventional leaders can watch what their team is doing, while a virtual team leader must rely on his team and the effectiveness of the planning and communication

• Guide Alignment of Goals, Priorities and Timelines with Tracking

• Effective and frequent Communication
  • Clearly defined direction, removing all ambiguity from the process, ensure nothing falls through the cracks
  • Employ empathetic listening skills, maintenance of confidences

• Timely feedback to individuals, team and CROs - often requires a Virtual “Open Door”

• Mastery of the technologies to be used to interact with the team
Leadership in Virtual Biotech is Crucial

The Seven Competences of an Effective Virtual Team Leader

- Organizational, Team-building & Interpersonal skills
  - Lead by example, establishing strong scientific and business ethics
  - Articulate very clear and specific performance, and behavior expectations
  - Enhance visibility of virtual members - Team members must feel valued, respected and rewarded
  - Bridge and appreciate diversity
  - Ensure cooperation, motivation, engagement, contribution
  - Establish good decision making processes
  - Employ good conflict management skills
  - Exploit Brainstorming opportunities using the collective

- Appropriate Delegation, Empowerment, Support and Training
  - Thorough understanding of the strengths and limitations of team, resources
  - Individual Members of the team should benefit from interactions with team
  - Create a culture of accountability
Virtual Biotech is enabled by Global CRO Ecosystem

- Largely responsible for speed, efficiency, flexibility and cost advantages of VB
- Pharma layoffs & spinouts produced new CROs filled with experienced scientists and top quality equipment provided wide range of R&D capability and expertise
- Communication tools have made cross-border collaboration much more feasible
- Much lower-cost geographies such as China and India offer high quality services with an improved user interface often with US trained scientists
  - Many Asian CROs establishing US-based teams to address limitations and IP concerns
- Many have internal experts that can refine experimental plans, or aid in interpretation, but this requires more complete disclosure
CRO Selection can be Key to Success ...or Failure

- Proven Competency and capacity to scale workforce and resources
- Range of services – Discovery, PK/ADMET through Process R&D & Manufacturing possible
- Quality of work and Compliance with standards
- Cost-effectiveness (including shipping, materials access, import costs)
- Timeliness, Responsiveness, & Benefits of Asynchronous workdays
- Referrals & Past Performance
- TRUST & Transparency
  - Facility visits/audits, review of internal practices, management, staff turnover
  - Local Team Leader and member selection/assessment
  - Security and accessibility of Labs and records, notebooks, documents, personnel
  - History of legal actions
  - Competing interests
  - Real-time access to status, data, eNotebooks, eRoom
Getting Started with CROs

• Initial Confidentiality agreement (CDA)
  • Often they may be servicing competitors!!

• Master service agreement (MSA) and associated Statement of Work (SOW)
  • Responsibilities & Expectations of parties
  • Documentation and practices
  • Key contacts for Decision making, Resolution of issues
  • Performance criteria, timelines, milestones
  • Processes
  • Timelines
  • Termination
  • Ownership of products, methodology and developed innovations
  • Payment schedule, Penalties and Incentives
  • Modes and frequency of Communication & Data access
Typical Outsourced Preclinical R&D Activities in VB

• Synthetic & medicinal chemistry
• Compound Handling, Storage, Inventory, Dispensing solid/solutions
• Computational Chemistry, Virtual Screening, Drug design
• Protein production, Enzymology, & x-ray crystallography
• Primary in vitro screening, High-throughput screening technologies
• *In vitro* properties, “off-target” & receptor profiling
• *In vivo* Pharmacokinetics/drug metabolism, *in vivo* pharmacology
• Safety Pharmacology, Toxicology, Genetic Toxicology
• Process R&D, GLP- & GMP-production
• Salt selection, Formulation, Polymorph analyses & characterization
Other Tasks Outsourced to Virtual Staff, CROs or CMOs

- Payroll/Benefits/Human Resources
- Administrative Assistant – calendaring, email filter, receptionist
- Accounting & Financial
- Travel
- Graphic web designer/developer
- IT/Communications/File Storage/Organization
- Database/Data Mining
- Grant writing, Public Relations
- Intellectual Property (Patents)
- Process R&D, Manufacturing
- Clinical trials
- Regulatory Affairs
Effectively Engaging and Managing CROs

Difficult Balances & Challenges:

• Seek quality across disciplines in full-service CROs to minimize information and materials exchanges
  • Strengths and weaknesses in CRO capabilities
  • Limiting Import/export restrictions and tariffs
  • Bespoke Biology often cannot be effectively outsourced

• Communication, Understanding and Trust at the level of sharing remains paramount
  • Sharing of biodata, Structure-activity relationships to enable medicinal chemistry and lead optimization
  • Desire to maintain confidentiality and only provide information on “Need to Know” basis
  • First Language, Cultural, Political, Time-zone differences
  • Fewer face to face interactions – heavy reliance upon the local leadership at CRO

• Instilling same urgency, motivation and commitment as internal staff
  • Creative arrangements to share risks, reduce costs and align incentives possible
  • Generating Teamwork approach without openly sharing all information

• Generally needs to be more directive, but with a collaborative spirit
“All right--let’s get started!”
Getting Virtual Biotech off to a Good Start

- Initial Team meetings should:
  - Ensure that team members are familiar with others background, experience and skill sets as a resource
    - Have team members lead a meeting in their area of expertise
  - Discuss how team roles and responsibilities align with the goals and objectives
  - Establish team process, reporting, responsibilities and assign mentors
  - Identify capability gaps and anticipate challenges to be addressed internally or externally
  - Strive to build and maintain trust
  - **Ideally be in person**

- Trust is critical for collaboration and problem solving, but more difficult to build in VB
  - Limited physical interaction, lack of social context - 93% of communications is non-verbal
  - Overcome Language barriers and Breakdown stereotypes
    - Share emotions, experiences, motivations, cultures
    - Never assume
  - Based upon cycles of reliability over time
Team Communication, Alignment and Workflow

• Logistics to rapidly exchange materials and compounds

• Good connectivity and responsiveness is critical to efficiently share ideas, information, data and respond to developments and changes in direction

• Ensure the team has any necessary training to use the tools effectively

• Keeping everyone on the same page and addressing concerns is essential
  • Computer based communication often lacks the communication cues used to convey trust
  • Conflict is exacerbated by communication delays or omissions, time zone differences, and lack of face to face contact in resolution
  • Face-time demands attention from participants
Virtual Team Bridging Technology Lifelines

Essential to establish reliable communication systems with team & CROs

• High-speed Internet Connectivity & enabling, compatible software
• Access to external literature and databases
• Mobile device connectivity with Team and CROs
• Daily phone/teleconference, text, e-mail and videoconference
• Meetings with Remote Desktop sharing
  • e.g. Zoom, Skype, WebEx, GoToMeeting
• Information management within secure environments
  • Data processing & management
  • Bio-/Chemo-Informatics
  • Shared workspaces (eRoom, eNotebooks), especially with CROs
  • Documents Syncing with alerts (e.g. Dropbox, Box, GoogleDocs, Sharepoint)
  • Web-based Structure/Data Databases (e.g. Dotmatics, CDD, JChem, etc.)
• Guide Alignment of Goals, Priorities and Timelines with Tracking (e.g. MS Project, Zoho)
Avoiding “Death by Conference Call”

• Keys to Effective Meetings with Team and External Resources
  • Clear agenda and appropriate preparation from participants
  • Slides, Data should be shared in advance
  • Schedule to ensure attendees may be fully involved
  • Manage time efficiently. Start on time and conclude within the scheduled time with a recap of actions
  • Well defined Expectations, Action items, Responsible parties with target dates
  • Minutes or recordings should be captured for those not able to join
  • Ensure engagement, solicit input, delegate responsibilities and empower
  • Minimize the temptation for participants to multitask, drift - engage all, videoconference
  • Ensure appropriate scope for participants with “deeper dives” reserved for smaller groups
  • Milestones, Momentum are linked to Morale – Track progress and Celebrate successes!
  • Technology glitches are inevitable and frustrating and back up options can minimize impact
VB Email and Virtual Communication “Netiquette”

- Keep group lists up to date, avoiding unintentional omissions
- Use the Subject line, Prioritization and Automatic replies effectively
- Ensure privacy and confidence are not violated
- Avoid using slang, jargon, emotional content, and attempts at humor that may not translate well or may be offensive
- Use clear, systematic file names
- Speak slowly and clearly, in short sentences
- Confirm understanding through restating and by asking questions
- Silence may be a concern ... or may just be connection delay, time to think, or awaiting an invitation to participate.
- Disallow side conversations, conference call domination, and meeting “hijacking”
- Ideally keep number of participants to no more than 7.
- When establishing first contact, include your full name and title, company name, address, role and objective.
- Be sensitive to the longevity of your information. Confidential information should be marked as such with the date, and source.
Concerns & **Recommendations**

- Company may be based upon a single premise, lead, or hypothesis which may be unvalidated, unreliable or under-developed
  - Early Proof of Concept is critical. Consider alternative fallback opportunities.
- Difficult to do truly innovative research if fully virtual
  - Semi-virtual model with internal bespoke biology or technology expertise and IP generation
- Costs increase with success as you proceed down the discovery/development cascade
- VB often not designed to reach adulthood, but for acquisition
  - May internalize sustained critical path activities as company matures
  - Plan carefully to attain major value inflection point. You don’t want to run out of funds before reaching a significant valuation.
- Concerns regarding quality of science and products? Taken less seriously by investors & VCs?
  - Carefully selected CROs, Leadership and Internal team with good documentation in VB wins accolades
  - Address internal limitations with expert consultants
Helping to realize the potential of Virtual Biotech

- **Driving rapid advancement** of science, understanding, and biological activity.
- **Developing a plan of action.** What to make, how to make it, where to produce it, what to do with it, how to evaluate it, & prioritizing where to go next.
- **Establishing early Proof-of-Concept evidence** at the cellular and **in vivo** level.
- **Generating relevant, reliable, quality data to drive decision making**
- **Intelligent benchmarking** against competition and navigating around prior art.
- **Identifying potential issues**, generating of key data to justify continued investment, and adjusting focus to address concerns.
- **Enhancing the quality, value, and potential** of the discoveries.
- **Determining when the product meets criteria for commercialization** and assembling an attractive, compelling, supporting data package.
- **Accessing the necessary capabilities and their timely entry**
- **Maintaining involvement, control, and security** of intellectual property.
- **Making the most of available funds** in a manner acceptable to sources.
Additional Information

- http://labiotech.eu/to-be-or-not-to-be-a-virtual-biotech/
- https://lifescivc.com/2014/06/biotechs-virtual-reality/
- https://www.imaginovation.net/blog/handling-a-virtual-team-smooth-out-the-process-with-these-suggestions/

- Team/Project Management  http://www.pcmag.com/article2/0,2817,2372953,00.asp

- Zoom Collaboration Tool  https://kb.iu.edu/d/bfqu
LIGHTNING ROUND II

Joshua Danish
Mike Wade
Jorge Jose
Fil Menczer
HIGH RESOLUTION INDOOR POSITIONING FOR EDUCATIONAL RESEARCH AND BEYOND

JOSHUA DANISH
LEARNING SCIENCES
SCHOOL OF EDUCATION
biosim

- Kylie Peppler, School of Education
- Joshua Danish, School of Education
- Armin Moczek, Biology Department
- Shenshen Han, Center for Research on Learning and Technology (CRLT)
- Ed Gentry Center for Research on Learning and Technology (CRLT)
- Janis Watson, Center for Research on Learning and Technology (CRLT)
- Naomi Thompson, School of Education

http://www.iu.edu/~biosim/
ANTSIM IN ACTION
THE PROBLEM
EXISTING SOLUTIONS

1. GPS: Works great, but only outdoors
2. Computer vision: Expensive, calibration, persistent ID is challenging
3. Indoor positioning (often for retail) is not fine grained enough (1 meter range)
4. All: COST, COST, COST
OUR SOLUTION

• Custom board using DWM1000 module produced by Decawave, with custom triangulation software and easy setup

• 3 Anchors can determine location on the fly

• Currently 8 tags in real-time with a 20cm error range.

• Moving towards a larger area and 40+ tags within one network

• Moving towards 3D tracking
MOVING FORWARD

• Support more tags and anchors
  • Now we only support 4 anchors and 8 tags (more anchors means better robustness and better error-correction, more tags means more clients to be tracked)
  • Theoretically 128 tags can be supported at most, as multiple devices positioning at once is performed in a TDMA manner
• Build a better customized antenna to extend the range
  • We now use the off-the-shelf antenna that comes with the chip
MOVING FORWARD

- Design an approach for setting up in a larger system
  - We now only support 1 “central” anchor (the anchor who reports the distances)
  - For a larger system, we might need multiple “central” anchors
THANKS!

JDANISH@INDIANA.EDU
Controlled Population Collapse of Agricultural Pests

Team:
Dr. Michael J. Wade
Dr. Gabriel Zentner
Dr. Doug W. Drury
Dylan Siniard
(1) Selfish genes spread rapidly from rare to common when introduced into a population owing to a transmission advantage; often called gene drive;
(2) Linked genes “hitch-hike” on the selfish gene drive and also spread through a population;
(3) The linked gene can be “conditionally deleterious,” reducing host viability or host fertility;
(4) CRISPR/cas-9 engineering can be used to create a synthetic gene drive, more efficient at spreading than naturally occurring gene drives*;
(5) Highly target specific, so no risk to beneficial insects.
Controlled Population Collapse of Agricultural Pests

(1) A single release achieves multiple generations of pest population repression;
(2) Results in 100% Population Extinction in 4 generations;
(3) No risk of accidental establishment of the released population;
(4) No risk of introgression into non-target populations;
(5) No risk to beneficial insects.

(6) **Target:** the Corn Root Worm, which costs U.S. farmers more than $1 billion/year to control in one crop.
Corn Root Worm
Corn Root

Worm Plus

Super ♂

♂

♀

Sterile ♀
One Release of Our Sterilizing Super♂♀ into a corn field

Population Extinction
Pigweed, *Amaranthus palmeri*: the most troublesome weed in the US.

Growers spend between $75 and $100 per acre annually on its control.

The cotton industry has invested >$1 billion to control this one plant in one crop in one decade.
Pigweed Plus

Super

♂

♂

♀

seedling

Sterile ♀
Supermales have **sterile daughters** and supermale sons.

No New Seeds are set and fewer seedlings emerge from seedbank.

No New Seeds are set and Pigweed is eliminated.
Imported fire ant, *Solenopsis invicta*, causes $6.7 billion in annual losses in the US.
Imported fire ant **Plus**

- Queen
- Egg
- Grub
- Worker
- Sterilizer
No New Eggs are laid and Colony goes extinct.

Queens are sterilized, No new Eggs are laid, Workers die off.

Workers feed sterilizer to queen.

No New Eggs are laid and Colony goes extinct.
Thank you to


Office of the Vice Provost for Research, FRSP for normal science funding
The rise of social bots

Filippo Menczer
(with Onur Varol, Clayton Davis, Emilio Ferrara, Prashant Shiralkar, Alessandro Flammini)

Center for Complex Networks and Systems Research
School of Informatics and Computing
Indiana University, Bloomington
Bossy Cracka @Junebug1952 · Sep 25
Obama Forbids FBI to use Religion in Identifying Terror Threats as ISIS OPENLY recruits in Mosques ln.is/www.breitbart.... Obama IS a MUSLIM

Tara McClintick @BooksByTara · 6h
Thank GOD for "internet information" bc mainstream media hides what thousands know: Vaccines CAUSE autism #CDCwhistleblower

Maggie Hittle @MHittle · Nov 12
WE PAY 4 THIS! @SteveWorks4You: More targeting: Obama spent $1M 4 project 2 suspend conservatives' TwitterAccounts washingtonexaminer.com/rep.-lamar-smi......
fake news just as likely to go viral
Eni Mustafaraj and Takis Metaxas. *From Obscurity to Prominence in Minutes: Political Speech and Real-Time Search*. *Proc. Web Science* 2010
Astroturf Detection

<table>
<thead>
<tr>
<th>Classifier</th>
<th>Accuracy</th>
<th>AUC</th>
</tr>
</thead>
<tbody>
<tr>
<td>AdaBoost</td>
<td>96.4%</td>
<td>0.99</td>
</tr>
<tr>
<td>SVM</td>
<td>95.6%</td>
<td>0.95</td>
</tr>
</tbody>
</table>
Real-time analysis and classification

Real-time query (Twitter search API)

Real-time feature (>1K extraction and classification)

Retrieving basic user data from Twitter
Retrieving user timeline from Twitter
Retrieving retweets/mentions from Twitter
Analyzing data with Truthy

Enter a screen name or try one of these examples
bots: @jusbieberphotos, @dtufreak, @lao232, @stanbieberfan
humans: @onurvarol, @jabawack

truthy.indiana.edu/botornot
1,150 features

<table>
<thead>
<tr>
<th>Class (# of features)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network (112)</td>
<td>Retweet, Mention, HT co-occurrence networks</td>
</tr>
<tr>
<td>User (56)</td>
<td>User meta-data</td>
</tr>
<tr>
<td>Social (208)</td>
<td>Friends statistics</td>
</tr>
<tr>
<td>Timing (24)</td>
<td>Temporal information</td>
</tr>
<tr>
<td>Content (411)</td>
<td>Part of Speech (PoS) tags and meme information</td>
</tr>
<tr>
<td>Sentiment (339)</td>
<td>Sentiment Analysis features</td>
</tr>
</tbody>
</table>
Spambots
Trained on honeypot data from Caverlee et al. @ TAMU

Trained on mixtures of honeypot and manually annotated data
self-promoting bots

spam bots

app bots
Estimation of Bot Population: 9–15%
As many as 48 million Twitter accounts aren’t people, says study

Michael Newberg | @MikeNewberg
Friday, 10 Mar 2017 | 1:08 PM ET

Study reveals whopping 48M Twitter accounts are actually bots

By PETER MARTINEZ | EGG NEWS | March 30, 2017, 8:48 PM

As many as 48 million accounts on Twitter are actually bots, study finds

Here’s How to Find Out if You Tweet Like a Bot

BY TOM BRANT | MARCH 14, 2017 03:01PM EST | 0 COMMENTS

Receivers suggest that as many as 15 percent of all Twitter accounts may be bots.

Up to 48 million Twitter accounts are bots, study says

Between 9 percent and 15 percent of tweets come from fake accounts, according to new research.
BotOrNot Python API

A Python API for Truthy BotOrNot.

Behind the scenes, this uses the BotOrNot's HTTP endpoint as illustrated in this notebook.

Quickstart

```python
import botornot

twitter_app_auth = {
    'consumer_key': 'xxxxxxxxx',
    'consumer_secret': 'xxxxxxxxxx',
    'access_token': 'xxxxxxxxxxx',
    'access_token_secret': 'xxxxxxxxxxxx',
}
bon = botornot.BotOrNot(**twitter_app_auth)

bon.check_account('@clayadavis')
```
Observatory on Social Media

This website highlights the results of a broad research project aimed to study information diffusion in social media. Use our tools to explore how people spread ideas through online social networks.

Recent Papers from @TruthyAtIndiana

Truthy @truthyatindiana
Hoaxy: A Platform for Tracking Online Misinformation
#truthypaper @www2016ca @snow_workshop
conets.indiana.edu/blog/2016/03/0...

Recent Talks from @TruthyAtIndiana

Congrats @clayadavis for best presenter prize at
#www2016 Dev Day for #truthytalk on @TruthyBotOrNot
via @jahendler
Tools (beta)

The who, what, where, when, and how of social media data

- **BotOrNot**: Check how bot-like a Twitter user behaves.
- **Trends**: Compare when memes gain and lose popularity.
- **Movies**: Generate movies of how conversations about a meme evolve over time.
- **Networks**: Explore who is discussing a meme and what memes are related.
- **Maps**: Examine where people are talking about a meme over time.
- **API**: Query our data for your own analysis.
Interactive Network Graph
Create a fully interactive network graph from a query to the OSoMe API

Try out one of these great queries:
#theOlympics #IceBucketChallenge #Kittens

Hashtag

# IceBucketChallenge

Start Date
8/8/2014

End Date
8/14/2014

Network Type
- Retweets and Mentions
- Co-Occurrence

Generate Graph
Share

Generate PNG
Get JSON

Nodes 475
Edges 1909
K Core Filtered for Performance
K 5
Orig Nodes 11979
Orig Edges 20037
Observatory on Social Media
#brexit
Visualize the spread of claims and fact checking

three million votes illegal aliens

- Relevant
- Recent

Search

Select claims and fact checking articles to visualize.

1. Select Top 20

2. Visualize

- **Reports:**
  - Three Million Votes in Presidential Election Cast by Illegal Aliens
    - From infowars.com on Nov 14, 2016
    - 17982 Tweets
    - 52300 Facebook Shares
  - Did 3 million undocumented immigrants vote in 2016?
    - From politifact.com on Nov 17, 2016
    - 9415 Tweets
    - 30820 Facebook Shares
  - Three Million Votes in Presidential Election Cast by 'Illegal Aliens'?
    - From snopes.com on Nov 16, 2016
    - 5899 Tweets
    - 12383 Facebook Shares
  - FALSE: Obama Encouraged 'Illegal Aliens' to Vote
    - From snopes.com on Nov 6, 2016
    - 1911 Tweets
    - 25327 Facebook Shares

- **Articles:**
  - UC Berkeley President Janet Napolitano Played Key Role in Providing Sanctuary to Illegal Aliens
    - From breitbart.com on Feb 2, 2017
    - 1574 Tweets
    - 16910 Facebook Shares
  - Italy Announces 'Zero Tolerance' for Illegal Aliens
    - From breitbart.com on Dec 31, 2016
    - 1060 Tweets
    - 44483 Facebook Shares
  - Hillary Clinton Received Over 800,000 Illegal Votes, Research Claims
    - From breitbart.com on Jan 27, 2017
    - 764 Tweets
    - 20653 Facebook Shares
  - California Licenses 800K Illegal Aliens as Motor Voter Law Looms
    - From breitbart.com on Dec 30, 2016
    - 744 Tweets
    - 3726 Facebook Shares
  - NPR: 25 Million Votes For Clinton 'Completely Fake' – She Lost Popular Vote
    - From yournewswire.com on Jan 29, 2017
    - 687 Tweets
    - 92438 Facebook Shares
### Most active users sharing **claims** in the last month

<table>
<thead>
<tr>
<th>screen name</th>
<th>tweets</th>
<th>BotOrNot score</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>breitbot</em></td>
<td>12921</td>
<td>54%</td>
</tr>
<tr>
<td>JoeFreedomLove</td>
<td>4852</td>
<td>71%</td>
</tr>
<tr>
<td>63red</td>
<td>4350</td>
<td>52%</td>
</tr>
<tr>
<td>sygau</td>
<td>3685</td>
<td>59%</td>
</tr>
<tr>
<td>AllAmericanGirl</td>
<td>3543</td>
<td>69%</td>
</tr>
<tr>
<td>vnuex</td>
<td>3477</td>
<td>62%</td>
</tr>
<tr>
<td>qkode</td>
<td>3453</td>
<td>58%</td>
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<tr>
<td>yceek</td>
<td>3399</td>
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<tr>
<td>nuiotwo</td>
<td>3386</td>
<td>62%</td>
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<tr>
<td>TroyCoby</td>
<td>3383</td>
<td>58%</td>
</tr>
<tr>
<td>npnikk</td>
<td>3348</td>
<td>64%</td>
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<tr>
<td>beforeitsnews</td>
<td>3114</td>
<td>74%</td>
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<tr>
<td>Shimekot</td>
<td>2632</td>
<td>90%</td>
</tr>
</tbody>
</table>

### Most active users sharing **fact checking** in the last month

<table>
<thead>
<tr>
<th>screen name</th>
<th>tweets</th>
<th>BotOrNot score</th>
</tr>
</thead>
<tbody>
<tr>
<td>PolitiFact</td>
<td>311</td>
<td>62%</td>
</tr>
<tr>
<td>NewsWhileFree</td>
<td>251</td>
<td>66%</td>
</tr>
<tr>
<td>vinnysgreen</td>
<td>218</td>
<td>59%</td>
</tr>
<tr>
<td>hrblock_21</td>
<td>213</td>
<td>48%</td>
</tr>
<tr>
<td>temr_rhm</td>
<td>198</td>
<td>56%</td>
</tr>
<tr>
<td>NickASAve</td>
<td>174</td>
<td>35%</td>
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<tr>
<td>Sws_EDU</td>
<td>143</td>
<td>42%</td>
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<tr>
<td>PascoRevolution</td>
<td>136</td>
<td>69%</td>
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<tr>
<td>DanClarkReports</td>
<td>132</td>
<td>29%</td>
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<tr>
<td>NYPolitifact</td>
<td>131</td>
<td>60%</td>
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<tr>
<td>newsgril123456</td>
<td>130</td>
<td>32%</td>
</tr>
<tr>
<td>TruthSerumUSA</td>
<td>126</td>
<td>58%</td>
</tr>
<tr>
<td>GatzTodaMax</td>
<td>118</td>
<td>42%</td>
</tr>
</tbody>
</table>
HOAXY beta
Visualize the spread of claims and fact checking.

### Most influential users sharing **claims** in the last month

<table>
<thead>
<tr>
<th>Screen Name</th>
<th>Retweets</th>
<th>BotOrNot Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>PrisonPlanet</td>
<td>149736</td>
<td>32%</td>
</tr>
<tr>
<td>TheOnion</td>
<td>131193</td>
<td>46%</td>
</tr>
<tr>
<td>RealAlexJones</td>
<td>90071</td>
<td>40%</td>
</tr>
<tr>
<td>infowars</td>
<td>49472</td>
<td>44%</td>
</tr>
<tr>
<td>politicususa</td>
<td>45589</td>
<td>64%</td>
</tr>
<tr>
<td>mitchelvii</td>
<td>37807</td>
<td>67%</td>
</tr>
<tr>
<td>PoliticusSarah</td>
<td>37589</td>
<td>59%</td>
</tr>
<tr>
<td>RealMuckmaker</td>
<td>33153</td>
<td>60%</td>
</tr>
<tr>
<td>TwitchyTeam</td>
<td>26685</td>
<td>67%</td>
</tr>
<tr>
<td>AllAmericanGirl</td>
<td>27815</td>
<td>66%</td>
</tr>
<tr>
<td>theblaze</td>
<td>25033</td>
<td>49%</td>
</tr>
<tr>
<td>ClickHole</td>
<td>23405</td>
<td>51%</td>
</tr>
<tr>
<td>BreitbartLondon</td>
<td>22820</td>
<td>57%</td>
</tr>
</tbody>
</table>

### Most influential users sharing **fact checking** in the last month

<table>
<thead>
<tr>
<th>Screen Name</th>
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</tr>
</thead>
<tbody>
<tr>
<td>PolitiFact</td>
<td>33532</td>
<td>62%</td>
</tr>
<tr>
<td>DavidCornDC</td>
<td>2293</td>
<td>48%</td>
</tr>
<tr>
<td>lnjang</td>
<td>1590</td>
<td>50%</td>
</tr>
<tr>
<td>Mikel_Jollett</td>
<td>1490</td>
<td>41%</td>
</tr>
<tr>
<td>sallykohn</td>
<td>1479</td>
<td>49%</td>
</tr>
<tr>
<td>PullMlk</td>
<td>1437</td>
<td>28%</td>
</tr>
<tr>
<td>AltStateDpt</td>
<td>1432</td>
<td>50%</td>
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<tr>
<td>OpenSecretsDC</td>
<td>1408</td>
<td>63%</td>
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<tr>
<td>RBReich</td>
<td>1121</td>
<td>34%</td>
</tr>
<tr>
<td>ShaunKing</td>
<td>1007</td>
<td>46%</td>
</tr>
<tr>
<td>JoyAnnReid</td>
<td>999</td>
<td>44%</td>
</tr>
<tr>
<td>TeaPainUSA</td>
<td>789</td>
<td>64%</td>
</tr>
<tr>
<td>CraigRozniecki</td>
<td>703</td>
<td>60%</td>
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</tbody>
</table>
Tweets/Retweets

<table>
<thead>
<tr>
<th>Source</th>
<th>Sites</th>
<th>Tweets</th>
<th>Users</th>
<th>URLs</th>
</tr>
</thead>
<tbody>
<tr>
<td>fake news</td>
<td>71</td>
<td>1,287,769</td>
<td>171,035</td>
<td>96,400</td>
</tr>
<tr>
<td>fact checking</td>
<td>6</td>
<td>154,526</td>
<td>78,624</td>
<td>11,183</td>
</tr>
</tbody>
</table>
• Social bots have entered our information networks and can manipulate our online discourse
• Structural, temporal, content, and user features extracted from socio-technical networks can be used to detect social bots
• Bots are getting smarter at exploiting humans to spread misinformation and/or influence opinions
• Need to better understand bot strategies, coordination, influence, and impact
Thanks!

cnets.indiana.edu

iuni.iu.iedu

NSF

JAMES S. MCDONNELL FOUNDATION

DARPA

Thanks!
An Angel Investor Overview

*Important Things You Need To Know To Help You Raise Capital*

Third Annual IUB Innovation Conference

April 6, 2017
Oscar Moralez

- BS, Medical Technology (Univ. of Texas Southwestern Med Center)
- MBA (Univ. of Colorado)
- Corporate Experience (13 yrs)
  - Boulder Community Hospital, Boulder
  - Mayo Medical Laboratories, Rochester
  - Covance Laboratories, Indianapolis
- Entrepreneur (10 yrs)
  - VisionTech Partners (Founder & Managing Director)
  - StepStone Business Partners (Founder & Managing Director)
  - BioStorage Technologies (Founder and COO)
    - $3.5 million angel capital raised (Indiana/Texas angels)
    - $6.0 million venture capital raised (NY VC)
    - Acquired Dec 2015 for $130 million by Brooks Automation
- Angel Investor (10 yrs)
  - 23 portfolio companies
Where does the money come from?
Capital Raise Amounts by Source

Capital Gap in Indiana (and U.S.)

- Idea
- Family, Friends, Owner's Money: $10K-250K
- Angels: $50K-3M
- Seed Capital: $2K-50M
- Venture Capital: $500K-3M
- Bank Financing: $500K-1M
- Private Placements: $5M+ & Up
- IPO's: $50M & Up

Market Success
## ANGELS FUND MAJORITY OF STARTUPS

<table>
<thead>
<tr>
<th>Angel Investors</th>
<th>Venture Capital</th>
</tr>
</thead>
<tbody>
<tr>
<td>• $24.6 billion</td>
<td>• $59.1 billion*</td>
</tr>
<tr>
<td>• 71,000 deals</td>
<td>• 4,380 deals</td>
</tr>
<tr>
<td>• 17,750 seed</td>
<td>• 186 seed</td>
</tr>
<tr>
<td>• 31,950 early stage</td>
<td>• 2,219 early stage</td>
</tr>
<tr>
<td>• 19,170 expansion</td>
<td>• 1,975 later/expansion</td>
</tr>
<tr>
<td>• 305,000 individuals</td>
<td>• 718 active firms</td>
</tr>
</tbody>
</table>

Sources: *Angel Investing Market for 2015, Center for Venture Research/ UNH; NVCA 2016 Yearbook; PwC MoneyTree

*(12 expansion-stage companies accounted for more than $10 B of this total)*
PORTFOLIO STRATEGY
RISKS & REWARDS OF ANGEL INVESTING

35% - 0X
Overall Multiple: 2.6X
Avg Holding Period: 3.5 years
Average IRR: 27%

Source: Returns of Angels in Groups, 2007

Exit Multiples
VisionTech Angels: Strength in Community!

• Formed in 2009
• Largest Angel investor network in Indiana (100 members)
• Chapters
  – Indianapolis
  – Fort Wayne/Warsaw
  – Greater Lafayette (Purdue University)
  – Bloomington (Indiana University)
  – Angel BOM (Business of Medicine)
• Accredited Investors
  – Diverse group (physicians, attorneys, financial, business leaders, entrepreneurs, academics, athletes, etc.)
• ACA-certified Angel Group
• Sector Focus: Information Technology, Life Sciences, Medical Devices, Agricultural Technology, Advanced Manufacturing Technology
• Geographic Focus: Indiana / Midwest
VisionTech Angels
Overview

• Have invested ~$11 million in 22 companies
  – Average: 9-12 members per deal
  – Investment Average per member: $25,000
  – Average deal range of $200K - $500K+
  – Goal is 20X+ return in 5-7 years for each investment while exceeding industry average of 22%-27% IRR in portfolio return

• Portfolio Strategy
  – 20+ companies per member

• 3 Exits

• Active Investors
VisionTech Angels
Investment Process

• Deal Flow
  – 400+ applications reviewed each year
  – 50-75 selected for screening each year
  – 12-15 selected each year for presentation to angel group
  – 4-6 new investments per year
  – 5-10 follow on investments per year

• Presentations to Angel Chapters
  – 6 x per year
  – 12-15 companies

• Due Diligence
  – Team / Analysts / Angels / Network / Syndicate
  – Comprehensive
  – Objective
  – Average 4 weeks

• Publish Due Diligence report to all members; Capital Call

• Close Transaction
  – Single purpose entity for investment
  – Total: 2-4 Months

• Portfolio Management
  – VisionTech Partners

1-2 Months
Key Things We Look For in Investments
(Strictly the Economics)

• Stage
  – Early commercialization (beta, pilot, etc.)
  – Greater than $250K in annual revenue
• Market Size
  – Greater than $250 million (addressable)
• Pre-Money Valuation
  – Less than $5 million
• Size of Round
  – Less than $2 million
• Preferred Equity or Convertible Debt
  – No common stock
• 10-20% equity ownership position
• Potential for 20-30X or more ROI
Characteristics we look for...

• Choose your **team** wisely
  – Number one reason angels invest
  – Stage appropriate team

• Know what you don’t know and **get help early**
  – Advisors / board
  – Peers / team members

• Good **planning** and **execution** are key
  – Problem solving, flexible, adaptable, quickness

• **Communication** is key (timely, complete)
  – Good and bad news
  – Regular reports (operations, financials, key highlights)

• **Cash** is king
  – Manage it responsibly and efficiently according to plan

• Sell, sell, sell...customer and market **validation**
Fundraising Lessons

- Fund raising is a time consuming process
- Plan in advance (months)
- Build a network (entrepreneurs/investors)
- Know the investment community
- Be prepared
- Manage the process
- Capital is available for a good opportunities
Oscar Moralez, Managing Director
omoralez@visiontech-partners.com
Musings on the University/Industry Translational Research Funding Gap

Nick Nikolaides, Ph.D.
Executive Director, The University of Cincinnati Skin Science & Technology Collaborative
Entrepreneur in Residence, The University of Cincinnati Technology Commercialization Accelerator
....Though I walk through the valley of the shadow of death....
Reality is........
<table>
<thead>
<tr>
<th>Areas of Knowledge</th>
<th>Required To Initiate Target ID &amp; Validation – Stage 1</th>
<th>Required To Initiate Screening &amp; Selection – Stage 2</th>
<th>Required To Initiate Lead Optimization – Stage 3</th>
<th>Required To Initiate Preclinical</th>
<th>Required To Initiate Preclinical &amp; Validation – Stage 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficacy</td>
<td>Putative molecular target identified with some rationale to demonstrate should ameliorate disease.</td>
<td>Target confirmed as likely to participate in pathophysiology or in amelioration of same.</td>
<td>Lead must show amelioration in most pertinent disease model(s).</td>
<td>Efficacy Putative molecular target identified with some rationale to demonstrate should ameliorate disease.</td>
<td>Lead must show amelioration in most pertinent disease model(s).</td>
</tr>
<tr>
<td>Safety/Tolerability</td>
<td>Some rationale as to how the modulation of the molecular target can be achieved without producing significant safety issues or treatment-limiting side effects.</td>
<td>Available data from Stage 2 (or current information on the target if no data exist) continue to support the potential for producing efficacy without significant safety issues or treatment-limiting side effects.</td>
<td>The Lead compound has no obvious serious safety issues that would preclude marketing for the intended indication (requires DSIA, Clinical, Regulatory and WSP input).</td>
<td>The Lead compound possesses a therapeutic agent consistent in the Chemistry Strategy are expected to yield patent protection of Level 3 or above.</td>
<td>The Lead compound has no obvious serious safety issues that would preclude marketing for the intended indication (requires DSIA, Clinical, Regulatory and WSP input).</td>
</tr>
<tr>
<td>Drugability</td>
<td>Factors concerning the target do not preclude identification of a potential therapeutic agent.</td>
<td>Opportunities for the use of biologicals in the disease state have been sought and evaluated.</td>
<td>The compound classes discussed in the Chemistry Strategy are expected to have appropriate physical properties (e.g., solubility and stability) for in vitro and in vivo testing.</td>
<td>The syntheses of compounds within the Lead chemical class is efficient enough to allow timely SAR exploration and lacks any obvious barriers to meeting TDC needs of the Product Profile.</td>
<td>The Lead compound has positive patentability opinion and positive Freedom to Practice opinion.</td>
</tr>
<tr>
<td>Proprietary Status</td>
<td>The team has made a judgment that there is reasonable access to anticipated research tools.</td>
<td>Opportunities to file for proprietary protection on targets, assays and methods have been considered.</td>
<td>The compound classes outlined in the Chemistry Strategy are expected to yield patent protection of Level 3 or above.</td>
<td>The Lead compound has no obvious serious safety issues that would preclude marketing for the intended indication (requires DSIA, Clinical, Regulatory and WSP input).</td>
<td>Patents filed on composition, method of use and chemical process are consistent with the project patent strategy.</td>
</tr>
<tr>
<td>Market Opportunity</td>
<td>The project targets an unmet medical need, and the Target Product Profile is consistent with the FA strategy.</td>
<td>The lead compound has no obvious serious safety issues that would preclude marketing for the intended indication (requires DSIA, Clinical, Regulatory and WSP input).</td>
<td>The Target Product Profile, updated to reflect the latest data on the Lead Class(es), the competitive technical landscape and the anticipated market environment at launch, continues to project a market opportunity that meets the minimum P&amp;GP standard.</td>
<td>The Target Product Profile, updated to reflect the latest data on the Lead Compound, the competitive technical landscape and the anticipated market environment at launch, continues to project a market opportunity that meets the minimum P&amp;GP standard.</td>
<td>The Target Product Profile, updated to reflect the latest data on the Lead Compound, the competitive technical landscape and the anticipated market environment at launch, continues to project a market opportunity that meets the minimum P&amp;GP standard.</td>
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**Efficacy**

- Putative molecular target identified with some rationale to demonstrate should ameliorate disease.

**Safety/Tolerability**

- Some rationale as to how the modulation of the molecular target can be achieved without producing significant safety issues or treatment-limiting side effects.

**Drugability**

- Factors concerning the target do not preclude identification of a potential therapeutic agent.

**Proprietary Status**

- The team has made a judgment that there is reasonable access to anticipated research tools.

**Market Opportunity**

- The project targets an unmet medical need, and the Target Product Profile is consistent with the FA strategy.
Translational research: Crossing the valley of death

Back in 2003 .........
Open Innovation

Source: Henry Chesbrough, UC Berkeley, Open Innovation: Renewing Growth from Industrial R&D
Hypothesis......

The confluence of Open Innovation and the University/Industry related translational research funding “valley of death” has “EXACERBATED the CONDITION”
Experiments & Observations
P&G Open Innovation – Connect & Develop

- 80+ brands; sales 180+ countries
- Operations in more than 80 global markets
- Built on Partnerships
- Driven by Innovation
- Global Advertising Leader
- Established: 1837
- HQ: Cincinnati
- 2016 Sales: $65 Billion
- Largest CPG Company in the World
P&G “Open Innovation” History . . .

A company founded in and grown by partnerships
Connect + Develop Innovation Network

- Consumers
- Retirees
- Independent Entrepreneurs
- Venture Capital
- Government Labs
- Individual Inventors
- Trade Partners
- Virtual Networks
- Joint Development Partners
- Suppliers
- Research Institutes
- Contract Labs
- Alliances
Connect + Develop Innovation Network

- >70 C+D Leaders Worldwide
- 11 Regional C+D Hubs
  - NA, LA, Europe, Israel, India, China, Japan
- 1,000s of networks
- 100s of university partners globally
P&G and Universities – Circa 2008

• Early credentialing work with Crest

• Patent donations

• Nearly 200 universities & research institutes, on more than 300 projects

• Most work had been opportunistic and tactical

• Almost 70% of university collaborations had been “one shot deals”

• 75% of spend in final quarter of FY, and 75% of that in final 2 weeks!!!!!!!!
P&G and Universities – Circa 2008

Source of Talent
- Technical Capability
- Knowledge Resources
- Innovation Capability
- Source of IP

Ad hoc Unaffiliated
Ad hoc Affiliation
Department Alliance
Engaged Affiliation
Institution Alliance

P&G 2008
Unilever
P&G future?
J&J
P&G and Universities – 2015

Source of Talent
- Technical Capability
- Knowledge Resources
- Innovation Capability

Source of IP

Ad hoc Unaffiliated
Ad hoc Affiliation
Department Alliance
Engaged Affiliation
Institution Alliance

P&G 2008
P&G 2015
The Need to Go Further.....

• R&D is fine, but now looking to the academic space more downstream...accelerators, incubators, start-ups, etc...

• “Ups the ante” for what universities need to provide to de-risk the opportunity.

• The translational research gap is better defined, and thus more costly.

• Now more than ever, the concept of co-creation is a must...co-creation in order to de-risk the R&D pipeline and allow for easier transitions to start-up, licensing opportunities, etc...
The Need to Go Further....
Mechanisms to Fund and De-risk

• Institutional Matches
• SBIR/STTR Programs
• NSF I/UCRCs
• NNMI - National Network for Manufacturing Innovation
• Regional funds, i.e. Ohio Third Frontier
• Regional Accelerators/Incubators, e.g. Cintrifuse, The Brandery
• Angel Investors/VC
Out with the old, in with new.......
Skin Science & Technology Collaborative

- Multi-College Effort – A&S, CEAS, CoP, CoM, CoN, CoB
- Organized out of UC Office of Research
- Foundational Industry Partner – P&G
- Current funding - $2M/year
- Basic Science to Commercialization
NSF I/UCRCs – University Inspired : Industry Enabled

I/UCRC Pre-competitive Research Portfolio: cooperatively defined & funded on shared value

Requires trust be built in the model, and between all partners in the center.
Intended and Actual Experiences of I/UCRCs- P&G’s POV

• Precompetitive research
  ➢ Resulted in “Nice to Have” research

• Open and deep discussions
  ➢ Business competitors sitting around “the table” – Tight Lips

• Fund and remain in Center: 3-5 year window
  ➢ Fund for 2 years and leave Center

• Impact on R&D Pipeline
  ➢ No measureable impact on R&D
Use I/UCRC Learnings to Structure \( S^2TC \)

- “Reverse” I/UCRC concept – Industry Inspired : University Enabled
- Inspired by market need : Enabled by academic expertise
- Non-Compete Industry Partners – Allow for “Need to have” research
- Pre-agreed IP and licensing terms
- Link with downstream funding – e.g. Third Frontier, Angel/Venture $
- Allow for academic competition – If UC doesn’t have “it”, find it elsewhere for our industry partners
- Build to **address** basic research to commercialization
- CO-CREATE!!!!!!
MIND THE GAP