In-Person and Live-Streamed

2023 Personalized Nutrition Innovation Day

October 3-4, 2023

Personalized Nutrition Initiative University of Illinois, Urbana-Champaign

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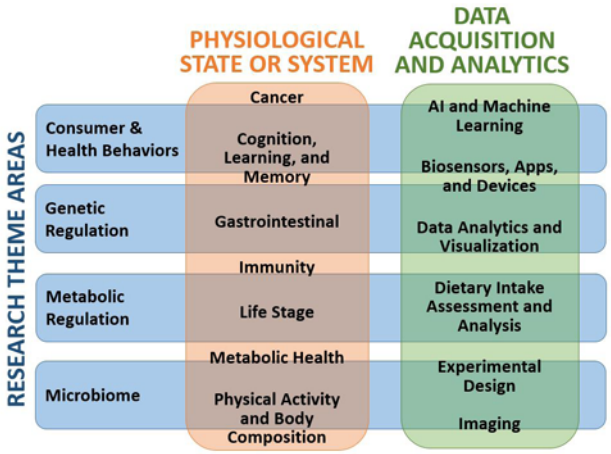
The Personalized Nutrition Initiative is a campus-wide partnership between the Office of the Vice Chancellor for Research and Innovation (OVCRI), the Carl R. Woese Institute for Genomic Biology (IGB), and the College of Agricultural, Consumer and Environmental Sciences (ACES).

Welcome

Welcome to the 2023 Personalized Nutrition Innovation Day hosted by the Personalized Nutrition Initiative at the University of Illinois Urbana-Champaign. A special welcome to the representatives from our eight External Partners and our External Advisory Committee members. We have many sessions planned to showcase personalized nutrition research and tours of facilities at the University of Illinois Urbana-Champaign.

The **Personalized Nutrition Initiative** facilitates transdisciplinary collaborative efforts across campus to answer fundamental questions regarding how nutrition modulates health and disease across the lifespan and to translate that information to clinical care and the public. The University of Illinois Urbana-Champaign is uniquely positioned to advance this field due to our long-standing international leadership in human, plant, and animal nutrition, engineering, and computer science, coupled with the emerging strengths in microbial systems biology, bioengineering, and medicine. Bringing expertise in bioengineering, engineering, and computer science to bear on nutrigenomic systems biology (e.g., biosensors for monitoring biomarkers, analysis of large datasets, and novel data visualization) could more rapidly advance the field. It would put a decidedly "Illinois" stamp on the approach. Collaborations with social and behavioral scientists are crucial to providing insights into how individuals, groups, and institutions make decisions, exercise power, and respond to change in areas pertinent to personalized nutrition.



Personalized nutrition offers a way to optimize human health and the quality of life by tailoring recommendations based not only on diet history and phenotype but also on an individual's genetics, microbiome, and metabolome. It encompasses almost all known aspects of science, ranging from the genomes of humans, plants, and microorganisms to the highest levels of analytical sciences, computing, statistics of large systems, and human behavior.

Sincerely,
Sharon Donovan, PhD, RD
Professor and Director, Personalized Nutrition Initiative

Leadership and Staff

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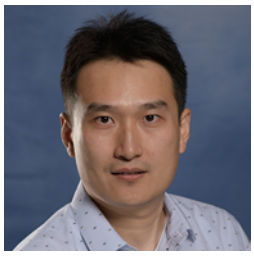

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External Advisory Committee

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Moises Torres-Gonzalez, PhD
VP, Nutrition Research, National Dairy Council

External Partners Program

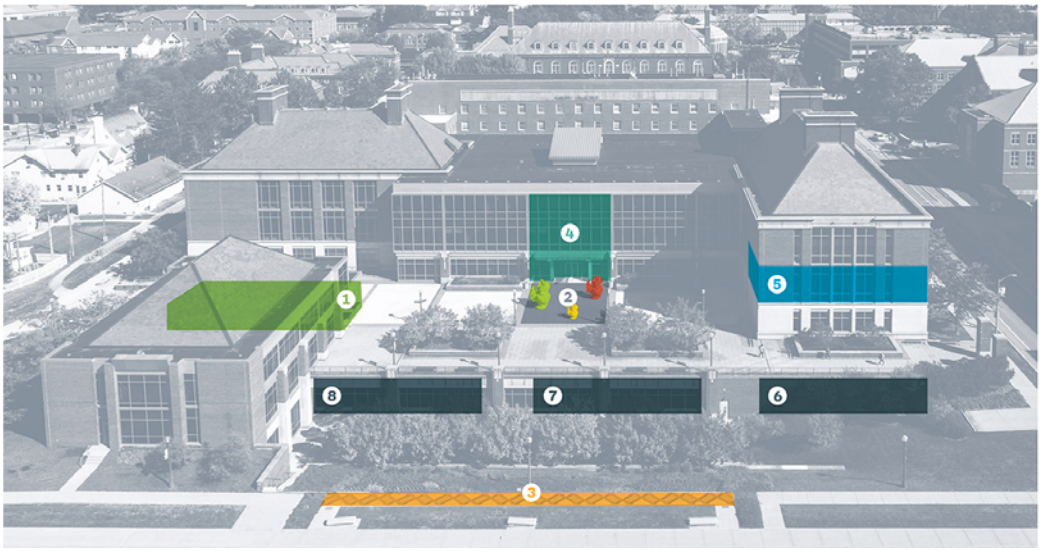
The External Partners Program for the Personalized Nutrition Initiative was designed to create opportunities for university and external researchers to learn from each other and accelerate translational developments in personalized nutrition. Through regular and structured discussions, science symposia, and potential collaborative research projects, our Personalized Nutrition Initiative campus researchers will learn about trends in industrial products and research needs, and our external colleagues will learn about campus-based personalized nutrition research as well as have the opportunity to share ideas in a non-competitive environment.

Personalized Nutrition Initiative External Partners advises the Director on a wide range of topics including, but not limited to, prioritizing research initiatives, strategic planning, procedures, Personalized Nutrition Initiative events, and the future structure of the External Partners Program. An External Partner is a company, association, or other entity outside of academia. The Director invites external partners to join the External Partners Program for an annual fee.

External Partner Program Members for 2023-2024 are:

- Amway
- Archer Daniels Midland Co
- General Mills
- Givaudan
- Mars Wrigley
- National Dairy Council
- PepsiCo
- Pharmavite

This event is hosted by the Personalized Nutrition Initiative at the Carl R. Woese Institute for Genomic Biology (IGB) and the ACES Library, Information and Alumni Center (ACES LIAC), University of Illinois Urbana-Champaign on Wednesday, October 3, 2023, 8:00 AM to 7:30 PM and October 4, 2023, 8:00 AM to 3:00 PM U.S. Central Standard Time (in-person and live-streamed).



Poster session and Lunch - Atrium of the IGB Research Building (#4 on the map)

Fox Family Innovation & Entrepreneurship Lecture - basement of the IGB Gatehouse (#1 on the map).

Oral presentations and panel discussions Sessions 1-3 - Monsanto Room (008) in the lower level of ACES LIAC, and these sessions are also live-streamed.

Agenda

Tuesday, October 3

8:00 – 10:30 A
Live-Streamed

External Advisory Committee Meeting (members only)
Including Breakfast
The Morgan-Caterpillar Room (130), ACES LIAC

8:00 – 10:00 A

Pre-scheduled Tours and Meetings with Researchers

10:00 A – 12 P

Lunch and Poster Session
Atrium, IGB Research Building (#4 on map)

12:00 – 1:00 P
Live-Streamed

Fox Family Innovation and Entrepreneurship Lecture
Gil Bander, PhD, *Founder and CSO, InsideTracker*
"Longitudinal Longevity Data Analysis - Insights and Lessons from a Decade of Insidetrack-ing"
IGB 612/614 (Additional seating in IGB 607)

1:00 – 1:30 P

Break (Walk to ACES LIAC)
The Heritage Room (107), ACES LIAC

1:30 – 5:30 P	**Personalized Nutrition Innovation Day** Monsanto Room (008), ACES LIAC
1:30 – 1:40 P Live-Streamed	**Welcome** Sharon Donovan, PhD, RD, *Director of the Personalized Nutrition Initiative, and Professor, Food Science & Human Nutrition, University of Illinois Urbana-Champaign (Illinois)*
1:45 – 2:45 P Live-Streamed	**Session 1: Data and Technology Opportunities in Personalized Nutrition** Moderator: Sharon Donovan, PhD, RD
	Keynote Speaker: Bruce Y. Lee, MD MBA *Professor of Health Policy and Management, City University of New York School of Public Health* "How AI, Data Science, and Systems Approaches Can Help Achieve More Personalized Nutrition"
	Keynote Speaker: Sunnie Southern, MS, RD, LDN *Go-to-Market Product Management Lead, Verily, an Alphabet precision health tech company* "Leveraging Personalized Nutrition as a Catalyst for Precision Health"
2:45 – 3:10 P	**Break and Refreshments** The Heritage Room (107), ACES LIAC
3:10 – 4:25 P Live-Streamed	**Session 2: Accelerating Personalized Nutrition Through Social and Behavioral Sciences** Moderator: Eva Pomerantz, PhD *Director, Center for Social and Behavioral Science, and Professor, Department of Psychology, Illinois*
	Machiel Reinders, PhD *Senior Researcher, Consumer Behavior and Marketing, Wageningen University and Research, Wageningen Economic Research* "Challenges and Opportunities for Behavioral Data in Personalized Nutrition"
	Joshua Anthony, PhD *Founder/CEO, Nlumn* "We Talked to More Than 3000 People About Personalized Nutrition and Health and They Said..."
	Mariette Abrahams, PhD, MBA *Founder/CEO, Qina* "Balancing Priorities - Why We Need to Blend in Social and Behavioural Data to Unlock True Consumer Behaviour"

Margarita Teran-Garcia, MD, PhD
Assistant Dean & Research Assistant Professor, Extension, Illinois
"MEXIMEDI Diet: A Personalized and Cultural Adaptation to Improve Health Outcomes in Mexican Adults"

John W. Erdman, Jr., PhD
Professor Emeritus, Food Science & Human Nutrition, Illinois, Chair of the Standing Committee for the Review of the Dietary Reference Intakes Framework
"Revising the Dietary Reference Intakes (DRI's) – Update"

4:30 – 5:20 P
Live-Streamed

Session 3: Panel Discussion: Opportunities for Gathering and Leveraging Personalized Nutrition Data

Moderator: Cathy Blake, PhD
Professor and Associate Dean for Academic Affairs, School of Information Sciences, Illinois

Panelists

Mariette Abrahams
Joshua Anthony
Bruce Y. Lee
Machiel Reinders
Sunnie Southern

5:20 – 5:30 P

Wrap-up

Sharon Donovan, PhD, RD

5:30 – 7:30 P

Reception with Hors d'oeuvres

The Heritage Room (107), ACES LIAC

Agenda

Wednesday, October 4

8:00 – 11:00 A
Live-Streamed

External Partners Meeting (members only)

Including Breakfast
IGB 612/614

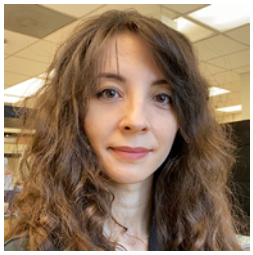
11:00 A – 12:00 P

Lunch

IGB 612/614

11:30A – 2:30 P

Pre-scheduled Tours and Meetings with Researchers



Ayca N Mogol, MS
Doctoral Student, Division of Nutritional Sciences, University of Illinois Urbana-Champaign

BIOGRAPHY

Ayca Mogol is a 4th year Ph.D. student in Dr. Zeynep Madak Erdogan's lab in the Division of Nutritional Sciences. Her research is on estrogen-receptor-positive metastatic breast cancer and drug resistance. She studies the metabolic, genetic, and epigenetic alterations caused by the commonly used breast cancer medications. She tries to understand how these alterations might contribute to drug resistance and explore potential mechanisms to overcome them. In addition to this, she works on translational cancer research in a C★STAR (Cancer Scholars for Translational and Applied Research) project in collaboration with the Cancer Center and Carle Hospitals. She investigates the changes occurring in glucose metabolism with liver metastasis of breast cancer.

Areas of Personalized Nutrition: Cancer | Metabolic Health

ABSTRACT

Clinical metabolic Abnormalities are Early Predictors of Liver Metastasis in Patients with ER+ Breast Tumors

Background and Hypothesis: Approximately 70% of human breast cancers express estrogen receptor-alpha (ERŒ±), providing a potential for targeted endocrine therapy. 30-40% of ER+ patients still experience recurrence and metastasis, with a 5-year relative overall survival rate of just 24% for patients with metastatic disease. In our preliminary analysis of the data from a large cohort of ER+ metastatic breast cancer (MBC) patients, liver metastasis was associated with reduced overall survival compared to other sites while on the standard-of-care ER antagonist, Fulvestrant. This supports data from previous clinical trials showing that liver metastatic patients are less responsive to ERŒ± targeting endocrine therapies than bone or lung metastatic patients. However, the factors underlying site-specific responses of MBC to ER antagonists are unknown.

Methods: In this study, we investigated the concept that the response of liver metastatic tumors is impacted by systemic glucose metabolism and that the presence of liver metastatic tumors impacts glucose homeostasis. In our preliminary studies, metastatic liver tumors upregulated glycogen deposition-related gene expression in response to Fulvestrant. A ketogenic diet restored Fulvestrant's response. Based on these results, we investigated if there was a relationship between metastatic site and response to endocrine therapies and if the metabolic status related to glucose homeostasis impacts metastatic disease outcome. We also searched if glucose homeostasis abnormalities can be indicators of established liver metastasis.

Results: We obtained electronic health records of 194 patients with stage IV receptor-positive breast cancer. We analyzed the glucose metabolism and/or liver health indicator blood test results, including but not limited to ALT, AST, and ALP. Our results showed that more than 85% of liver metastatic patients have another accompanying metastasis, and these patients are at a higher risk of diabetes diagnosis compared to other metastatic site patients. A higher % of patients with liver metastasis were deceased. We also observed increased levels of ALT, AST, and ALP with liver metastasis, and our preliminary analysis indicates that these blood biomarkers, along with disease status (diabetes, hypertension, lipidemia), are good predictors of liver metastasis.

Conclusions: Determining early changes in clinical metabolic indicators predicting liver metastasis with high accuracy will provide an easy diagnostic tool and potential novel ways to exploit these vulnerabilities to improve therapy response and quality of life of liver metastatic patients.

Funding: This study is supported by the CCIL-Cancer Scholars for Translational and Applied Research (C★STAR) Program award (to ANM).

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Benjamin Levine, BS
Doctoral Student, Division of Nutritional Sciences, University of Illinois Urbana-Champaign

BIOGRAPHY

Benjamin Levine is a second year PhD student in the Division of Nutritional Sciences at the University of Illinois Urbana-Champaign. The goal of his research is to create a better understanding of how diet and psychological stress influence host-microbiota communication, the enteric nervous system, and gastrointestinal motility.

Areas of Personalized Nutrition: Gastrointestinal Health | Microbiome

ABSTRACT

Fructan Chain-Length Influences Enteric Microbiota-Host GABAergic Signaling

Background and Hypothesis: Nearly half of adults suffer from a functional gastrointestinal disorder (FGID) - characterized by intestinal dysmotility. The low-FODMAP (fermentable oligo-, di-, mono-saccharides and polyols) diet is the primary clinical treatment for FGIDs. However, this diet fails in half of patients and reduces overall diet quality. Fructans are a FODMAP subtype that vary in chain-length. Long-chain fructans are more slowly fermented and produce gradual decreases in luminal pH compared to short-chain fructans. Reduced pH promotes enteric microbial gamma-aminobutyric acid (GABA) synthesis, a neurotransmitter which modulates intestinal motility via enteric nervous system (ENS) activity. Therefore, we hypothesize that varying fructan chain-lengths have distinct effects on enteric microbiota-host GABAergic signaling.

Methods: Female and male C57BL/6 mice (N=120) were randomly assigned to one of four experimental diets for two weeks: fiber-free diet (FFD, base diet), 20% cellulose (CELL), 10% cellulose + 10% short-chain fructooligosaccharide (scFOS), or 10% cellulose + 10% inulin (INU) (a long-chain fructan). Ileal (ILE) and proximal colon (PC) contents were analyzed for pH, and GABA concentration using ELISA. Expression of 94 genes related to ENS function from ILE and PC tissue was analyzed using Fluidigm qPCR.

Results: Compared to FFD, both fructan diets reduced pH in PC digesta and raised pH of ILE digesta. All fiber-containing diets increased ILE and PC luminal GABA concentrations vs FFD. Fructan diets influenced expression of motility-related gene expression more consistently in PC compared to ILE. INU enhanced expression of 9 ILE GABA receptor subunits, whereas only 3 were enhanced by scFOS. In PC, both fructan diets diminished expression of 8 GABA receptor subunits.

Conclusions: These data indicate that chain length influences enteric microbiota-host GABAergic signaling in a segment-dependent manner, suggesting that FODMAP chain-length may differentially impact intestinal motility. Ongoing studies are investigating how these changes in GABAergic signaling contribute to intestinal motility phenotypes.

Funding: None.

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BIOGRAPHY

Ziyu Zhou received her bachelor's degree in Cellular and Organismal Physiology from University of Minnesota, Twin Cities in 2022. She joined the Mei lab in August 2022. She currently studies how the microbiome, and in particular Helicobacter spp., contribute to colorectal cancer pathogenesis in mice with Ptbp1 deficiency. She is using gnotobiotic mice to study the effects of cancer mouse microbiome on inflammation and tumorigenesis. She also studies the function of Ptbp1 in Paneth cells in small intestinal regeneration and homeostasis.

Areas of Personalized Nutrition: Cancer | Data Analytics & Visualization | Gastrointestinal Health | Immunity | Microbiome

ABSTRACT

Identify the Role of Dysbiotic Gut Microbiota in Driving Colitis-Associated Colorectal Cancer Development

Background and Hypothesis: Inflammatory bowel diseases (IBD) are a heterogeneous group of chronic inflammatory disorders in the gastrointestinal tract that affect millions of individuals. Patients with IBD are at a significantly increased risk of developing colorectal cancer. Gut microbiota composition in patients with IBD and colorectal cancer is found to be less diversified compared to those of healthy people. Yet it remains largely unclear whether altered gut microbiota composition plays a role in the disease pathogenesis. Our previous studies indicate that an RNA-binding protein named PTBP1 plays an important role in preventing colitis-associated colorectal cancer. Deletion of PTBP1 in intestinal epithelial cells results in less diversified gut microbiota compositions than those of their wild-type sibling control mice. We hypothesize that dysbiotic gut microbiota in PTBP1 knockout mice promotes colitis and colorectal cancer development.

Methods: We transplanted gut microbiota from knockout mice and wild-type control mice to germ-free mice and treated these mice with Azoxymethane and dextran sodium sulfate to induce colitis-associated colorectal cancer. We performed the histological analysis to determine the severity of inflammation and tumorigenesis in these mice. We further performed advanced computational analysis and colony isolation assay to identify bacteria species that are more abundant in knockout mice.

Results: We found that mice received gut microbiota from PTBP1 knockout mice developed more severe inflammation than those received the control healthy gut microbiota. The PTBP1 knockout mice contained abundant Helicobacter spp. in their fecal microbiota and one of the species is Helicobacter bilis, an enterohepatic helicobacter species that has been reported to trigger host immune reactivity to commensal bacteria upon its colonization in the intestine.

Conclusions: Our results indicate that gut microbiota from PTBP1 knockout mice promotes inflammation and Helicobacter bilis may be one of the key species that provoke inflammation.

Seed Grant Funding from the Personalized Nutrition Initiative at Illinois

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Marcia H. Monaco, PhD

Research Assistant Professor, Department of Food Science and Human Nutrition, University of Illinois Urbana-Champaign

BIOGRAPHY

Marcia Monaco Siegel received her B.S. in Dietetics at the Pontificia Catholic University of Campinas in Brazil, her M.S. in Food Science and Human Nutrition at the University of Rhode Island and her Ph.D. in Nutritional Sciences at the University of Illinois in 1994. Her scientific training was followed with a postdoctoral fellowship in the laboratories of Drs. Matt Wheeler and Sharon Donovan at University of Illinois, where she worked on the development of an IGF-I transgenic line of swine. Marcia is involved in several projects that focus on the understanding of the role of nutrition, particularly components of breast milk, in the development of the gastrointestinal tract, immunity and microbiota. She has over 25 years of experience in using the piglet as a model for biomedical research and often collaborates with other investigators in the adaptation of the piglet model for their research. She also oversees undergraduate research experience in the Donovan Lab. In the spring of 2011, Marcia received the Professional Staff Award for Excellence from the College of Agricultural, Consumer and Environmental Sciences. In the spring of 2020, Marcia received the Outstanding Advisor, Mentor, & Educator from the Department of Food Sciences& Human Nutrition.

Areas of Personalized Nutrition: Biosensors | Apps & Devices | Gastrointestinal Health

ABSTRACT

Biosensor Approach to Quantify Exosomal microRNAs in Human Milk and Neonatal Serum

Background and Hypothesis: Human milk (HM) contains non-coding RNA species, including microRNAs (miRNAs) that regulate physiological and pathological processes. The extent to which HM miRNAs are absorbed into circulation and reach other tissues. The aim of the study is to apply novel analytical technology to quantitate miRNA in HM and serum and to study the kinetics of miRNAs absorption in different matrices in the piglet model. We hypothesized that the timing and extent of miRNA uptake vary among the matrices tested.

Methods: Colostrum-deprived piglets underwent umbilical portal and arterial catheterization within 3 hours of birth. To assess the kinetics of absorption, catheterized piglets (n=6/group) were assigned to receive 22 ml of: 1) pooled HM; 2) infant formula; 3) infant formula + HM-derived exosomes (HMDE); or 4) HMDE in PBS. Blood samples were drawn from both catheters at 0, 15, 30, 60, 90, 120, 180, 240 min post-feeding. RNA was extracted from HM, HMDE, and piglet serum and submitted for miRNA sequencing. Three miRNAs (miR-335, miR-200c, and miR-30d) were identified, due to their specificity to HM, to be further quantified by digital photonic resonator absorption microscopy (PRAM) using the target recycling amplification process (TRAP).

Results: Sequencing of HM and HMDE demonstrated >95% overlap in miRNAs. In piglets fed HM, four patterns of absorption were observed among miRNAs and were not proportional to the concentrations in HM. Approximately 45% of HMDE were not detected in piglet serum.

Conclusions: Some, but not all, HM miRNAs are absorbed and enter the circulation. Different patterns of HM miRNAs absorption suggest that HMDE are not absorbed intact. On-going analyses will compare the effect of matrix on absorption and will test the efficacy of PRAM/TRAP for the detection of miRNA in HM and serum.

Funding: Personalized Nutrition Initiative Seed Grant, University of Illinois, and the National Institutes of Health (R01EB029805).

Seed Grant Funding from the Personalized Nutrition Initiative at Illinois

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Kelly Bost, PhD

Professor, Department of Human Development and Family Studies, University of Illinois Urbana-Champaign

BIOGRAPHY

Professor Kelly Bost is a faculty member in the Department of Human Development and Family Studies at the University of Illinois Urbana-Champaign. Her research examines how families and parent-child attachment relationships impact children's socioemotional and health-related outcomes using multi-method approaches. Dr. Bost's work is advancing knowledge about the role of self-regulatory processes in the development of pediatric obesity, and cuts across disciplinary boundaries to examine complex interactions between biological and family factors to ultimately improve the health and well-being of children and families.

Areas of Personalized Nutrition: Cognition | Learning & Memory | Consumer & Health Behaviors | Imaging

ABSTRACT

Self-Regulation and Children's Eating Behavior

Background and Hypotheses: Over childhood, temperament and the quality of parent-child interactions influence emerging self-regulation skills important for healthy eating behavior. However, mechanisms underlying these associations at socio-behavioral and neurobiological levels of influence are understudied. This pilot project aims to collect brain imaging data on a sample of 6-8 yr old children participating in the STRONG Kids2 (SK2) birth cohort study and to characterize interpersonal and eating synchrony in parent-child dyads during family mealtimes. We hypothesize that regulation characterized across brain, behavioral, and dyadic levels of analysis will impact children's eating-related behavior.

Methods: Participants include children between 6 -8 yrs of age enrolled in the SK2 study. Brain activity is collected during a food/emotion Focused Attention task in a 3T scanner, along with simultaneous eye-tracking. Videotaped family mealtimes (n = 110) are coded to determine sequential and matched verbal/emotional exchanges and food approach/withdrawal behaviors in dyads using video-based tracking. Longitudinal measures of child temperament and eating behaviors are collected as part of the SK2 protocols.

Results: Pilot brain imaging/eye-tracking data have been collected and pipelines have been created for analysis. Eye-tracking data reveal that children are adhering to the attentional cues. Focusing on the FG area was linked to increased activation in brain regions linked to emotion and salience processing, including the amygdala (AMY). Focusing on the BG area was linked to increased activation in regions linked to contextual processing, including the parahippocampal place area (PPA). Behavioral results were consistent with the eye-tracking and brain imaging. Mealtime analysis indicates that mutual responsiveness is associated with higher executive control ($P < .05$) and lower food fussiness ($P < .05$) in children, and that nonverbal synchrony is associated with dietary fiber and water intake. Modeling of SK2 data has revealed that children higher on Negative Affectivity ($P < .001$) and lower on Effortful Control ($P < .01$) at 18mo are more likely to emotionally overeat at 36 mo.

Conclusions: Gaining insight into how child temperament and parenting phenotypes translate into eating dysregulation will be important for identifying precision approaches to obesity prevention and nutritional health.

Funding: We greatly appreciate the families who are enrolled in the SK2 Research Program. This work is funded by the Personalized Nutrition Initiative. The SK2 birth cohort study is funded by the National Dairy Council (S. Donovan and B. Fiese, Co-PIs), and additional family, behavioral, and brain data through USDA National Institute of Food and Agriculture, Hatch Project ILLU-793-380 to Kelly Bost, and seed funding through the Center for Social and Behavioral Research. Funding to collect brain imaging data on 50 additional participants has been received from TMCity Foundation (PIs include K. Bost, F. Dolcos, S. Dolcos, S. Donovan).

Seed Grant Funding from the Personalized Nutrition Initiative at Illinois

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Doctoral Student, Department of Statistics, University of Illinois Urbana-Champaign

BIOGRAPHY

Bo Yuan is a 3rd year Ph.D. candidate in the Statistics Department at the University of Illinois Urbana-Champaign. She is advised by Prof. Shulei Wang. Before that, she received her M.S. degree in Statistics from the University of Chicago, and B.S. degree in Mathematics from the Beijing Normal University

Areas of Personalized Nutrition:
Data Analytics & Visualization | Microbiome

ABSTRACT

RSim: A Reference-Based Normalization Method via Rank Similarity

Background and Hypotheses: Microbiome sequencing data normalization is crucial for eliminating technical bias and ensuring accurate downstream analysis. However, this process can be challenging due to the high frequency of zero counts in microbiome data, which leads us to a question whether a new normalization method can be developed that is both robust to the prevalent zero counts and corrects the compositional bias.

Methods: We propose a novel reference-based normalization method called normalization via rank similarity (RSim) that corrects sample-specific biases, even in the presence of many zero counts. The RSim normalization is a scaling method motivated by the normalization method in the experiment with spike-in bacteria. Instead of estimating sampling fraction directly, RSim first identifies a set of non-differential abundant taxa via the pairwise rank similarity of taxa and then scales the counts to ensure that the total sum of coverage in this estimated set is the same across samples. To accurately identify non-differential abundant taxa, RSim employs a new empirical Bayes approach to control the misclassification rate.

Results: Our numerical experiments demonstrate that RSim reduces false discoveries, improves detection power, and reveals true biological signals in downstream tasks such as PCoA plotting, association analysis, and differential abundance analysis.

Conclusions: Our investigation into how normalization results can affect downstream analysis shows that the unobserved sampling fraction is a common confounder in high throughput sequencing data analysis. Compositional bias may confound the results of almost all types of downstream analysis, ranging from data visualization to statistical testing. This confounding factor creates false clusters or discoveries and obscure signals of interest in data analysis and interpretation. Our numerical experiments demonstrate that RSim normalization can eliminate compositional bias better than existing methods, reducing false discovery and increasing detection power in downstream analysis, including PCoA plotting, association analysis, and differential abundance analysis. We hope this new normalization method can improve the current data analysis pipeline and enable biological researchers to make more scientific discoveries.

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BIOGRAPHY

Alice Oloo is a 3rd year PhD student in the Kinesiology and Community Health Department with a primary interest in researching about the indoor air quality in public housings. Her career is goal is to be a field researcher working with an organization whose aim is to develop practical solutions that reduce the negative impacts of environmental exposures on human health and improve public health outcomes. The goal is to advocate for more sustainable practices such as safe and livable public housing for underserved communities and for policies that protect them and their environment.

Areas of Personalized Nutrition:
Immunity | Physical Activity & Body Composition

ABSTRACT

A Pilot Study of Diet Quality, Indoor Air Pollution, and Inflammation in School-Aged Children

Background and Hypothesis: Studies of the obesogenic effect of air pollution among children have reported mixed findings, potentially because few studies focus on biologically relevant constituents of particulate matter (PM). Further, antioxidant intake has promise as an intervention to reduce the adverse effects of PM, but more data are needed about how diet modifies the effect of PM on inflammation. Here we aim to investigate how diet quality and adiposity modify relationships between indoor PM and systemic inflammation in children.

Methods: We aim to enroll 30 children ages 6-11 years into our study. Over the course of two home visits, we are collecting indoor PM samples, assessing diet quality via a food diary and measurements of skin carotenoids, measuring adiposity via bioimpedance, and collecting urine samples for cytokine analysis. Indoor PM samples will be analyzed for oxidative potential (PMOP) using a dithiothreitol assay. Food diary data will be used to generate a Healthy Eating Index (HEI) score for each participant. Urinary cytokines will be assessed via ELISA. Associations between PMOP and cytokines will be modeled using linear mixed models. We will then explore effect modification by adiposity, HEI, and skin carotenoids.

Results: To date, 11 children have been enrolled into our study (n=8 girls) with a mean (SD) age of 8.6 (1.4) years. Adiposity ranged from 12.6 to 32.1% and was negatively correlated with skin carotenoids (r=-0.52). Indoor PM concentrations (n=6) ranged from 8.1 to 41.8 Œ°g/m3. After excluding a potential outlier, indoor PM was weakly correlated with adiposity (r=0.22, n=5) and negatively correlated with skin carotenoids (r=-0.63, n=5)

Conclusions: As our study continues, it will provide key pilot data to assess associations between PMOP and systemic inflammation in a potentially sensitive population and inform future work on how diet may disrupt the relationship between air pollution and inflammation-mediated outcomes.

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Areas of Personalized Nutrition: Consumer & Health Behaviors | Data Analytics & Visualization | Dietary Intake Assessment & Analysis | Physical Activity & Body Composition

ABSTRACT

Does Lifestyle (Diet, Activity, and Sleep) Influence Severity and Outcomes of Psoriasis?

Background and Hypothesis: Psoriasis is an autoimmune dermatosis that can greatly impact a patient's quality of life. While its autoimmune etiology has been a primary target for current treatment modalities, lifestyle factors, and recommendations are understudied. Lifestyle factors (e.g. smoking, obesity, stress) are known to be attributed with worse symptomatology. We hypothesize that lifestyle modifications may contribute to improved symptomatic relief. We examined data from the National Health and Nutrition Examination Survey (NHANES) data, seeking a correlation between dietary habits, physical activity, and sleep trends on the severity of psoriasis.

Methods: A cross-sectional study was conducted using NHANES data spanning five years. Metrics including BMI, age, gender, and comorbidities such as diabetes, hypertension, and sleep disorders were compared between participants with and without psoriasis. Activity levels and dietary habits were also analyzed. Individuals within the psoriasis group were further categorized by disease severity, and their dietary intake was compared.

Results: Of 26,043 participants, 682 individuals with and 25,361 without psoriasis were found. The psoriasis group depicted a significant ($p<0.001$) spike in BMI, age, sleep disorder incidences, and diabetes, while hypertension remained insignificant. Dietary and activity patterns did not showcase marked differences between the cohorts. Psoriatic disease severity was classified in NHANES as little to none (N=269), mild (N=119), moderate (N=76), and extensive (N=23). Patients with milder disease severity consumed significantly ($P<0.05$) lower amounts of total sugar and saturated fats. Patients with milder disease severity were found to consume significantly ($p<0.1$) greater amounts of medium-chain fatty acids and lower amounts of long-chain fatty acids compared to patients with moderate and extensive severity.

Conclusions: Recognition of these nuances within nutrition can facilitate personalized dietary recommendations that may potentially lead to psoriatic symptom improvement.

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Areas of Personalized Nutrition: Cognition| Learning, & Memory | Gastrointestinal Health | Metabolic Health | Microbiome

ABSTRACT

Optimizing Bioactive Metabolites in a Whole Food Matrix (Yogurt) by the Addition of LABs and Metabolic Co-Factors

Background and Hypothesis: Fermented food intake is associated with improvements in human immune function. These benefits may lie in the bioactivity of metabolites found in fermented foods. A group of aryl-lactates: phenyllactic acid (PLA), 4-hydroxyphenyllactic acid (4-HPLA), and indole-3-lactic acid (ILA); are biochemically related metabolites downstream of microbial aromatic amino acid (ArAA) metabolism that has been identified to have a positive impact on human health. These led us to hypothesize that lactic acid bacteria found in fermented foods may produce these aryl-lactates and that we can manipulate their production in a whole food matrix by the addition of metabolic cofactors.

Methods: 20 LABs were cultured in their respective media with metabolic cofactors for 24h and sent to Metabolomics Core for liquid chromatography/mass spectrometry (LC/MS) analysis to investigate the production of aryl-lactates. To test if ArAA metabolism can be manipulated in a fermented food matrix, yogurt was made and fermented for 5 h with LABs and cofactors. Samples were taken weekly to test aryl lactate production during storage. Samples were taken to the Metabolomics Core for LC/MS analysis.

Results: Out of the 20 LABs, three distinct groups were identified based on their production of aryl-lactates, characterized as low ($\bar{x}$ 55.86 µg), medium ($\bar{x}$ 625.23 µg), and high ($\bar{x}$ 856.32 µg) producers. Yogurt with the addition of specific LABs and a blend of aryl pyruvate increased the production of aryl lactates by 20-fold after fermentation and 30-fold during 4 weeks of storage compared with yogurt with just starter culture.

Conclusions: Optimization of aryl-lactates in a whole food matrix can be achieved through the addition of selected strains and the addition of metabolic cofactors.

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Gibong Hong is currently a PhD student in Information Sciences at the University of Illinois Urbana-Champaign. His current research interests lie in the application of Natural Language Processing, especially in the area of Information Extraction and Text Generation for Biomedical text and Educational domain.

Areas of Personalized Nutrition: AI & Machine Learning

ABSTRACT

Mining the Scientific Literature to Support Personalized Nutrition Applications

Background and Hypothesis: Published literature is a rich source of scientific evidence relevant to personalized nutrition; however, this evidence remains largely buried in unstructured text and is not readily accessible to computational AI/ML models that may benefit from it. We hypothesize that natural language processing (NLP) techniques can be used to extract granular information relevant to personalized nutrition at scale from the literature and support computational models. In this work, we develop a benchmark corpus focusing on diet-microbiome interactions and NLP models to automatically recognize these relationships from published articles.

Methods: We annotated 165 PubMed titles/abstracts with entities, their relationships as well as their certainty levels. 16 entity types (e.g., Nutrient, Microorganism, Metabolite) and 13 relation types (e.g., Affects, Increases, Decreases) were annotated. In addition, Results sections of 30 articles were annotated. We also semi-automatically mapped entities to unique identifiers in relevant knowledge bases (e.g., NCBI Taxonomy, FOODON, MeSH). We experimented with state-of-the-art BERT-based named entity recognition and relation extraction models for NLP).

Results: The annotated corpus consists of 14,449 entities and 4,206 relations. 9,792 entities were mapped to 1,419 unique identifiers. The performance of the best named entity recognition model was 72.8 F1 score with strict boundary matching (82.7 with soft boundary matching). Relation extraction, on the other hand, was less successful, with 32.5 F1 score based on strict matching for argument boundaries and types (41.9 with only strict argument boundary matching).

Conclusions: The annotated corpus can serve as a comprehensive benchmark dataset for diet-microbiome interactions. The performance of the state-of-the-art NLP models on this dataset is lower than expected, suggesting that extraction of diet-microbiome interactions from the literature is challenging. The work on improving these models is ongoing.

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David is a third-year Informatics PhD student at the University of Illinois Urbana-Champaign and Outcomes Research Fellow at Carle Health. His research focuses on consumer health and wellness technologies that aid in primary prevention of disease, with the goal of providing individuals with tools to make better decisions around physical activity and nutrition across the wide variety of contexts encountered in everyday life. His current projects use machine learning and deep learning to improve dietary intake data collection.

Areas of Personalized Nutrition: AI & Machine Learning | Biosensors | Apps, & Devices | Dietary Intake Assessment & Analysis

ABSTRACT

Crowdsourcing Food Volume Data: A Mobile App to Build Large-Scale Datasets for Image-Based Dietary Analysis

Background and Hypothesis: Despite advancements in image-based food classification through deep learning, estimating food volume with high accuracy remains an unsolved challenge. Existing solutions - like using objects with known dimensions in images or employing specialized cameras - have limitations and have not yet resulted in a standard that scholars agree upon. The lack of a unified approach impedes the creation of robust datasets for model training. Therefore, we aim to identify underlying limitations in current food volume estimation methods and propose how they might be mitigated using a smartphone application.

Methods: We analyzed publicly available food image datasets, from the past decade, used in machine learning and deep learning for dietary analysis. We searched for datasets that included annotations related to ingredients, mass, or volume, and the presence of image depth data.

Results: We found 40 datasets serving various functions: classification, segmentation, and volume estimation. These datasets vary in scale, with 11 to 1,200 classes and 646 to 247,636 total images. On average, each class had 201 images. Surprisingly, only eight datasets contained image depth data, and only two datasets included detailed annotations concerning ingredient mass or volume.

Conclusions: The shortage of suitable datasets for volume estimation hampers progress in automated dietary analysis. There is an urgent need for larger, more diverse datasets featuring both annotated and depth-mapped images. We suggest joining this data collection effort with the well-established 3-day food record exercise in dietetic education, using a mobile application that leverages the latest smartphone imaging technology.

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BIOGRAPHY

Maribel Barragan is a fifth-year Ph.D. candidate and a registered dietitian. She received her BS and completed her dietetic internship at California State University, Fresno. As an undergraduate student, her research focused on improving the health of Hispanic families through community-based nutrition interventions. This passion has continued into her graduate studies, where she has developed culturally appropriate and personalized dietary interventions to effectively reduce the prevalence of diet-related metabolic conditions in the Hispanic community. Upon receiving her Ph.D., Maribel wants to continue expanding the field of personalized nutrition.

Areas of Personalized Nutrition: Consumer & Health Behaviors | Metabolic Health

ABSTRACT

A Cultural Adaptation to Improve Metabolic Health Outcomes in Mexican Adults (MEXIMEDI Diet): A Randomized Controlled Pilot Study

Background and Hypothesis: Noncommunicable diseases (NCDs) affect six in ten US adults. The Mediterranean dietary pattern (MedDiet) has evidence-based benefits in managing NCDs. Implementing a MedDiet among Mexican adults and assessing its impact has yet to be explored. Therefore, we conducted a 5wk, randomized, parallel-arm controlled trial to assess if culturally tailoring a MedDiet increases adherence compared to a traditional MedDiet. Additionally, we evaluated the effects of this intervention on health outcomes. The hypothesis was that culturally tailoring the MedDiet would result in greater dietary adherence and improvements in metabolic outcomes compared to individuals in the traditional MedDiet.

Methods: Mexican-born adults residing in the US (n=42) were randomized to two arms, one with (MEXIMEDI, n=21) or without (MedDiet, n=21) cultural adaptations. Thirty-four participants completed the study (81% retention rate), 20 in the MEXIMEDI and 14 in the MedDiet group. All participants received eucaloric personalized meal plans with instructions to prepare 3 meals and a snack for 35 days. Participants prepared meals individually and tracked their intake using self-reported food logs. Meal plans were matched for macronutrients. Fasting blood samples were collected at baseline, wk-3, and wk-5 to assess changes in metabolic status. Additionally, skin carotenoids, using a Veggie Meter¬Æ, and blood pressure (BP) were assessed weekly. Repeated-measures-ANOVA were utilized to determine changes in health outcomes.

Results: There were no significant differences in adherence between the diets. However, individuals with greater adherence to either diet significantly decreased their systolic (P=0.003) and diastolic (P=0.03) BP. No other significant changes were observed.

Conclusions: Cultural adaptation of the MedDiet did not lead to greater dietary adherence. However, individuals with at least 50% adherence to either dietary pattern observed significant BP reduction after 5 weeks. Future studies with larger sample sizes and longer duration are needed to examine the effect of a MedDiet among Mexican adults.

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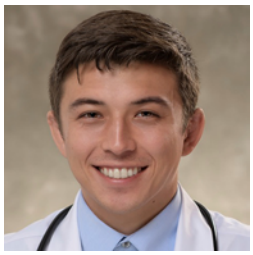

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Areas of Personalized Nutrition: Data Analytics & Visualization | Gastrointestinal Health

ABSTRACT

Trends from 2013-2021 in Utilization and Cost of Proton Pump Inhibitors; Analysis from the Medicare Part D Database

Background and Hypothesis: Proton pump inhibitors (PPIs) are widely prescribed medications for managing upper gastrointestinal (GI) disorders, including gastroesophageal reflux disease (GERD) which affects 1 in 5 Americans. PPIs consistently rank among the most prescribed drugs in the US. Despite their efficacy, safety concerns have arisen as recent studies suggest potential serious adverse events associated with long-term use. Guidelines have shifted towards conservative prescribing and dosing recommendations. We examined trends in PPI utilization and cost among Medicare Part D beneficiaries from 2013-2021 and their clinical implications.

Methods: We used Python to extract all instances of PPIs being prescribed at least once between 2013-2021 in each state from the Medicare Part D prescribers database. Univariate regressions were performed independently for each state to identify the slope and significance of the change in PPI claims over time. We calculated the Pearson correlation coefficient (R) for each state and looked at national trends to determine if a uniform policy was being followed.

Results: At the national level, R was -0.007. Our analysis revealed varied adherence to PPI guidelines by state, with 25 states showing significant decreases in PPI use, including California (slope: -9688 claim change/year, R: -0.91). The remaining 25 states, including Illinois (slope: 6478 claim change/year, R: 0.33), showed increases in PPI use through the 2013-2021 period.

Conclusions: While state trends varied in their PPI use, no significant trend was identified nationally. As providers become increasingly aware of potential risks associated with PPIs, future research may reveal a decreasing trend nationwide. PPIs continue to be prescribed inappropriately and our results support the recommendation for providers to carefully consider the indication for PPI therapy in patients. Additionally, our results highlight the need to incorporate personalized nutrition as part of a broader strategy to reduce PPI usage, promoting a lifestyle approach to managing acid-related disorders.

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BIOGRAPHY

Leona Yi-Fan Su (Ph.D., University of Wisconsin-Madison) is an assistant professor in the Charles H. Sandage Department of Advertising at the University of Illinois Urbana-Champaign and a faculty affiliate of its Center for Digital Agriculture, Informatics Programs, Institute of Communications Research, and Personalized Nutrition Initiative. Her research focuses on how social media and emerging technologies such as chatbots influence public attitudes, social behaviors, and brand communication, particularly in scientific, health, and environmental contexts.

Dr. Su's research examines the interplay between media and society, with a particular focus on how social media and new technologies influence human communication and social behaviors in the context of scientific and health topics. It has appeared in New Media & Society, Information, Communication & Society, Telematics and Informatics, Science Communication, Health Communication, Environmental Communication, and Science and Public Policy, among other peer-reviewed publications. Dr. Su is currently a co-principal investigator on an NSF-funded project that examines the effectiveness of using humor for communication about science, particularly on social media. As a principal investigator, she is also leading a CDA project that computationally analyzes tweets about an emerging food technology, with the aim of understanding branding strategies and public opinion.
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Areas of Personalized Nutrition: AI & Machine Learning | Consumer & Health Behaviors | Experimental Design

ABSTRACT

Digital Solutions to Correcting Public Misperceptions About Food and Nutrition

Background and Hypothesis: This poster presentation showcases our studies that employ various digital solutions to debunk public misperceptions about a range of food and nutrition issues. In study 1, we proposed that format and source variation in Twitter posts correcting food-preparation misinformation would affect those posts' perceived credibility, and thus, how much they changed beliefs/behavior. In study 2, we hypothesized that using text-based chatbots could decrease the dangerous belief that produce should be washed in bleach. And in study 3, we propose that the effectiveness of debunking the supposed cancer-fighting capabilities of alkaline diets will vary across social media messages, text-based chatbots, and audio chatbots as well as across brief vs. detailed debunking information.

Methods: Study 1 was an online experiment with a 3 (corrective-message format; between-subjects) x 2 (source; between-subjects) x 2 (food-related topic; within-subjects) mixed design, conducted among 855 participants. Study 2 was a survey experiment with 55 participants. In study 3, we plan to conduct a 3 (modality) x 2 (information length) online experiment among 1,200 participants.

Results: In study 1, video correction by lay authors resulted in significantly higher perceived message credibility than text correction did, and increased participants' intentions to adopt the recommended practices. In study 2, interacting with a text-based debunking chatbot significantly decreased food-related misperceptions and behavioral intentions, relative to when such information was not provided. Study 3 is currently awaiting IRB approval.

Conclusions: WOur studies to date demonstrate the promise of digital media/tools with various features and message designs for debunking food and nutrition-related misinformation, and clarify some of the mechanisms whereby they achieve this. As such, they are steps toward the goal of comprehensive practical advancement in personalized nutrition.

Funding: We thank the Campus Research Board and Personalized Nutrition Initiative for supporting these projects.

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Areas of Personalized Nutrition: Gastrointestinal Health | Metabolic Health | Microbiome

ABSTRACT

Microbiomes Matter: The Path to Regenerative Systems of Farm, Food and Health in the Age of Climate Change

Background and Hypotheses: Healthcare has shifted towards a holistic and personalized understanding of the factors influencing human well-being. Recognizing the role of food as medicine has become increasingly prominent in discussions about improving global health, but no medical school elective courses yet engage in this discourse. This perspective aligns with the principles of regenerative systems thinking, emphasizing the need for sustainable food systems to enhance healthcare outcomes. Soil health, often overlooked, plays a pivotal role in shaping the quality of the food we consume. Antibiotic resistance, soil microbiomes, and nutrient uptake are all interconnected aspects that affect not only the health of our food but also our own well-being.

Methods: We discuss an elective course in food systems and soil health that delves into the complex web of factors influencing the quality of our food. It employs a systems lens to explore topics such as the impact of temperature on farms and nutrition, disability-adjusted life years, and the planetary health perspective.

Results: Through the course, medical students gain insights into sustainable food systems, supply chains, and the importance of regenerative agriculture. They engage with stakeholders from organic and regenerative sectors, gaining a deep understanding of the intricate relationships within food production. The course also provides a comprehensive overview of the gut microbiome, nutrition, and the economics of food systems, including their impact on lifestyle diseases. It addresses the role of new technologies and community food webs in reshaping our healthcare landscape.

Conclusions: The integration of food systems and soil health education into medical training represents a transformative shift towards more holistic healthcare practices. It encourages students to advocate for community food justice, participate in outreach, and explore the intersections of technology and culture in the context of food systems. By fostering a systems-oriented mindset, medical students are better equipped to address the complex challenges of healthcare and promote regenerative, sustainable, and healthier food systems. This approach ultimately contributes to improved gut health, reduced lifestyle diseases, and greater well-being for individuals and communities.

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Areas of Personalized Nutrition: Dietary Intake Assessment & Analysis | Physical Activity & Body Composition

ABSTRACT

From Neuro-pigments to Neuroimaging: Linking Macular Carotenoids to Brain Structural Integrity in Childhood

Background and Hypothesis: Carotenoids are plant pigments with antioxidant capacity and the carotenoid lutein is selectively accumulated in retinal and brain tissue. Further, lutein and zeaxanthin collectively comprise macular pigment where they confer neuroprotective effects against inflammation and oxidative damage. Opportunely, macular pigment optical density (MPOD) can be assessed non-invasively and is highly correlated with brain concentrations of lutein and greater cognitive abilities. However, no previous study has investigated the relationship between MPOD and neuroimaging markers of brain structure in childhood. Thus, this ongoing project aims to assess relationships between macular carotenoid status and structural, functional, and viscoelastic properties of the brain in children.

Methods: Fifty-eight children 7-13 years have been recruited from East-Central Illinois. MPOD is assessed using heterochromatic flicker photometry and skin and carotenoids were assessed using reflection spectroscopy (VeggieMeter™). Cognitive function is assessed utilizing attentional control (Eriksen Flanker) and hippocampal memory (spatial reconstruction) tasks. Resting-state functional connectivity and volumetric data are assessed with magnetic resonance imaging (MRI). Viscoelastic properties of brain tissues are measured using magnetic resonance elastography.

Results: Forty-four subjects have completed the entire study protocol. Twenty-six (9 females, 8.1 ±1.6 years) of the participants completed the study protocol in the fall of 2021. MPOD and skin carotenoids were not related to cognitive performance. Skin, but not macular carotenoids were negatively related to elastic strength of tissue in the parahippocampal cortex. Shear, but not elastic strength, of the parahippocampal cortex was related to spatial reconstruction task performance. Shear strength of the lateral and medial orbifrontal cortices was positively related with attentional control task performance and negatively related with inter-trial variability.

Conclusions: Tissue integrity is related to both task performance and carotenoid status, however, greater sample sizes are required to elucidate these relationships.

Funding: Personalized Nutrition Initiative and the Division of Nutritional Sciences.

Seed Grant Funding from the Personalized Nutrition Initiative at Illinois

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BIOGRAPHY

Stephen found his roots first in psychology (B.S) and later as a neuroscientist (PhD) at the University of Illinois Urbana-Champaign. His mission is to create tools, teams, and frameworks that enable others to cut through misinformation and data overload to understand the science. He helps researchers at global nutrition organizations take a visual and evidence-based approach to scientific substantiation for regulatory and scientific affairs.

Areas of Personalized Nutrition: Analytics and Visualization

ABSTRACT

A Tool for Interactive Visualization of the FDA's GRAS Notice Inventory

Background and Hypothesis: The United States Food and Drug Administration Office of Food Additive Safety evaluates the safety and lawfulness of ingredients used in food. A strong understanding of the regulatory frameworks for evaluating safety is typically overlooked by industry and academic scientists without focused training in regulatory affairs. We hypothesized that creating a visual tool to explore the FDA's decisions on submitted GRAS Notices could enable a deeper understanding of the regulatory landscape.

Methods: We annotated the Food Ingredient GRAS Notice Inventory data with the type of substance (lipid, protein, carbohydrate, etc.), intended use (nutritional, preservative, flavor, etc.), target population (infants or general population), duration of examination, notifier, country of origin, and FDA decision. Data were visualized using Tableau to identify macro-level trends over time.

Results: The total average duration (median [interquartile range]) between Notice filing and closure was 183 (159, 263) days. Submissions by Notifiers from the US (590), Japan (81), Canada (64), China (62), and the Netherlands (51) accounted for 76% of the notices. Carbohydrates (203), microorganisms (172), lipids (167), enzymes (166), and plant extracts (146) accounted for the top 5 substances. Nutritional additives (489) accounted for nearly half of the uses, followed by technical agents (186), food hygiene/processing (170), infant formula (146), flavors (139), and preservatives (99). Proteins were the most questioned substance for both infant and general populations. Microorganisms and enzymes were the least commonly questioned substance for infant and general populations, respectively.

Conclusions: This tool is intended to enable those without regulatory training to quickly identify high-level trends in regulatory decisions made by the FDA. Furthermore, it can be used as an educational tool for academics, a working reference for regulatory professionals, and a guide for industry scientists.

Funding: No external funding was received for this work.

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BIOGRAPHY

Kowshika Sarker is a doctoral student in computer science at the University of Illinois Urbana-Champaign. She has a BS in computer sciences and engineering from Bangladesh University of Engineering and Technology. Before coming to the University of Illinois, she was a software engineer for Samsung R&D Institute and a Lecturer in the Department of Computer Science at the East West University in Bangladesh. She has experience in analyzing information regarding genomic variants, transcriptomic read patterns, and phenotypic symptoms to prioritize pathogenic genes in a cohort of rare disease patients. She also has experience constructing knowledge graphs based on relationships among metabolite compounds such as participation in the same metabolic reaction(s) or pathway(s) and imputing missing metabolite concentrations based on the neighbors' concentrations in the graph

Areas of Personalized Nutrition: AI & Machine Learning | Data Analytics & Visualization | Dietary Intake Assessment & Analysis | Metabolic Regulation

ABSTRACT

Augmenting Nutritional Metabolomics with a Genome-Scale Metabolic Model for Assessment of Diet Intake

Background and Hypothesis: Metabolomics-based diet assessment and diet-specific biomarker metabolite detection are becoming ubiquitous. Existing studies offer a limited understanding of the underlying biochemical dynamics due to a lack of information on the holistic metabolic system changing the metabolite concentrations. Moreover, small cohort sizes of feeding trials inhibit the applicability of automated representation learning-based empirical performance improvement. The hypothesis was that incorporation of knowledge about human metabolic system into computational analysis of nutrition data via design of interpretable knowledge-based features will enable more accurate predictive modeling and facilitate understanding of causal factors for nutrition studies.

Methods: We integrate prior knowledge of the human metabolic system, specifically from a genome-scale metabolic model, with metabolomic concentrations to draw novel insights into diet-related metabolism and improve dietary intake assessment. We propose multiple feature design approaches utilizing such integration; including the construction and analysis of a heterogeneous knowledge network.

Results: Experimental results show that our proposed features offer novel hypotheses for a deeper understanding of the underlying diet-specific metabolism - such as prospective metabolic reactions and metabolic subsystems involved in biomechanism. Our proposed features also often exceed or match baseline empirical performances of diet assessment, when used alone or together with metabolite concentrations.

Conclusions: Overall, our study shows the great promise of incorporating knowledge networks such as knowledge about the human metabolic system into computational analysis of nutrition data for understanding the metabolic mechanism and enabling personalized nutrition.

Funding: We thank the Personalized Nutrition Initiative at the University of Illinois Urbana-Champaign for providing seed funding for this research.

Seed Grant Funding from the Personalized Nutrition Initiative at Illinois

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Master Student, Department of Electrical and Computer Engineering, University of Illinois Urbana-Champaign

BIOGRAPHY

SKai Chieh (Jeff) Chang is a 2nd-year master's student studying electrical engineering under the guidance of Mark Hasegawa-Johnson. He received his B.S. in electrical engineering from the University of Illinois at Urbana-Champaign. His interest lies in audio recording and playback hardware, audio signal processing, and multimodal machine learning.

Areas of Personalized Nutrition: AI & Machine Learning | Biosensors | Apps, & Devices | Consumer & Health Behaviors

ABSTRACT

Classification of Infant Sleep/Wake States: Cross-Attention Among Large Scale Pretrained Transformer Networks using Audio, ECG, and IMU Data

Background and Hypothesis: Infant sleep is critical to brain and behavioral development and is an integral part of an infant's biorhythms. Sleep patterns and changes coordinate in important ways with infants' awake times, including feeding, although few studies have assessed multiple biorhythms using a single platform. An overall goal of our team's research program is to fill this gap, and in the current study we focus on a key first step of identifying infant sleep and wake states, broadly defined. Prior studies on infant sleep/wake classification have been largely limited to reliance on expensive and burdensome polysomnography (PSG) tests in the laboratory or wearable devices that collect single-modality dat.

Methods: To facilitate data collection and accuracy of detection, we aimed to advance this field of study by using a multi-modal wearable device, LittleBeats (LB), to collect audio, electrocardiogram (ECG), and inertial measurement unit (IMU) data among a cohort of 28 infants. We employed a 3-branch (audio/ECG/IMU) large scale transformer-based neural network (NN) to demonstrate the potential of such multi-modal data. We pretrained each branch independently with its respective modality, then finetuned the model by fusing the transformer layers with cross-attentio.

Results: We show that multi-modal data significantly improves sleep/wake classification (accuracy = 0.880) compared with use of a single modality (accuracy = 0.732).

Conclusions: Our approach to multi-modal mid-level fusion may be adaptable to a diverse range of architectures and tasks, expanding future directions of infant behavioral research.

Funding: We thank the Personalized Nutrition Initiative at the University of Illinois Urbana-Champaign for providing seed funding for this research. This research was also supported by funding from the National Institute of Mental Health (R21MH112578), the National Institute of Drug Abuse (R34DA050256), the National Institute of Food and Agriculture (ILLU-793-368).

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Fox Family Innovation and Entrepreneurship Lecture

Gil Blander, PhD
Founder and CSO, InsideTracker

"Longitudinal Longevity Data Analysis - Insights and Lessons from a Decade of Insidetrack-ing"

BIOGRAPHY

Dr. Gil Blander is internationally recognized for his research in the basic biology of aging and translating research discoveries into new ways of detecting and preventing age-related conditions. He leads a team of biology, nutrition & exercise physiology experts, and data scientists at InsideTracker, and has been featured in CNN Money, The New York Times, Forbes, Financial Times, The Boston Globe to name a few.

Dr. Gil Blander received a Ph.D. in biology from the Weizmann Institute of Science and completed his post-doctoral fellowship at MIT, before going on to found InsideTracker. InsideTracker was founded in 2009 by top scientists from acclaimed universities in the fields of aging, genetics, and biology, InsideTracker is a truly personalized nutrition and performance system. Our mission is to help people add years to their lives and life to their years by optimizing their bodies from the inside out.

By analyzing an individual's data, InsideTracker can give their client a crystal clear picture of what's going on inside them along with a science-backed action plan for improving their health and becoming their best self.

Innovation Day

Welcome

Sharon Donovan, PhD, RD

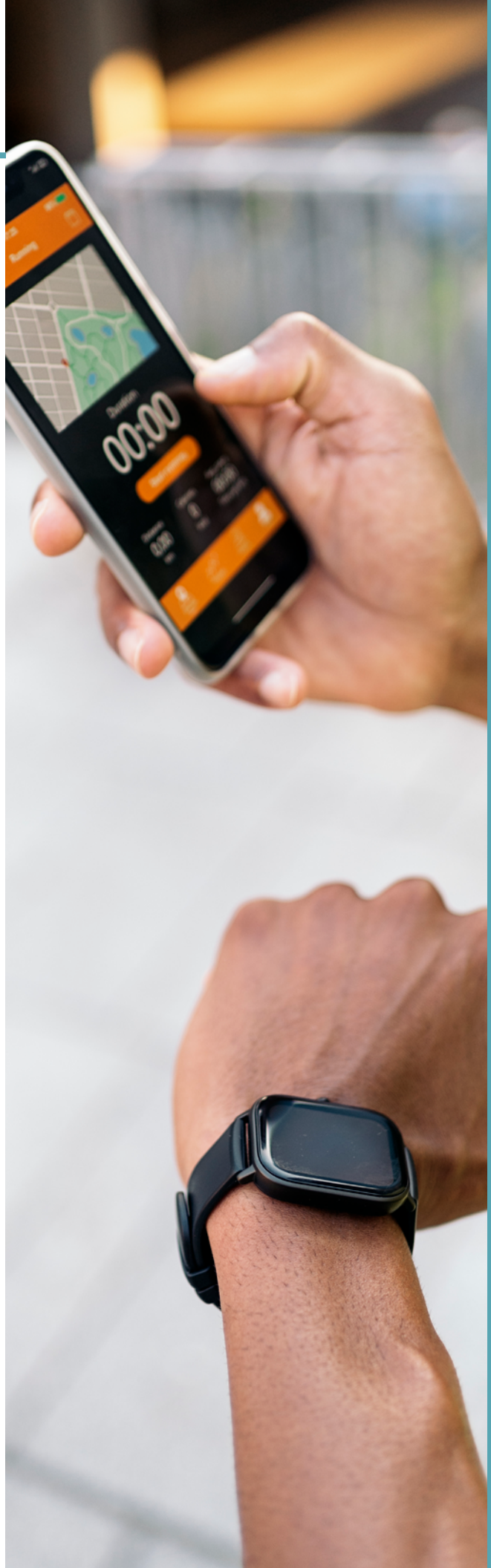
Professor and Director of the Personalized Nutrition Initiative, University of Illinois Urbana-Champaign

BIOGRAPHY

Sharon Donovan received her BS and PhD in Nutrition at the University of California at Davis. After completing a post-doctoral fellowship in Pediatric Endocrinology at the Stanford University School of Medicine, she joined the faculty at the University of Illinois Urbana-Champaign, where she is the Melissa M. Noel Endowed Chair and Professor. In July 2020, she was named the inaugural Director of the Personalized Nutrition Initiative.

Dr. Donovan's laboratory conducts basic and translational pediatric nutrition research, with a focus on the nutritional regulation of gut microbiome development and health outcomes, which has resulted in over 250 peer-reviewed publications and book chapters and more than $35M in grant support.

She served as President of the American Society for Nutrition for 2011-2012 and the International Society for Research on Human Milk and Lactation (ISRHML) for 2018-2020. Dr. Donovan served on the 2020-2025 Dietary Guidelines for Americans Scientific Advisory Committee and was elected to National Academy of Medicine in 2017.



Session 1:
Data and Technology Opportunities in Personalized Nutrition

Moderator: Sharon Donovan, PhD, RD
Professor and Director of the Personalized Nutrition Initiative, University of Illinois at Urbana-Champaign

Keynote Speaker and Panelist:

Bruce Y. Lee, MD MBA
Professor of Health Policy and Management, City University of New York School of Public Health

BIOGRAPHY

Bruce Y. Lee is a systems modeler, computational, artificial intelligence (AI), and digital health expert, professor, writer, and journalist. Currently, he is a Professor of Health Policy and Management at the City University of New York (CUNY) Graduate School of Public Health & Health Policy where he is Executive Director of the Center for Advanced Technology and Communication in Health (CATCH), PHICOR and AIMINGS (Artificial Intelligence, Modeling, and Informatics for Nutrition Guidance and Systems) Center. Dr. Lee is also founder and CEO of Symsilico.

Dr. Lee has authored over 255 scientific publications (including over 105 first author and over 85 last author) nearly all of which have focused on developing and using new systems, computational, and AI/modeling methods. Dr. Lee has written extensively for the general media. He is a Senior Contributor for Forbes, maintains a blog "A Funny Bone to Pick" for Psychology Today and has written for the New York Times, Time, The Guardian, and MIT Technology Review. His work and expertise have been featured in media such as the New York Times, USA Today, Los Angeles Times, CBS News, USA Today, Bloomberg, and National Public Radio (NPR). His Twitter handle is @bruce_y_lee

Keynote Speaker and Panelist:

Sunnie Southern, MS, RD, LDN
Go-to-Market Product Management Lead, Verily, an Alphabet precision health tech Health

BIOGRAPHY

Sunnie Southern is an entrepreneurial product management executive with extensive experience creating and scaling healthcare and life sciences products for technology, pharmaceutical, and healthcare companies. She currently leads the product go-to-market strategy for Alphabet's precision health tech company, Verily. She previously led outbound product management for Google Cloud Healthcare AI products and served as a Generative AI Ambassador. She is also a 3X founder in health innovation consulting, AI enabled personalization software, and global health tech startup commercialization.

Sunnie has a master's degree in human nutrition and foods, maintains her status as a registered dietitian, and is licensed to practice dietetics in the state of Ohio. She is passionate about transforming health by leveraging technology and data science to empower people to make informed decisions about health for themselves, their families, and the people in their care.

Sunnie has served on the Xavier Artificial Intelligence Initiative's AI Explainability Workgroup, the White House Precision Medicine Initiative, HHS Open Data Initiative, CMS Grant Review Committee, and been recognized as one of the "10 Most Influential Women in Technology".

Session 2:
Accelerating Personalized Nutrition Through Social and Behavioral Sciences

Moderator: Eva M. Pomerantz, PhD

Director, Center for Social and Behavioral Science and Professor, Department of Psychology, University of Illinois, Urbana-Champaign

BIOGRAPHY

Dr. Pomerantz is the Director of the Center for Social and Behavioral Science (CSBS) at the University of Illinois, Urbana-Champaign. In this role, her key aim is to facilitate social and behavioral science (SBS) among faculty on campus, improve the eco-system for conducting SBS research, and develop partnerships with the community to use SBS to enhance people's lives as well as future SBS research. As a Provost Fellow from 2019 to 2021, in collaboration with the Office of the Provost and two faculty task forces, Dr. Pomerantz coordinated major changes to the University of Illinois, Urbana-Champaign promotion and tenure guidelines to (1) support team and interdisciplinary research, (2) recognize publicly engaged research, and (3) enhance diversity, equity, and inclusion contributions among faculty. Dr. Pomerantz is also a faculty member in the Department of Psychology at the University of Illinois, Urbana-Champaign. Her research focuses on how parents can facilitate children's motivation and learning, most recently focusing on these issues in the area of mathematics. Dr. Pomerantz's research has been funded by the National Science Foundation and the National Institute of Mental Health, as well as other funding agencies.

Speaker and Panelist: Machiel Reinders, PhD

PhD, Senior Researcher, Consumer Behavior and Marketing, Wageningen University and Research, Wageningen Economic Research

BIOGRAPHY

Machiel J. Reinders is a senior researcher in Food Consumer Science at Wageningen Economic Research, part of Wageningen University & Research. He coordinates and conducts (international) consumer research projects and has the role of senior scientist within the organisation. His research focuses on consumer behaviour and behavioural change in relation to healthy and sustainable food choices, with a specific interest in designing, testing and evaluating behavioural interventions and personalised nutrition. He has published his work in international peer-reviewed journals like Appetite, Food Quality and Preference, International Journal of Behavioural Nutrition and Physical Activity and Trends in Food Science and Technology.

Speaker and Panelist: Joshua Anthony, PhD

Founder/CEO, Nlumn

BIOGRAPHY

Joshua Anthony is the founder and CEO of the personalized nutrition consultancy Nlumn. Nlumn works with food, nutrition and health technology companies to translate the latest science and consumer trends needed to deliver new products and services to the personalized nutrition marketplace. Nlumn's mission is to make personalized nutrition accessible to help every individual make better choices and live a healthier life. Throughout his career as a scientist, innovator, and entrepreneur, he has focused on helping people live healthier through better nutrition. Before starting Nlumn, he was a founder and Chief Science Officer of the personalized nutrition company Habit. Over the past 25 years, he has led all phases of the product lifecycle from discovery to commercialization for food and nutrition companies, including Campbell Soup Company, Mead Johnson Nutrition, and Unilever. During this time, he developed a deep understanding of technical, environmental, and societal trends. He applied this knowledge to help companies better address evolving consumer wellness needs and enabled the launch of more than 150 science-based products, businesses, and services.

Speaker and Panelist: Mariëtte Abrahams, PhD, MBA

Founder/CEO, Qina

BIOGRAPHY

Mariëtte Abrahams is the CEO and Founder of Qina, a platform and specialized consultancy that helps companies explore, connect and innovate in personalized nutrition. Qina provides market intelligence, research and innovation services by combining intelligence tools and consultancy services via a global network of domain experts. Mariette has worked in the clinical and medical nutrition industry for over 20 years and leverages her combined expertise in nutrition, business and research to create a healthier future at the intersection of nutrition, technology and society.

Speaker : Margarita Terán-Garcia, MD, PhD, FTOS

Assistant Dean and Program Leader for Integrated Health Disparities, Illinois Extension, University of Illinois Urbana-Champaign

BIOGRAPHY

Dr. Teran-Garcia is a pediatric physician-scientist with a Ph.D. in Metabolism/Nutrient-gene interactions from the University of Texas at Austin and a Fellow of The Obesity Society (F.T.O.S.). Dr. Terán conducts transdisciplinary research on obesity and other nutrition-related diseases (e.g., diabetes, hypertension) among low-income populations. She works on promoting health and wellness among families of Hispanic heritage and translates evidence-based science to community-based programs that serve children and families in need. She is a faculty member of the Carle Illinois College of Medicine, the Division of Nutritional Sciences, an Affiliate of the Personalized Nutrition Initiative, the Family Resiliency Center, and the Center for Latin American and Caribbean Studies. As Program Leader for Integrated Health Disparities, Dr. Terán is combating health disparities with advocacy, leadership, and teamwork to increase awareness and promote new systems or policies for comprehensive, sustainable solutions from micro- to macro-environments for health.

Speaker:
John W. Erdman, Jr., PhD

Professor Emeritus, Food Science & Human Nutrition, Illinois and Chair of the Standing Committee for the Review of the Dietary Reference Intakes Framework

BIOGRAPHY

Dr. Erdman is Emeritus Professor of Food Science and Human Nutrition at the University of Illinois at Urbana Champaign. He recently served as Deputy Director of the Interdisciplinary Health Sciences Institute on the Illinois campus. He has an active research program with 2 Ph.D. students. He has authored over 240 original research articles and over 400 total publications (H-Index is 65). He is a Fellow of the American Society for Nutrition (ASN), the Institute of Food Technologists (IFT) and the American Heart Association (AHA). He is past President of the American Society for Nutritional Sciences (now ASN). He has served on over two dozen committees for the Institute of Medicine, National Academy of Sciences (NAS). He is currently chair of the Standing Committee for the Review of the Dietary Reference Intakes Framework and past chair of the Committee on Military Nutrition Research for NAS. He was elected as a Member of the Institute of Medicine (now National Academy of Medicine). He has received numerous honors for research, teaching and mentoring. His B.S., M.S., M.Phil. and Ph.D. are in Food Science from Rutgers University.

Session 3:
Panel Discussion: Opportunities for Gathering and Leveraging Personalized Nutrition Data

Moderator: Cathy Blake, PhD

Professor and Associate Dean for Academic Affairs, School of Information Sciences, University of Illinois Urbana-Champaign

BIOGRAPHY

Catherine Blake is a professor in the School of Information Sciences and Health Innovation Professor in the Carle Illinois College of Medicine. She holds a courtesy appointment in the Department of Computer Science and is affiliated with the National Center for Supercomputing Applications, Informatics, Center for Health Informatics, and the Personalized Nutrition Initiative. She is the principal investigator for the NSF's Midwest Big Data Innovation Hub and is leading a study to assess the use of Artificial Intelligence for targeted search (CSL/Behring). She is co-PI for projects to develop a cadre of health data literacy ambassadors (a collaborative effort with Illinois extension to reach teens; extend text mining methods to identify critical facets of privacy statements (CISCO) and estimate risk as part of a big data-theoretic approach to quantify organizational failure mechanisms in probabilistic risk assessment.

Blake's research explores both human and automated methods to synthesize evidence from text. She brings industrial experience as a software developer, formal training in information and computer science, and almost two decades of research experience in text mining and natural language processing, primarily in biomedicine. Much of her work centers around the Claim Framework that provides both a conceptual framework along with a set of automated methods that extract key findings from empirical studies in medicine, toxicology, and epidemiology that was developed as part of a grant on evidence-based discovery. She has also explored text mining in humanities to detect authorship from movie reviews, and in news stories to recognize textual entailment in news stories and create multiple document summaries. Blake earned master's and doctoral degrees in information and computer science at the University of California, Irvine and bachelor's and master's degrees in computer science at the University of Wollongong.

Panelist: Mariëtte Abrahams, PhD, MBA

Founder/CEO, Qina

Panelist: Machiel Reinders, PhD

PhD, Senior Researcher, Consumer Behavior and Marketing, Wageningen University and Research, Wageningen Economic Research

Panelist: Joshua Anthony, PhD

Founder/CEO, Nlumn

Panelist: Sunnie Southern, MS, RD, LDN

Go-to-Market Product Management Lead, Verily, an Alphabet precision health tech Health

Panelist: Bruce Y. Lee, MD MBA

Professor of Health Policy and Management, City University of New York School of Public Health

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