

**RESOLUTION TO APPROVE NEW BACHELOR OF SCIENCE DEGREE
IN BEHAVIORAL DECISION SCIENCE**

WHEREAS, behavioral decision science is rapidly generating insights that are important to society, with more firms and governments creating positions and teams to analyze and implement behavioral change; and

WHEREAS, behavioral decision scientists are emerging as essential contributors to a multitude of domains that involve choices, risk assessment/management, and decision-making; and

WHEREAS, the bachelor of science in behavioral decision science will provide a complete framework to identify the essential variables in big and small data and will act as the link between information acquisition, information processing and human choice, training undergraduate students in the emerging field of causal behavior analytics; and

WHEREAS, the bachelor of science in behavioral decision science will provide students an understanding of economic and psychological models for how people optimally make decisions, along with an understanding of basic neural mechanisms and substrates that aid understanding of the decision-making process; and

WHEREAS, the bachelor of science in behavioral decision science will prepare graduates for employment in the private and public non-profit sectors, in state and federal government agencies, the health industry, the legal profession, and for post-baccalaureate training; and

WHEREAS, the College of Science is in an excellent position to initiate a bachelor of science in behavioral decision science in that it draws from the expertise at Virginia Tech in economics, psychology, and neuroscience; and

WHEREAS, the degree is the only one of its kind in the Commonwealth of Virginia, and will be one among only a few behavioral decision science programs in the U.S., establishing Virginia Tech as a key leader in education for one of the most creative and impactful areas of scientific inquiry of the future.

NOW, THEREFORE BE IT RESOLVED that the bachelor of science in behavioral decision science be approved effective spring 2021 and the proposal forwarded the State Council of Higher Education for Virginia (SCHEV) for approval, and to the Southern Association of Colleges and Schools (SACS) for notification.

RECOMMENDATION:

That the above resolution recommending the establishment of the bachelor of science in behavioral decision science be approved.

June 2, 2020

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Description of the Proposed Program

Program Background

Virginia Polytechnic Institute and State University (Virginia Tech) requests approval for a Bachelor of Science (B.S.) degree in Behavioral Decision Science to commence in the fall of 2020. This degree program will be situated within the College of Science, and co-managed by the dean's office and our Academy of Integrated Science (also within the College of Science).

The purpose of the proposed degree program is to prepare graduates to collect and use data to improve decision-making processes. The program will combine principles of psychology, economics, and neuroscience to train students in decision theory, behavioral economics, and the neurobiology of decision making. Students will learn to use data to identify patterns of human behavior and design the context in which people make decisions to alter choices in predictable ways. Graduates of the proposed program will be prepared to collect and use data to improve the decision-making processes of people, corporations, and policy makers with the ultimate goal of improving well-being and quality of life. Graduates will possess the knowledge and skills needed in the analysis of risk and strategy, program and policy evaluation, statistical analysis of large, complex datasets and the culling of information from these datasets to inform good decision outcomes. Graduates will be prepared for entry-level positions in today's pioneering businesses (e.g., Amazon, Uber, Facebook) as well as to serve as behavioral decision scientists in government, management and political consulting, and the non-profit sector¹. Graduates will also be prepared to work in areas such as public policy, risk management, and decision-making in legal and medical contexts. Further, graduates of the proposed program will be prepared for graduate programs in decision science, psychology, economics, business, law, and public health.

The proposed B.S. in Behavioral Decision Science will be the first of its kind in the Commonwealth, and one of only a handful of similar degrees across the nation. The B.S. in Behavioral Decision Science degree will combine the strengths of several departments within the College of Science (e.g., psychology, economics, and neuroscience) with extensions and applications to many other academic units on Virginia Tech's campus. Virginia Tech currently has active and growing research groups in decision theory and behavioral economics, neuroeconomics and the neurobiology of decision making, the effects of social media on behavior, risk and resilience in teen and adult decisions, organizational decision practices and policies, health decisions, attribution bias in consumer choice, and race and gender differences in decision processes.

The world is getting more and more complicated and every time people make a decision, they are overwhelmed by options. While “the more the better” approach increases our freedom, it also makes it more challenging to make *good* decisions.² In this context, a good decision is one that confers a high sense of satisfaction and a clear path of action for the person or group making the decision. Under conditions where too many options exist for the decision-maker, research finds much lower satisfaction, higher regret, and increased sense of not meeting expectations. The proposed B.S. in Behavioral Decision Science degree program will train its graduates to become

¹ Kamensky, J. (2019). Nudge in the city: Using science to improve public services. Retrieved from Government Executive (<https://www.govexec.com/management/2019>).

² Grant, A. M., & Schwartz, B. (2011). Too much of a good thing: The challenge and opportunity of the inverted U. *Perspectives on Psychological Science*, 6, 61-76.

'choice architects'³ in support of making good decisions in both individual and group level contexts. Students will learn to apply rigorous cross-disciplinary, scientific methods of data collection, pattern identification, and choice predictability in order to implement interventions to address major societal challenges (e.g., saving for the future, promoting medical tests, practicing environmentally conscious behaviors, reducing poverty).

Due to its broad area of application, students in the proposed program will learn to draw from theories in psychology, economics, and neuroscience. Psychological theories will prove crucial to understanding how and whether different people respond to situational changes. Economic theories are key for understanding and implementing the right incentives to drive change. Neuroscience provides insights into the unobservable yet fundamental cognitive, sensory, and affective processes underlying decision making. Neuroscience and the growing field of neuroeconomics informs the understanding of how people react to, acquire, process, elaborate and act on information in dynamic environments. Neuroscience will further reveal which decisions are driven by situational context and driven by goals and motivation. That is, the way information is acquired and elaborated on by neural circuits in the brain is one active area of research on choice, and modeling these processes helps to increase prediction of choice in behavior. Indeed, clinical interventions that fail to impact these "choice circuits" in the brain are often seen to fail in changing behavior. For this reason, psychology, economics, and neuroscience must work in synergy to inform students in behavioral decision science about what data to collect, analyze, and interpret to predict people's choices in different contexts.

Collectively, current theories and methods across psychology, economics, and neuroscience seek to understand and improve the process and nature of decision making across levels of functioning that span individuals, groups, institutions, and cultures. A better understanding of behavior that brings together insights from these different disciplines is key to the design of policies for improving lives today and in the future. These insights will also facilitate the understanding of what data need to be collected and from whom so that analyses can yield relevant information for behavior and decisions.

The combined focus of the behavioral aspects of psychology, economic, and neuroscience of the proposed B.S. in Behavioral Decision Science degree provides the complete framework to identify the essential variables in big and small data and will act as the link between information acquisition, information processing, and actions. In doing so, the proposed degree will train students in the emerging field of causal behavior analytics. To this end, the curriculum provides the coursework and experiential learning opportunities for students to study the decision making process as it pertains to the behavior of individuals and groups (e.g., corporations, organizations, governments). Required courses in this new degree program will cover major aspects of behavioral and decision sciences, including: (1) quantitative and analytic approaches/methods governing human behavior and decision-making, (2) experimental approaches to understanding individual and collective decisions, including how cognitive, emotional, economic, social, and political factors affect such behaviors, and (3) promoting evidence-based approaches for the implementation of improved decision-making across a variety of cultural and contextual frameworks. Because of the relative recency of the field of behavioral economics, students are at the forefront of an area that is experiencing continual growth. Students in the proposed program will learn to both conduct and apply academic research on decision making and behavior, and the

³ Parikh, A., & Parikh, P. (2017). *Choice architecture: A new approach to behavior, design, and wellness*. New York, NY: Routledge Publisher.

effects of decision making for industrial, government, and community outcomes. Through the proposed curriculum and undergraduate research training, students will be able to describe and apply the theories and methods of Behavioral Decision Science. They will gain an understanding of economic models for how people optimally make decisions, and psychological models of how people tend to deviate from classic economic models. The students in the proposed degree program will learn to effectively integrate these models, along with an understanding of basic neural mechanisms and substrates that aid understanding of the decision making process (e.g., psychophysiological responses to incentives). Students will receive rigorous training in analyzing data from a variety of perspectives including field studies, experimental and non-experimental designs, as well as developing predictive models from data and evaluating the quality of behavioral measures.

The insights from the field of behavioral decision science are becoming more and more important to society, with more firms and governments creating positions and teams to analyze and implement behavioral change. The proposed Virginia Tech B.S. in Behavioral Decision Science degree program will prepare students to handle the breadth and depth of data that need to be properly interpreted and acted upon when shaping policy or guiding organizations. These students will be integral in directing future outcomes in society and the world.

Mission

The mission statement of Virginia Tech is: “Inspired by our land-grant identity and guided by our motto, Ut Prosim (That I May Serve), Virginia Tech is an inclusive community of knowledge, discovery, and creativity dedicated to improving the quality of life and the human condition within the Commonwealth of Virginia and throughout the world.”

The proposed B.S. in Behavioral Decision Science aligns with the university’s mission by building an inclusive, interdisciplinary community that train students in the quantitatively-based techniques of knowledge discovery focused on human behavior. The proposed degree program will improve “the quality of life and the human condition within the Commonwealth of Virginia and throughout the world” through scholarly work that will make real-life impact by providing practitioners and policy makers the necessary tools to improve well-being and effective decision making both within and outside organizations.

Admission Criteria

Admission to the proposed B.S. in Behavioral Decision Science will be dictated by the general admission policies of Virginia Tech as follows:

- 18 units of high-school course work
- 4 units of English
- 3 units of math (includes algebra I, geometry, and algebra II)
- 2 units of laboratory science (chosen from biology, chemistry, or physics)
- 2 units of social science (one must be history)
- 3 additional academic units (foreign language is highly recommended)
- 4 elective units

Virginia Tech does not require a minimum SAT or ACT score at this time.

- SATs: Mid-50% = 1160-1340 (average 1250)

- ACTs: Mid-50% = 24-28 (average 26)

Virginia Tech does not have a minimum GPA at this time.

- GPA: Mid-50% = 3.81-4.24 (average = 4.0)

Applicants whose native language is not English must demonstrate proficiency in English by taking the Test of English as a Foreign Language (TOEFL), the International English Language Testing System (IELTS), or the Pearson Tests of English (PTE) test.

- TOEFL: Students taking the TOEFL must have the following scores:
 - Internet-Based Test (IBT): 80 with no sub-section score less than 16
 - Computer-Based Test (CBT): 233
 - Paper-Based Test (PBT): 550
- IELTS: Students taking the IELTS must obtain a score of 6.5, with no subscore below 6.5.
- PTE: Students taking the PTE must obtain a score of at least 53.

Target Population

No specific groups will be targeted for the proposed degree program.

Curriculum

The proposed B.S. in Behavioral Decision Science degree program will require 120 credit hours. A capstone course will be required.

The curriculum is structured by 27 credit hours of core coursework and 18 credit hours of restricted elective coursework organized by two themes: Analysis of Decision Making (9 credits) and Application of Decision Making (9 credits).

The focus of the core curriculum is advanced analysis of rational choice theory as well as a formal introduction to alternative models of behavioral economics. The core curriculum is unique due to the proposed new courses that focus on the study of decision making specifically from the point of view of human brain and behavior. This differs from existing curricula in psychology, neuroscience, or economics by focusing on the interaction between human cognition and the mathematical constraints that are inherent to dynamical systems of choices. The core curriculum is also unique by virtue of requiring a combination of coursework in psychology, economics and neuroscience that is not attainable for students of existing majors. Students will gain a rich combination of knowledge that draws from the methods of all of the disciplines involved in the proposed degree program. Students will learn about the complex biological, social, and mathematical processes that guide human behavior and how to apply principles of behavior that influence decision making across several scales. Students will understand the biological processes that provide motivation, enable learning and memory, and determine which behaviors feel rewarding. They will understand how these biological processes shape thought within an individual and interactions between individuals and groups. Further, students will be able to analyze and predict how these behavioral patterns, in turn, shape the efficacy of groups, including organizations and larger populations. They will be able to quantify the effects of decisions in terms of both human behavioral and econometric outcomes.

The focus of the Analysis of Decision Making theme is coursework that is designed to educate students beyond the foundational level on mechanisms and processes of behavioral decision science across a variety of scientific disciplines. Moreover, these courses offer targeted instruction on the analysis of data across many contexts and using a variety of cutting edge analytic techniques.

The focus of the Application of Decision Making theme is coursework that is designed to educate students in the multitude of ways in which behavioral decision science is relevant to real world situations and contexts that involve individuals, groups, corporations, governments, etc. These courses target connections between experimental design, data analysis, and implementation/interpretation that behavioral decision scientists must understand in order to affect real and sustainable change.

All students in the proposed B.S. in Behavioral Decision Science program will be required to take BDS/PSYC 4194: Predicting Social Behavior as a capstone experience. Students will be required to collaboratively select a real-world case study (from a repository provided by the instructor), form a hypothesis about it, clean, parse, and apply modeling techniques and data analysis principles to ultimately create a predictive model. This project will culminate in a presentation delivered to the class that summarizes the team's question of interest, method, and results. The final team project represents a culmination of the methodologies and techniques students have learned throughout the course.

Three new courses were developed for the proposed degree program. New courses are denoted with an asterisk.*

Program Requirements

General Education Requirements: 45 credit hours

Discourse: 9 credits

Critical Thinking in the Humanities: 6 credits

Reasoning in the Social Sciences: 6 credits

Reasoning in the Natural Sciences: 6 credits

Quantitative and Computational Thinking: 9 credits

Critique and Practice in Design and the Arts: 6 credits

Critical Analysis of Identity and Equity in the United States: 3 credits

Core Courses: 27 credit hours

BDS 2005: Fundamentals of Behavioral Decision Science (3 credits)*

BDS 2006: Fundamentals of Behavioral Decision Science (3 credits)*

CMDA 2014: Data Matter (3 credits)

ECON/BDS 3134: Choice and Behavior (3 credits)*

ECON 3254: Analysis of Economic Data (3 credits)

PSYC 1094: Principles of Psychological Research (3 credits)

PSYC 2064: Introduction to Neuroscience of Behavior (3 credits)

STAT 3005: Statistical Methods (3 credits) or STAT 3604: Statistics for Social Sciences (3 credits)

Capstone – 3 credit hours

BDS/PSYC 4194: Predicting Social Behavior (3 credits)

Restricted Electives: 18 credit hours

Theme I: Analysis of Decision Making – 9 credit hours (students choose three courses)

CMST 2064: The Rhetorical Tradition (3 credits)
 CMST 3134: Public Advocacy (3 credits)
 ECON 3104: Microeconomic Theory (3 credits)
 ECON 4304: Introduction to Econometric Methods (3 credits)
 ECON 4424: The Theory Of Games And Economic Behavior (3 credits)
 ECON 4434: Experimental Economics (3 credits)
 ECON/NEUR/PSYC 4454: Neuroeconomics (3 credits)
 ENGL/PSYC 1524: Language and the Mind (3 credits)
 NEUR 3084: Cognitive Neuroscience (3 credits)
 NEUR 3144: Mechanisms Of Learning And Memory (3 credits)
 NEUR 3234: The Artificial Brain (3 credits)
 PHIL 2304: Global Ethics (3 credits)
 PHIL 3505: Modern Logic And Its Development (3 credits)
 PHIL 3506: Modern Logic And Its Development (3 credits)
 PSCI/IS 3104: Security Studies: Theories And Concepts (3 credits)
 PSYC 2044: Psychology Of Learning (3 credits)
 PSYC 2084: Social Psychology (3 credits)
 PSYC 3094: Advanced Research Methods In Psychological Science (3 credits)
 PSYC 4024: Industrial And Organizational Psychology (3 credits)
 PSYC 4054: Personality Research (3 credits)
 PSYC 4064: Physiological Psychology (3 credits)
 PSYC 4074: Sensation And Perception (3 credits)
 PSYC 4084: Advanced Social Psychology (3 credits)
 PSYC 4094: Theory of Psychological Measurement (3 credits)
 PSYC 4114: Cognitive Psychology (3 credits)

Theme II: Application of Decision Making – 9 credit hours (students choose three courses)

ACIS 1504: Introduction To Business Analytics & Business Intelligence (3 credits)
 BMES 4134: Global, Societal, And Ethical Considerations In Biomedical Engineering (3 credits)
 ECON 1104: Economics of Gender (3 credits)
 ECON 3034: Economics of Poverty and Discrimination (3 credits)
 ECON 4044: Public Economics (3 credits)
 ECON 4404: Economics of Organizations (3 credits)
 ECON 4214: Economics of Health Care (3 credits)
 ENGE 2094: Create!: Ideation & Innovation (3 credits)
 PSCI/IS 3134: Global Conflict and War (3 credits)
 PSYC 2014: Psychology Of Social Interventions (3 credits)
 SOC 2034: Diversity And Community Engagement (3 credits)
 SOC/HIST/STS 2604: Introduction To Data In Social Context (3 credits)
 SPIA 4464: Data and the Art of Policy-Making and Planning (3 credits)
 STAT 1014: Data In Our Lives (3 credits)

Free Electives – 30 credit hours

Total: 120 credit hours

See Appendix A for a sample plan of study.
See Appendix B for course descriptions.

Student Retention and Continuation Plan

All students in the proposed B.S. in Behavioral Decision Sciences program will be assigned a professional advisor. In conjunction with the College of Science, Office of the Dean staff, the professional advisor identifies at-risk students by reviewing transcripts and plans of study on an annual basis. Students will be required to meet with their advisor at least once per semester to assess progress in the program, discuss their plan of study, and recommend appropriate courses and minor programs based on student interest and goals. Advisors monitor progress toward degree completion, discuss any difficulties, and assist in identifying remediation strategies for improvement and success. In addition to the primary advisor, students experiencing difficulties can receive help through the College of Science (COS) Dean's office. The COS Dean's office offers professional advising, identifies students who are not making satisfactory progress toward graduation, and works with the student and the student's advisor to help implement remediation strategies. For example, students may be referred to the Student Success Center, writing center, study groups, tutoring, peer academic coaching, or the Seminar Series on Academic Success. Further, the Division of Student Affairs offers several programs in support of student success. For example, Career Services assists students in finding relevant internships and employment upon graduation.

Faculty

Faculty members from the departments of psychology, economics, and statistics will teach core courses in the proposed degree program.

Three faculty members from the Department of Psychology will teach core content in the proposed program. All faculty hold masters or doctoral level degrees in the discipline area in which they teach.

Three faculty members from the Department of Economics will teach core content in the proposed program. All faculty hold masters or doctoral level degrees in the discipline area in which they teach.

Two faculty members from the Department of Statistics will teach core content in the proposed program. All faculty hold masters or doctoral level degrees in the discipline area in which they teach.

One new faculty member will be hired into either the Department of Psychology, Department of Economics, or the School of Neuroscience to support the proposed degree program with both administrative and instructional responsibilities. The faculty member will be hired at the associate or full professor level in a tenure-track position. The faculty member is expected to hold a doctorate in psychology, economics, or neuroscience. Additional qualifications include being a senior scholar in the field of behavioral science with a background in either economic, psychology, and/or neuroscience that specifically has focused on issues of decision making. This new faculty member will serve as the Program Director.

Additionally, faculty members from the following departments have committed to allowing students within the proposed program to enroll in the restricted elective coursework required for the thematic areas: 6 faculty members from the Department of Psychology, 2 faculty members

from the Department of Economics, 3 faculty members from the School of Neuroscience, 1 faculty member from the Department of Political Science, 2 faculty members from the Department of Philosophy, 2 faculty members from the Department of Communication, 2 faculty members from the Department of Sociology, 1 faculty member from the Department of Biomedical Engineering, 1 faculty member from the Department of Business Information Technology, 1 faculty member from the Department of English, and 1 faculty member from the School of Public and International Affairs. All faculty members hold masters or doctoral degrees in the discipline area in which they teach.

Collectively, all faculty members have been directly involved in the development of the curriculum and the design of the proposed degree program, comprise a collective 150 years of teaching experience, and are active scholars and experimental researchers in their respective fields.

See Appendix C for faculty curriculum vitae (abbreviated).

Program Administration

The B.S. Behavioral Decision Science degree will be administered through, and granted by, the Dean's office of the College of Science. Within the College of Science, the management of this degree program will be assisted by the College's Academy of Integrated Science (<https://www.ais.science.vt.edu/>). The Academy will be responsible for recruitment, retention, course assignment and the advising of students. The director of the Academy of Integrated Science will facilitate the approval of new courses as in-major electives, and approve electives for particular plans of study (such as for transfers and studies abroad). Currently under the direction of a full professor, the Academy supports interdisciplinary, science-based degree programs, curricula, and minors within the College of Science. The Academy provides a multidisciplinary platform for faculty whose teaching and research interests are associated with these programs; fostering and enhancing research opportunities in alignment with its degree programs; and strengthening interdepartmental collaboration in discovery, learning, and engagement.

The proposed B.S. in Behavioral Decision Science degree program will have a program director. In addition to teaching in the proposed program, the program director will be responsible for program oversight, promotion, and assessment. In addition, the director will facilitate the approval of new courses as in-major electives, and approve electives for particular plans of study (such as for transfers and studies abroad).

A professional advisor will be hired in the initial year to serve as the first point of contact for potential degree program students, advise students regarding coursework selection, and monitor student progress.

Student Assessment

Student learning will be assessed throughout the proposed program via a variety of mechanisms in each course. Measures include, but are not limited to examinations, quizzes, laboratory exercises and reports, student projects (individual and group), written papers, case studies, homework assignments, and oral presentations. Student grades are assigned based upon measurements of their learning in the courses. Student success in meeting these learning

objectives will be measured through an evaluation of accomplishments in the courses that constitute the core of the proposed curriculum. Several courses in the core curriculum will include experiential learning exercises. These activities will provide an opportunity to evaluate higher order learning skills such as critical and creative thinking.

Learning Outcomes

Students will be able to:

- Design experiments for behavioral decision research questions
- Discuss the role of statistics in aiding the detection of systematic variance
- Distinguish between manipulated and non-manipulated variables as these relate to issues of correlation and causation
- Identify heuristic and mental models affecting choice and human behavior at different points of the decision cycle
- Apply decision science across a variety of real-life issues and problems in interdependent settings
- Explain the structure, development, and plasticity of the nervous system
- Interpret trends and patterns in complex data sets
- Analyze the sequence of building a predictive model of behavior
- Evaluate the quality, bias, and generalizability of a model's predictions
- Articulate the major economic, psychological and neuroscientific models of individual and group decision making
- Summarize major behavioral regularities which violate the rational choice paradigm

Thematic area specific student learning outcomes

Analysis of Decision Making

- Describe a variety of small- and large-scale design approaches for addressing empirical questions about decision making.
- Depict data distributions and the results of statistical analyses using computer software (e.g., Excel)
- Analyze the process by which models are validated and improved to better predict social outcome

Application of Decision Making

- Describe how social policy promotes and demotes positive decision making
- Articulate ethical issues involved in the specification and validation of data-driven models
- Summarize how predictive analytics are applied to social contexts

Curriculum Map for B.S. in Behavioral Decision Science

Learning Outcomes	Courses	Assessment Methods
Design experiments for behavioral decision research questions.	PSYC 1094: Principles of Psychological Research	Formative: quizzes; written assignments (e.g., a research proposal on a topic involving measurement of behavior at

		<p>both the individual and group level)</p> <p>Summative: midterm and final exams (e.g., items on the exam contrasting longitudinal and cross-sectional design)</p>
Discuss the role of statistics in aiding the detection of systematic variance.	<p>PSYC 1094: Principles of Psychological Research CMDA 2014: Data Matter STAT 3005: Statistical Methods or STAT 3604: Statistics for Social Sciences ECON 3254: Analysis of Economic Data</p>	<p>Formative: quizzes; written assignments (e.g., a presentation on effect size estimation and Bayesian computations to examine variance)</p> <p>Summative: midterm and final exams (e.g., items on the exam defining measures of central tendency)</p>
Distinguish between manipulated and non-manipulated variables as these relate to issues of correlation and causation.	<p>PSYC 1094: Principles of Psychological Research CMDA 2014: Data Matter ECON 3254: Analysis of Economic Data</p>	<p>Formative: quizzes; written assignments (e.g., a research proposal that is strictly correlational, including partial correlations)</p> <p>Summative: midterm and final exams (e.g., items on the exam about the limitations of correlation for understanding mechanisms)</p>
Identify heuristic and mental models affecting choice and human behavior at different points of the decision cycle.	<p>BDS 2005: Fundamentals of Behavioral Decision Science BDS 2006: Fundamentals of Behavioral Decision Science</p>	<p>Formative: quizzes; written homework assignments (e.g., comparing decision heuristics in real world contexts)</p> <p>Summative: midterm and final examination (e.g., items on the exam about accuracy - effort trade-offs in decision making)</p>
Apply decision science across a variety of real-life issues and problems in interdependent settings.	<p>BDS 2006: Fundamentals of Behavioral Decision Science</p>	<p>Formative: class activities; decision making scenario-based exercises (e.g., a presentation on a novel implementation in a high school to increase awareness</p>

		of climate change) Summative: midterm and final examination (e.g., essay on the exam discussing how 'nudges' are thought to work)
Explain the structure, development, and plasticity of the nervous system.	PSYC 2064: Introduction to Neuroscience of Behavior	Formative: class participation; class discussions (e.g., a presentation on a developmental outcome that is highly likely but potentially alterable by context such as thalidomide and limb development) Summative: midterm and final exams (e.g., items on exam that require differentiation between multiplicity versus uniformity of outcomes)
Interpret trends and patterns in complex data sets.	CMDA 2014: Data Matter STAT 3005: Statistical Methods or STAT 3604: Statistics for Social Sciences ECON 3254: Analysis of Economic Data BDS/PSYC 4194: Predicting Social Behavior	Formative: laboratory exercises where students analyze novel datasets. Summative: final project (e.g., analyzing and interpreting large complex data set)
Analyze the sequence of building a predictive model of behavior.	BDS/PSYC 4194: Predicting Social Behavior	Formative: class discussions; laboratory exercises where students develop research questions and construct a predictive model Summative: midterm and final examination (e.g., items on the exam that require students to exam a model and identify relevant versus irrelevant predictors in a path)
Evaluate the quality, bias, and generalizability of a model's predictions.	BDS/PSYC 4194: Predicting Social Behavior	Formative: class discussions; class activities (e.g., class discussion of model bias having to do with starting

		assumptions) Summative: final project (e.g., demonstration of how a change in basic assumptions in a model can lead to two different modeled outcomes within the same data set)
Articulate the major economic, psychological and neuroscientific models of individual and group decision making.	BDS 2005: Fundamentals of Behavioral Decision Science BDS 2006: Fundamentals of Behavioral Decision Science	Formative: class discussions; decision making scenario-based exercises (e.g., a presentation on deciding right from wrong depending on the context of the ethical paradox) Summative: midterm and final examination (e.g., items on the exam about problem framing and its effects on decision making)
Summarize major behavioral regularities which violate the rational choice paradigm.	BDS/ECON 3134: Choice and Behavior (3 credits)	Formative: class discussions; class participation; scenario based exercises (e.g., presentation on a case study of irrational behavior) Summative: midterm and final exams (e.g., items on the exam about conflicts between rational choice and personal preferences)

Employment Skills/Workplace Competencies

Graduates of the proposed program will be qualified for employment in a multitude of businesses and industries (both for profit and non-profit). Students who graduate from the proposed degree program will possess the following employment-related skills:

- Orchestrate the collection of data for the analysis of risk and strategy.
- Interpret data to improve decision making.
- Conduct analyses of large, complex data sets and cull information from these data sets to inform decision outcomes.
- Build strong relationships and collaborations across units that write code for data analysis projects, units that primarily deal with data analysis, and upper administration that invest in the interpretation and implementation of data for decisions.

- Engage in productive practices for strategic planning and program/policy evaluation.
- Integrate principles of decision making across psychology, economics, and neuroscience domains to inform recommendations on best practices to employers.
- Present written, oral, and graphic information on data modeling and data interpretation to technical and non-technical audiences.

Program Assessment

Annually, the College of Science, through the Academy of Integrated Science (AIS), will engage in systematic curriculum assessment and provide a yearly survey that assesses students' progress and satisfaction with the program. Each semester during the academic year, the AIS (in cooperation with the Departments of Economics, Psychology, Statistics, and the School of Neuroscience) will review faculty evaluations. Faculty will utilize the results of surveys to assess the program. Students in courses selected for curriculum evaluation will be asked to indicate how well the learning objectives have been addressed by the course. The AIS will conduct and report annual assessments of student learning outcomes beginning in 2021 in accordance with Assessment and Evaluation in Virginia Tech's Office of Academic Decision Support. Following the initial year, 2-3 student learning outcomes will be assessed annually and submitted to the Office of Assessment and Evaluation, with all outcomes being assessed at least once in 5 years. Assessments of student learning outcomes and competencies will be embedded within each course and will be administered through normal processes already in place, such as tests, written papers, oral presentations, and project work.

In addition to annual assessment reports, each academic department at Virginia Tech participates in academic program review approximately every five years. Virginia Tech's Academic Program Review process requires programs to conduct a comprehensive evaluation of their activities. This process provides a mechanism for ongoing, systematic review of academic departments with the explicit purpose of fostering continuous improvement. The review process emphasizes reflection, analysis, conversation, and feedback; an honest assessment of program strengths/weaknesses/opportunities for improvement; and documentation of resource needs. The results of this process are intended to facilitate a strong vision for the future.

The level of analysis for this review is the academic department inclusive of all degree, certificate, intercollege, and online programs. In addition to reviewing academic programs, departments are asked to provide an overview of the department and information in the following areas: student learning and support; faculty and staff profiles (research/creative activity/scholarly work); teaching, outreach, and international involvement; and inclusion and diversity. The department is expected to discuss its vision for the department over the next five years and include improvement strategies and plans.

As part of the Academic Program Review process, departments complete a self-study report that is reviewed and evaluated by a team of peer reviewers. Reviewers may be internal to Virginia Tech and/or external to Virginia Tech depending upon the department's preferences and resources. Departments are given comprehensive feedback from the review team that includes information on the department's strengths and opportunities for further reflection and action. The next periodic report encompassing this new degree will take place in Fall 2025.

Benchmarks of Success

The proposed B.S. in Behavioral Decision Science program will be considered successful if:

- It maintains an ongoing enrollment of 80 or more majors by the target year
- 80% of students that enter the degree as first-year students complete the program requirements in 4 years
- 75% of graduates secure employment in business, government, health, and/or allied-related fields within one year of graduation
- 25% of graduates enter a professional or graduate degree program within one year of graduation
- 75% of employers remain satisfied with graduate job performance after 2 years

Annual assessment data will allow program administration and faculty to determine if the benchmarks are being reached. If any benchmark is not being met, the program leadership and faculty members will determine appropriate strategies to correct any deficiencies. Strategies may include a comprehensive review of the advising approaches and the program coursework to include course sequencing in the plan of study, course content, and the selection of elective courses. For example, if employment related data does not meet benchmarks, eliciting targeted feedback from alumni as well as employers who have hired graduates of the proposed degree program will be used for strategic planning for improvement.

Expansion of Existing Programs

The proposed B.S. in Behavioral Decision Science program is not an expansion of an existing certificate, concentration, emphasis, focus, major, minor, or track currently offered at Virginia Tech.

Relationship to Existing Virginia Tech Degree Programs

The proposed program is not similar to and will not adversely affect other degree programs at Virginia Tech.

Compromising Existing Degree Programs

No degree programs will be compromised or close as a result of the initiation and operation of the proposed degree program.

Collaboration or Standalone

This is a standalone program. No other organization was involved in its development, and no other organization will collaborate in its operation.

Justification for the Proposed Program

Response to Current Needs (Specific Demand)

We now live in a world awash with data, and across the U.S., undergraduate degree programs that train students in data analytics are proliferating. However, the effective bridge from data analysis to implementation requires a focus on *human behavior*: Given information, why do humans make choices that can be detrimental to their well-being in the long run? How do humans weigh the differential consequences of their options to maximize gain? What biases exist in different contexts that lead individuals, groups, corporations and governments to settle for less-than-optimal decision strategies? Current degree programs in data analytics often miss the whole understanding of how humans act in the environment. As Lars Hansen, the David Rockefeller Distinguished Service Professor of economics at the University of Chicago and a

2013 recipient of the Nobel Memorial Prize in Economics, stated "Data seldom, if ever, speaks for itself. To use data effectively requires valid and revealing conceptual frameworks for understanding and interpreting patterns in data. Uncertainty as confronted by decision makers necessarily includes challenges for how best to use data in insightful ways."⁴

The data deluge around us makes it imperative for the new generation of students to not only have the right skills for synthesizing, interpreting, and asking the appropriate questions from the myriad of information sources that they will be required to process in their daily work, but to also understand basic theories and mechanisms of decision making. Behavioral decision science bridges the gap between data and action by blending the theories and methods of psychology, economics, neuroscience, all bounded by current best practices in statistics. A better understanding of human behavior that brings together insights from these different disciplines is critical to improving the judgment and decision making of individuals, groups, and organizations, and will be key to the design of policies for improving lives today and in the future. These insights will also facilitate the understanding of what data need to be collected and from whom so that analyses can yield better understanding of behavior and decisions. Thus the behavioral focus of the proposed B.S. in Behavioral Decision Science provides the complete framework to identify the essential variables in big and small data and will act as the link between information acquisition, information processing and our actions. In doing so, the proposed degree will connect behavior with data analytics and train undergraduate students in the emerging field of causal behavior analytics.

The need for undergraduates trained in behavioral decision science can be seen across several general domains, such as government, industry, and healthcare. Applications of behavioral decision science in these arenas are rapidly increasing. Thus, the relevance of students trained in behavioral decision science extends across several applied fields of human functioning. A discussion of these three areas of application (government, industry, healthcare) is used below to illustrate the timeliness of the proposed degree program for this growing market.

Government Applications of Behavioral Decision Science

In terms of the government workforce, more than 60 governments in 23 countries around the world have pioneered best practices based on behavioral decision science. Governments have increasingly used behavioral decision science to improve the well-being of their constituents. The growing demand for behavioral decision science education is parallel to the increase of access to more data and more complex decisions.⁵ In 2010 the UK established the "Behavioural Insights Team" (BIT), also known unofficially as the "Nudge Unit", to apply behavioral economics and psychology to try to improve government policy and services. Today, BIT is now a semi-private corporation with offices around the world, including New York. As Ben Quinn of *The Guardian* reports, "BIT's clients range from governments and public bodies to the World Bank, and its work spans traditional "nudge" territory – such as using behavioral psychology to

⁴ Schrage, A. (2018). A Nobel-winning economist's tips for how to deal with a more uncertain world. Retrieved from Quartz, November 14. (https://qz.com/1417105/lars-hansen-a-nobel-winning-economist-has-tips-for-dealing-with-uncertainty/?fbclid=IwAR38gf_2zbZrPIVhpOf44FKBvF-oXBN3svR6k2QC4uD0WUSDbJFHgr6RO4c)

⁵ Bloomberg Cities (2017). Behavioral science is quietly revolutionizing city governments. July 11. (<https://medium.com/@BloombergCities/behavioral-science-is-quietly-revolutionizing-city-governments-74615a0ec2f>).

prompt people to pay their taxes or make better use of public services – to involvement with Colombia’s peace process.”⁶

Success from this program has led to the United States adopting a similar program. The White House Office of Science and Technology Policy has a "Social and Behavioral Sciences Initiative", whose goal is to translate academic research findings into improvements in federal program performance and efficiency using rigorous evaluation methods. In 2015, President Obama issued an Executive Order that formally established the Social and Behavioral Sciences Team (SBST) and directed government agencies to use insights from the social and behavioral sciences to improve the efficiency and effectiveness of their work. The SBST has worked with more than 20 federal agencies on 70 projects, from easing health-insurance enrollment, to helping veterans access education benefits, to relieving student debt. Related, the U.S. Department of Agriculture has also funded behavioral science initiatives to improve the health of welfare recipients by easing the process of obtaining SNAP benefits and promoting consumption of healthier diets. Subsequently, other countries such as Singapore and Australia have also developed their own Behavioral Insight teams. BIT has even documented a new technique that reduces paperwork and builds confidence in job applicants, resulting in a 17.5% increase in moving individuals into the work force and off of federal assistance.⁷

Industry Applications of Behavioral Decision Science

Firms and governments are turning to behavioral decision science at an unprecedented rate.⁸ In terms of the general industrial workforce, there are numerous businesses using behavioral decision science who have already made a big splash. One prominent example is the startup, Lemonade Insurance Company. Under the traditional model, insurer’s and users’ incentives are fundamentally misaligned. Every successfully paid claim reduces the insurance company’s profit, hence the difficulty in getting them accepted in the first place (which, in turn, encourages fraudulent behavior by users). To correct for this, Lemonade takes 20% of premiums as a flat fee to cover its costs and earn profit. This solution removes the financial conflict of interest from the organization. The company’s policies helps facilitate honesty from customers by requesting honesty pledges at the beginning (compared to the end) of a claim and donating surplus premiums to the customer’s preferred charity, which lessens their financial interest in overclaiming. This is a potent example of behavioral decision principles being applied to real-world consumer practices.

Another example is Timeful Inc, who developed the Timeful app that offers a central location for time management, calendar functions, to-do list and scheduling features. The application incorporates behavioral decision science research by emphasizing understanding people’s

⁶ Quinn, B. (2018). The ‘nudge unit’: the experts that became a prime UK export. Retrieved from The Guardian, November 10. <https://www.theguardian.com/politics/2018/nov/10/nudge-unit-pushed-way-private-sector-behavioural-insights-team>.

⁷ Boffey, D. (2012). Writing exercises help jobseekers find work, claims government's nudge unit. Retrieved from The Observer, December 29. <https://www.theguardian.com/politics/2012/dec/30/jobseekers-dole-nudge-unit-psychology>

⁸ Righter, G., & Metzler, B. (2019). Strategic Decisions Group and Pownoodle bring next-generation decision processes and digital technology to the 'everyday decision' world. Retrieved from Cision, February 28. https://www.prweb.com/releases/strategic_decisions_group_and_pownoodle_bring_next_generation_decision_processes_and_digital_technology_to_the_everyday_decision_world/prweb16135915.htm.

schedule, habits and needs. Users can tell Timeful they want to exercise three times a week or that they need to call the bank by next Tuesday, and the Timeful system will make sure they get it done based on an understanding of both their schedule and priorities. Timeful Inc was acquired by Google in 2015.

Further, a number of leading companies have dedicated behavioral science teams including Walmart, Pepsico, and Morningstar. Likewise, nearly 50 tech companies including Google, Microsoft, Airbnb, Uber, Facebook, and numerous smaller companies have been emphasizing hiring behavioral scientists. The New York Times⁹ has reported that the need for workers who can identify optimal choices and key areas for behavioral change is growing, and assisted by increases in technology. Thus, the big data revolution and increase in job demand of analytics is tandem with the demand to draw inferences from that data and form a bridge between engineers and implementation.

Health and Healthcare Applications of Behavioral Decision Science

In terms of the health care workforce, the lessons of behavioral decision science offer strategies and theories to help health organizations seeking to improve the lives of others. Behavioral decision science can significantly improve health and well-being of people and society at large, saving people's life. Indeed, as recent Nobel Laureate Richard Thaler and his co-author, Cass Sunstein, said in their popular 2008 book, *Nudge*¹⁰, "By knowing how people think, we can make it easier for them to choose what is best for them, their families and society."

The discovery and implementation of nudges to promote societal flourishing, for example by improving health outcomes, is a rapidly growing area of interest. A striking illustration of this comes from a recent study finding that by reducing the default number of pills in a prescription, the overall level of prescribed opioids fell by 15%¹¹. Nudges have been tremendously effective at promoting early medical screening for deadly diseases, increasing organ donation rates, and reshaping medical packages to reduce suicide by pills ingestion – one of the major challenges of the modern world. These are just a few of the myriad of examples demonstrating the effectiveness of nudges in policy design.

Another example of a company addressing current societal issues, such as obesity, with behavioral decision science is Shapa, a company who designed a scale that promotes healthy behaviors and by addressing the "loss aversion" people feel when they find their weight has slightly increased, even though weight can fluctuate as much as three pounds on a given day. This negative feedback can prevent people from making healthy decisions, despite being useless as an indication of the person's progress. Instead, the Shapa scale is designed to create reminders to encourage healthy decisions and to present a coarse measure of weight on a five-point scale (i.e., people are either a little better, a little worse, much better, much worse, or basically the same). The rating system takes into account the way people actually gain and lose weight, allowing users to focus on progress rather than daily variation. In a randomized controlled trial,

⁹ Wakabayashi, D. (2018). Firm led by Google veterans uses A.I. to 'nudge' workers toward happiness. Retrieved from the New York Times, December 31. <https://www.nytimes.com/2018/12/31/technology/human-resources-artificial-intelligence-humu.html>.

¹⁰ R. H. Thaler & C. R. Sunstein (2008). *Nudge*. Yale University Press.

¹¹ Chaudhary, N. (2018). *Can we nudge our way to responsible opioid prescribing?* Retrieved from ABC News, August 2. <https://abcnews.go.com/Health/nudge-achieve-responsible-opioid-prescribing-column/story?id=56962488>.

on average, people using a standard scale gained 0.91% of their body weight per month. However, those using Shapa scale lost 0.61% body weight per month.

By combining economics, psychology, and neuroscience into one cohesive *Behavioral Decision Science* degree, Virginia Tech will be at the national and international forefront in preparing students to address the demands of law and governance bodies, industry, and health care organizations. Moreover, the graduates from this program will be well-prepared and competitive for entry into advanced degree programs in behavioral decision sciences across the U.S. and abroad. Given how nascent this developing area is, this degree allows Virginia Tech to become a pioneer in this space.

Employment Demand

The proposed B.S. degree in Behavioral Decision Science will prepare students to seek entry-level positions in today's pioneering businesses (Amazon, Uber, Facebook, etc.), as well as positions in government, management and political consulting, and the non-profit sector. The graduates of this program will be prepared to enter the work force in the areas of network analysis and public policy, risk management, consulting, and decision-making in legal and medical contexts. Additionally, graduates from the B.S. Behavioral Decision Science will be ideal candidates for graduate study at both master's and doctoral levels in decision science, as well as other advanced areas such as psychology, economics, business, law and public health.

The Bureau of Labor Statistics and the Virginia Employment Commission do not currently provide specific job data for a job title called "behavioral decision scientist." Behavioral decision science is an interdisciplinary field, and employment projections need to be considered for the types of jobs requiring the skills provided. Gains are projected to occur in related employment categories for which Behavioral Decision Science will provide excellent preparation (e.g., Operation Research Analysts, Management Analysts, Marketing Managers, and Market Research Analysts). The high growth rates in projected demand are clear indicators of the value and prescience of the interdisciplinary Behavioral Decision Science degree.

Table 1: Employment Projections from the Bureau of Labor Statistics, 2018-2028 (BLS)

Occupational Title	SOC Code	Employment, 2018	Projected Employment, 2028	Change, 2018-28	
				Percent	Numeric
Operation Research Analysts ¹²	15-2031	109,700	137,900	26%	28,100
Management Analysts ¹³	13-1111	876,300	994,600	14%	118,300
Marketing Managers ¹⁴	11-2021	259,200	280,100	8%	20,900

¹² U.S. Department of Labor, Bureau of Labor Statistics, accessed 26 September 2019, <https://www.bls.gov/ooh/math/operations-research-analysts.htm#tab-6>

¹³ U.S. Department of Labor, Bureau of Labor Statistics, accessed 26 September 2019, <https://www.bls.gov/ooh/business-and-financial/management-analysts.htm#tab-6>

¹⁴ U.S. Department of Labor, Bureau of Labor Statistics, accessed 26 September 2019, <https://www.bls.gov/ooh/management/advertising-promotions-and-marketing-managers.htm#tab-6>

Market Research Analysts ¹⁵	13-1161	681,900	821,100	20%	139,200
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Table 3: Employment Projections from the Virginia Employment Commission (VEC), 2016-2026

Occupation Title	SOC Code	2016 Estimated Employment	2026 Projected Employment	Total 2016-2026 Employment Change	Total Percent Change	Annual Change
Operation Research Analysts	15-2031	8,097	11,055	2,958	36.53%	296
Management Analysts	13-1111	57,824	68,510	10,686	18.48%	1,069
Marketing Managers	11-2021	3,992	4,506	514	12.88%	51
Market Research Analysts	13-1161	19,241	24,390	5,149	26.76%	515

Source: Virginia Employment Commission, Labor Market Information¹⁶

Comparing Tables 2 and 3, the strong projected demand at the national level is, in every case, exceeded in Virginia. Not only is there experienced growth within the core area, but students who acquire a double major, or a minor, to complement their Behavioral Decision Science degree, will also be competitive in other fields that utilize data driven decisions, but lack the behavioral component as part of the training.

Further, Behavioral Decision Science related careers are likely to continue growing well into the future as they are relatively protected from automation. “The hardest activities to automate with currently available technologies are those that involve managing and developing people, or that apply expertise to decision making, planning, or creative work.”¹⁷

See Appendix X for employment announcements.

See Appendix X for letters of employment demand.

Student Demand

Students from the College of Science were surveyed about interest in the proposed B.S. Behavioral Decision Science degree in fall 2019. The survey provided encouraging results for the program. Of the xxx students who responded, xxx were either freshmen or sophomores. Of these xxx responders, xx (x%) indicated that they would definitely consider the major, xx (x%)

¹⁵ U.S. Department of Labor, Bureau of Labor Statistics, accessed 26 September 2019, <https://www.bls.gov/ooh/business-and-financial/market-research-analysts.htm#tab-6>

¹⁶ Virginia Employment Commission, Labor Market Information, accessed 26 September 2019, <https://virginiaworks.com/occupational-projections/>

¹⁷ <https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/where-machines-could-replace-humans-and-where-they-cant-yet>

indicated that they would be highly likely to consider the degree program, and xx (xx%) said they would likely consider the major. There was also considerable interest in Behavioral Decision Science as a second major.

See Appendix X for the original survey. Results are included as a separate document behind the survey.

See Appendix X for prospective students' emails.

STATE COUNCIL OF HIGHER EDUCATION FOR VIRGINIA
SUMMARY OF PROJECTED ENROLLMENTS IN PROPOSED PROGRAM

Projected enrollment:

Year 1		Y						Year 5 Target Year (4-year institutions)		
<u>2020 - 2021</u>		<u>2</u>		<u>2022 - 2023</u>		<u>2023</u>		<u>2024 - 2025</u>		
<u>HDCT</u>	<u>FTES</u>	<u>HDCT</u>	<u>FTES</u>	<u>HDCT</u>	<u>FTES</u>	<u>HDCT</u>	<u>FTES</u>	<u>DCT</u>	<u>FTES</u>	<u>GRAD</u>
<u>20</u>	<u>20</u>	<u>40</u>	<u>40</u>	<u>60</u>	<u>60</u>	<u>80</u>	<u>80</u>		<u>80</u>	<u>18</u>

Assumptions:

Retention percentage: 90%

Percentage of full-time students 100%

Percentage of part-time students 0%

Full-time students credit hours per semester: 15

Full-time students graduate in 4 years

Duplication

No public institution in the Commonwealth offers a Bachelor of Science (B.S.) in Behavioral Decision Science.

At the national level, the B.S. in Decision Science offered by Carnegie Mellon University is closest to Virginia Tech's new undergraduate degree program. Currently Carnegie Mellon offers the only undergraduate major in the nation that integrates analytical and behavioral approaches to decision making. This major is grounded in theories and methods drawn from psychology, economics, philosophy, statistics, and management science. In addition to gaining a broad education in the principles of judgment and decision making, Carnegie Mellon's Decision Science majors gain broadly applicable skills in research design and analysis. The core courses present fundamental theories and results from the study of decision making, along with their application to real-world problems. They also introduce students to methods for collecting and analyzing behavioral data. Finally, the elective courses provide students with additional knowledge in areas of decision making that meet their personal, intellectual, and career goals. The B.S. programs from Carnegie Mellon and Virginia Tech have similarities in the degree design, topics covered, and program outcomes.

Also of interest is the concentration in Behavioral Decision Sciences for the AB degree offered by Brown University. By virtue of its broad interdisciplinary nature, the study of decision making at Brown University covers work found in a variety of more traditional disciplines including psychology, cognitive science, economics, philosophy, computer science, and neuroscience. The requirements for the concentration includes 13 courses where only one is common for all students that declare the concentration, the others being chosen from various restricted lists so that the students can tailor the concentration to their interests. Both in its design and in its implementation this concentration differs greatly from Virginia Tech's B.S. in Behavioral Decision Science.

Other universities outside of Virginia offer B.S. degrees in Decision Science located in Business Schools. The purpose and goals of these business degrees are very different from those of the science-based degree program offered by Virginia Tech. For one, Decision Science degrees in business schools are solely focused on business analytics with a heavy emphasis on marketing and supply chain management. They rarely extend their curricula to economic, psychological and/or neurobiological theories of choice and decision behavior. Second, these business degrees seek students from backgrounds in business and computer science, but rarely from scientific disciplines. Third, these degrees are mostly designed at the executive masters and doctorate levels.

Projected Resource Needs for the Proposed Program

Resource Needs

Virginia Tech, the College of Science, and the Academy of Integrated Science have the resources needed to initiate and sustain the proposed degree program. The following categories detail the resources needed to initiate and sustain the proposed program from its initiation in 2020-2021 through the target year 2024-2025. Assessments of need for full-time faculty, part-time faculty, and adjunct faculty are based on the ratio of 1.0 FTE of instructional effort for every 20 FTE students in lower division courses and 14 FTE students in upper division courses for an average of 1.0 FTE faculty instructional effort for every 17 FTE students. The proposed program will require a total of 1.75 FTE faculty instructional effort in 2020-2021, rising to 4.85 faculty instructional effort by the target year of 2024-2025.

Full-time Faculty

In the initial year, 2020-2021, one faculty member who currently teaches in the Department of Psychology will be reallocated to dedicate 1.0 FTE instructional effort to the proposed degree program. One faculty member who currently teaches in the Department of Economics will be reallocated to dedicate 0.50 FTE instructional effort to the proposed degree program.

In year 2, 2021-2022, the new faculty member hired in year 1 to serve as program director for the proposed program, will be reallocated to dedicate 0.75 FTE instructional effort to the proposed degree program. The representative portion of the faculty member's salary and fringe benefits equals \$165,000 in salary and \$54,450 in fringe benefits for a total of \$219,450.

Part-time Faculty

In the initial year, 2020-2021, one faculty member who currently teaches in the Department of Economics will be reallocated to dedicate 0.25 FTE instructional effort the proposed program.

The proposed degree program will require an additional total of 2.35 FTE instructional effort of part-time faculty by the target year.

Three current faculty members from the Department of Psychology will be reallocated to dedicate 0.35 FTE instructional effort each to the proposed program for a total of 1.05 FTE.

Two current faculty members from the Department of Economics will be reallocated to dedicate 0.35 FTE instructional effort each to the proposed program for a total of 0.70 FTE.

Two current faculty members from the Department of Statistics will be reallocated to dedicate 0.30 FTE instructional effort to the proposed program for a total of 0.60 FTE.

Adjunct Faculty

No adjunct faculty are required to initiate or sustain the proposed degree program.

Graduate Assistants

In the initial year, 2020-2021, two new graduate teaching assistants (GTA) will be needed to support the proposed degree program. Each GTA will receive a salary of \$10,775 and fringe benefits of \$1,212 per academic year. The 2 GTAs will receive salaries of \$21,550 and fringe benefits of \$2,424 for a total of \$23,974.

By the target year, 2024-2025, a total of 4 graduate teaching assistants (GTA) will be needed to support the proposed degree program. Each GTA will receive a salary of \$10,775 and fringe benefits of \$1,212 per academic year. The 4 GTAs will receive salaries of \$43,100 and fringe benefits of \$4,848 for a total of \$47,948.

Classified Positions

In the initial year, 2020-2021, one new faculty member will be hired to dedicate 0.25 FTE administrative effort to the proposed degree program as the program director. The faculty member will be hired at the associate or full professor rank. The representative portion of the faculty member's salary and fringe benefits as program director equal \$55,000 in salary and \$18,150 for a total of \$73,150.

In the initial year, 2020-2021, one professional advisor will be hired to support the proposed degree program. The advisor will be hired with an approximate salary of \$45,000 and fringe benefits of \$24,525 for a total of \$69,525.

Targeted Financial Aid

No targeted financial aid will be available or is needed to initiate and sustain the proposed program.

Equipment (including computers)

One new computer will be purchased to support the new professional advisor hire for the proposed program. The computer is estimated at a cost of \$2,500.

One new computer will be purchased to support the new faculty member who will serve as the program director for the proposed program. The computer is estimated at a cost of \$4,000

Existing office furniture will be used for both the new professional advisor and the new faculty member.

Library

No new library resources are needed to initiate or sustain the proposed degree program. The Virginia Tech Library has adequate and appropriate resources for faculty and student research, teaching, and learning to support the proposed degree program in the form of books, journals, and online journals and subscriptions such as the Virtual Library of Virginia (VIVA).

Telecommunications

No additional telecommunications costs are needed to initiate or sustain the proposed degree program. Existing telecommunication systems are in place and will be used for the new professional advisor position and for the new program director hire.

Space

No new space is needed to initiate and sustain the proposed degree program. Office space is available in the College of Science for the new professional advisor position, and in the Academy of Integrated Science as well as the home department for the new director hire.

Other Resources (specify)

In the initial year, 2020-2021, the 2 Graduate Teaching Assistants (GTAs) will be provided tuition remission at the rate of \$17,739 per student per academic year. The tuition remission for the 2 GTAs will total \$35,478.

By the target year, 2024-2025, two additional GTAs will be needed for a total of 4 GTAs. The tuition remission for the 4 GTAs will total \$70,956 per academic year. The tuition remission for the 4 GTAs will be approximately \$319,572 cumulatively.

Resource Needs: Parts A-D

Part A: Answer the following questions about general budget information.

- Has the institution submitted or will it submit an addendum budget request to cover one-time costs? Yes No
- Has the institution submitted or will it submit an addendum budget request to cover operating costs? Yes No
- Will there be any operating budget requests for this program that would exceed normal operating budget guidelines (for example, unusual faculty mix, faculty salaries, or resources)? Yes No
- Will each type of space for the proposed program be within projected guidelines? Yes No
- Will a capital outlay request in support of this program be forthcoming? Yes No

Part B: Fill in the number of FTE and other positions needed for the program

	Program Initiation Year 2020 – 2021		Expected by Target Enrollment Year 2024 – 2025	
	On-going and reallocated	Added (New)	Added (New)***	Total FTE positions
Full-time faculty FTE*	1.50		0.75	2.25
Part-time faculty FTE **	0.25		2.35	2.60
Adjunct faculty				0.00
Graduate assistants (HDCT)		2.00	2.00	4.00
Classified positions		1.25		1.25
TOTAL	1.75	3.25	5.10	10.10

*Faculty dedicated to the program. **Faculty effort can be in the department or split with another unit.

*** Added **after** initiation year

Part C: Estimated resources to initiate and operate the program

	Program Initiation Year 2020-2021		Expected by Target Enrollment Year 2024-2025	
Full-time faculty	1.50	0.00	0.75	2.25
salaries	\$142,500		\$165,000	\$307,500
fringe benefits	\$47,025		\$54,450	\$101,475
Part-time faculty (faculty FTE split with unit(s))	0.25	0.00	2.35	2.60
salaries	\$25,000		\$300,000	\$325,000
fringe benefits	\$8,250		\$99,000	\$107,250
Adjunct Faculty	0.00	0.00	0.00	0.00
salaries				\$0
fringe benefits				\$0
Graduate assistants	0.00	2.00	2.00	4.00
salaries		\$21,550	\$21,550	\$43,100
fringe benefits		\$2,424	\$2,424	\$4,848
Classified Positions	0.00	1.25	0.00	1.25
salaries		\$100,000		\$100,000
fringe benefits		\$42,675		\$42,675

Personnel cost				
salaries	\$167,500	\$121,550	\$486,550	\$775,600
fringe benefits	\$55,275	\$45,099	\$155,874	\$256,248
Total personnel cost	\$222,775	\$166,649	\$642,424	\$1,031,848
Equipment		\$6,500		\$6,500
Library				\$0
Telecommunication costs				\$0
Other costs		\$35,478	\$284,094	\$319,572
TOTAL	\$222,775	\$208,627	\$926,518	\$1,357,920

Part D: Certification Statement(s)

The institution will require additional state funding to initiate and sustain this program.

Yes _____
Signature of Chief Academic Officer

No _____
Signature of Chief Academic Officer

Please complete Items 1, 2, and 3 below.

1. Estimated \$\$ and funding source to initiate and operate the proposed program.

Funding Source	Program initiation year 2020 - 2021	Target enrollment year 2024 - 2025
Reallocation within the department <i>(Note below the impact this will have within the department.)</i>	\$0	\$0
Reallocation within the school or college <i>(Note below the impact this will have within the school or college.)</i>	\$431,402	\$1,357,920
Reallocation within the institution <i>(Note below the impact this will have within the institution.)</i>	\$0	\$0
Other funding sources <i>(Specify and note if these are currently available or anticipated.)</i>	\$0	\$0

2. Statement of Impact/Funding Source(s). A separate detailed explanation of funding is required for each source used and a statement of impact on existing resources.**Reallocation within the school or college**

The College of Science will fund the proposed degree program through a combination of salary savings (e.g., retirements and vacated faculty lines) and from Virginia Tech's incentive-based performance budget which generates revenue directly to the college.

In the initial year, 2020-2021, the College of Science will reallocate existing resources to fund the hires of the program director position (0.25 FTE) and the professional advisor position (1.0 FTE). The portion of the program director's total salary dedicated to administrative duties for the proposed program equals \$55,000 with fringe benefits of \$18,150 for a total of \$73,150. The professional advisor will receive \$45,000 in salary and \$24,525 in fringe benefits for a total of \$69,525. The total combined salary costs for the new hires in the initial year equal \$100,000 and fringe benefits of \$42,675 for a total cost of \$142,675.

The college has sufficient funds to support the equipment costs (including computers) for the new program director position and the professional advisor position totaling \$6,500.

In the initial year, 2020-2021, the college will reallocate resources for one faculty member who currently teaches in the Department of Psychology to dedicate 1.0 FTE instructional effort to the proposed degree program. The faculty member's salary will be \$95,000 and fringe benefits of \$31,350 for a total cost of \$126,350.

In the initial year, 2020-2021, the college will reallocate resources for one faculty member who currently teaches in the Department of Economics to dedicate 0.5 FTE instructional effort to the proposed degree program. The portion of the faculty member's salary dedicated to the program will be \$47,500 and fringe benefits of \$15,675 for a total cost of \$63,175.

In the initial year, 2020-2021, the college will reallocate resources for one faculty member who currently teaches in the Department of Economics to dedicate 0.25 FTE instructional effort to the proposed degree program. The portion of the faculty member's salary dedicated to the program will be \$25,000 with \$8,250 in fringe benefits for a total cost of \$33,250.

In the initial year, 2020-2021, the college will reallocate resources to fund 2 graduate teaching assistants (GTAs) for the proposed degree program. Combined, the 2 GTAs will receive salaries of \$21,550 and fringe benefits of \$2,424 for a total of \$23,974.

In the initial year, 2020-2021, the college will reallocate resources to fund tuition remission for the 2 graduate teaching assistants (GTAs) for the proposed degree program. Each GTA will receive tuition remission in the amount of \$17,739 for a combined total of \$35,478.

In year 2, 2021-2022, the college will reallocate resources for the faculty member hired as the program director within the initial year to be reallocated to dedicate 0.75 FTE instructional effort to the proposed degree program. The portion of the faculty member's salary dedicated to instruction for the proposed program equals \$165,000 and \$54,450 in fringe benefits for a total of \$219,450.

By the target year, 2024-2025, the college will reallocate resources for 3 faculty members who currently teach in the Department of Psychology to dedicate 0.35 FTE each for a combined FTE of 1.05 FTE instructional effort to the proposed degree program. The representative portion of the faculty members' salaries equal \$140,000 with fringe benefits of \$46,200 for a total of \$186,200.

By the target year, 2024-2025, the college will reallocate resources for 2 faculty members who currently teach in the Department of Economics to dedicate 0.35 FTE each for a combined FTE of 0.70 FTE instructional effort to the proposed degree program. The representative portion of the faculty members' salaries equal \$90,000 with fringe benefits of \$29,700 for a total of \$119,700.

By the target year, 2024-2025, the college will reallocate resources for 2 faculty members who currently teach in the Department of Statistics to dedicate 0.30 FTE each for a combined FTE of 0.60 FTE instructional effort to the proposed degree program. The representative portion of the faculty members' salaries equal \$70,000 with fringe benefits of \$23,100 for a total of \$93,100.

By the target year, 2024-2025, the college will reallocate resources to fund 2 additional graduate teaching assistants (GTAs) for a total of 4 GTAs for the proposed degree program. The 4 GTAs will receive a total of \$43,100 in salary and \$4,848 in fringe benefits for a total of cost of \$47,948.

By the target year, 2024-2025, the college will reallocate resources to fund tuition remission for 2 additional graduate teaching assistants (GTAs) for a total of 4 GTAs for the proposed degree program. Each GTA will receive tuition remission in the amount of \$17,739. Cumulative tuition remission costs for the 4 GTAs equals \$319,572.

The College of Science and associated departments (Psychology, Economics, and Statistics) have sufficient existing resources to support the salaries and fringe benefits for the new hires and faculty reallocations and for the graduate teaching assistants' salaries, fringe benefits, and tuition remission. No additional funds will be needed because existing resources will be utilized. The reallocation of these resources will not negatively impact any other academic program in the college or college resources. The reallocation of these resources will not negatively impact any other program in the departments of Psychology, Economics, or Statistics or departmental resources.

3. Secondary Certification.

If resources are reallocated from another unit to support this proposal, the institution will **not** subsequently request additional state funding to restore those resources for their original purpose.

Agree _____
Signature of Chief Academic Officer

Disagree _____
Signature of Chief Academic Officer

Appendices

Appendix A
Sample Plan of Study

Full-time students

Year	Fall Semester	Spring Semester
First Year	General Education (3)	PSYC 1094: Principles of Psychological Research (3)
	General Education (3)	General Education (3)
	General Education (3)	General Education (3)
	General Education (3)	General Education (3)
	General Education (3)	General Education (3)
Second Year	BDS 2005: Fundamentals of Behavioral Decision Science (3)	BDS 2006: Fundamentals of Behavioral Decision Science (3)
	PSYC 2064: Introduction to Neuroscience of Behavior (3)	CMDA 2014: Data Matter (3)
	Theme 1 Restricted Elective Course (3)	Theme 2 Restricted Elective Course (3)
	General Education (3)	General Education (3)
	General Education (3)	General Education (3)
Third Year	STAT 3604: Statistics for Social Sciences (3)	ECON 3254: Analysis of Economic Data (3)
	BDS/ECON 3134: Choice and Behavior (3)	Theme 2 Restricted Elective Course (3)
	Theme 1 Restricted Elective Course (3)	General Education (3)
	Free Elective Course (3)	Free Elective Course (3)
	Free Elective Course (3)	Free Elective Course (3)
Fourth Year	Theme 1 Restricted Elective Course (3)	BDS/PSYC 4194: Predicting Social Behavior (3)
	General Education (3)	Theme 2 Restricted Elective Course (3)
	Free Elective Course (3)	Free Elective Course (3)
	Free Elective Course (3)	Free Elective Course (3)
	Free Elective Course (3)	Free Elective Course (3)

Credit Hours – First Year – Fall Term	15
Credit Hours – First Year – Spring Term	15
Credit Hours – Second Year – Fall Term	15
Credit Hours – Second Year – Spring Term	15
Credit Hours – Third Year – Fall Term	15
Credit Hours – Third Year – Spring Term	15
Credit Hours – Fourth Year – Fall Term	15
Credit Hours – Fourth Year – Spring Term	15
TOTAL CREDIT HOURS	120

Appendix B Course Descriptions

New courses are denoted with an asterisk (*).

Core Courses

PSYC 1094: Principles of Psychological Research (3 credits)

Philosophical foundation and ethical issues in psychological research. Research design and methodology. Analytic approaches to developing, understanding, interpreting psychological data.

*BDS 2005: Fundamentals of Behavioral Decision Science (3 credits)

Introduction to the major scientific models of decision making and applications to real-life situations. Economic models highlighting optimal choices and psychological models highlighting decision making tendencies. Emphasis on individual decision making in non-strategic choice settings. Probabilistic reasoning and economic model of rationality. Violations of the rational choice model, and psychological, physiological, and statistical models that accommodate this behavior. Applications to social settings and longer periods of time. Common ethical dilemmas and making ethical choices as an individual.

*BDS 2006: Fundamentals of Behavioral Decision Science (3 credits)

Introduction to the major scientific models of decision making and applications to real-life situations. Economic models highlighting optimal choices and psychological models highlighting decision making tendencies. Individual decision making in interactive and strategic choice settings as well as group decision making. Simultaneous, sequential, dynamic, repeated, and incomplete information games. Preferences for fairness, reciprocity, and cultural differences in interactions. Limitations when making group decisions. Ethical reasoning and computational analysis of strategy. Applications to voting, negotiations, and cooperation.

PSYC 2064: Introduction to Neuroscience of Behavior (3 credits)

Introduction to biological factors that produce behavior. Neuroanatomy and neurophysiology. The development of the nervous system, and neuroplasticity. Basic biological processes pertaining to sensation and perception. Conducting neuroscience research, and evaluating neuroscience-related claims in the popular media. The ethical and responsible use of nonhuman animal subjects; the ethical application of research findings in neuroscience to current problems such as psychopathy and neurodegenerative disease.

CMDA 2014: Data Matter (3 credits)

This course develops fundamental analytical and programming skills to complete the “analytic pipeline”, including specifying research questions, selecting/collecting data ethically and responsibly, processing and summarizing datasets, and stating findings, while considering all assumptions made. Students will identify vulnerabilities in analyses, including sources of bias and ethical implications. Some programming skills recommended, but not required. Some prior use of data recommended, but not required.

*ECON/BDS 3134: Choice and Behavior (3 credits)

Theories of rational choice, utility, and revealed preference. Intertemporal decision problems and choice under uncertainty with applications to insurance and investments. Behavioral regularities and evidence of violations of rational choice theory. Behavioral models that accommodate this

behavior. Applications of behavioral models to economic problems, policy, and organization design.

STAT 3005: Statistical Methods (3 credits)

Basic statistical methodology: exploratory data techniques, estimation, inference, comparative analysis by parametric, nonparametric, and robust procedures. Analysis of variance (one-way), multiple comparisons, and categorical data. Includes real-world examples. Develops problem-solving skills and ethical reasoning within the context of learning from data.

STAT 3604: Statistics for Social Sciences (3 credits)

Statistical methods for nominal, ordinal, and interval levels of measurement. Topics include descriptive statistics, elements of probability, discrete and continuous distributions, one and two sample tests, measures of association. Emphasis on comparison of methods and interpretations at different measurement levels. Includes real-world applications to develop problem-solving skills and ethical reasoning within the context of learning from data.

ECON 3254 Analysis of Economic Data (3 credits)

Sources of economic data. Application of spreadsheet and/or statistical software to analysis of economic relationships using graphical and regression techniques. Emphasis is on economic applications rather than statistical theory.

BDS/PSYC 4194: Predicting Social Behavior (3 credits)

Overview of the process of predicting human choices, preferences, and actions in social contexts. Applications of measurement theory to data preparation, formatting, and scaling. Implications of psychological biases for data transformation and cleaning. Theory-guided predictor variable selection and development. Applications of machine learning to social settings. Evaluating prediction quality, bias, and generalizability. Developing predictive models in software. Ethical and societal implications of predicting human behavior.

Restrictive Electives Theme I: Analysis of Decision Making

CMST 2064 The Rhetorical Tradition (3 credits)

Analysis of great classic and contemporary theories of rhetoric developed throughout the world during the past 2500 years to demonstrate the dynamic, critical nature of persuasive communication. Study of methodological approaches to rhetorical criticism, ethics of message creation, communication contexts, emerging perspectives, and impact of changing culture on rhetorical theory.

CMST 3134 Public Advocacy (3 credits)

Practical reasoning and argumentation about questions of community significance, emphasizing critical thought, rhetorical strategies, and advocacy. Junior standing required.

ECON 3104 Microeconomic Theory (3 credits)

Theories of demand, production, perfectly and imperfectly competitive price determination, and general market equilibrium. Analytic applications.

ECON 4304: Introduction to Econometric Methods (3 credits)

An introduction to econometric modeling techniques, including regression methods. Particular emphasis on the special problems posed by economic data.

ECON 4424 The Theory Of Games And Economic Behavior (3 credits)

Introduction to games and solution concepts, such as prisoner's dilemma, non-cooperative equilibrium and Nash's bargaining solution. These concepts are applied in analyzing economic problems including bargaining problems, oligopoly and agency.

ECON 4434 Experimental Economics (3 credits)

This is a course in the use of laboratory methods to study behavior in economics and the social sciences. Students will study state-of-the-art methodology in experimental economics, including experimental design, laboratory technique, financial incentives, and analysis of data. Students will participate in, design, and conduct experiments in bargaining, auctions, asset markets, public goods and commons situations, and risky decision-making.

ECON/NEUR/PSYC 4454 Neuroeconomics (3 credits)

Neural processes related to reward, learning, reflection, delay of gratification, and social interaction. Clinical uses of neuroeconomics research techniques. Implications of neuroeconomics in economics, policy, law and business.

ENGL 1524/PSYC 1524 Language And The Mind (3 credits)

Examination of what is unique about human language and the evidence that language affects thought. Investigation of how listeners categorize sounds, parse sentences, and access meaning. Examination of what brain damage and speech errors reveal about language in the brain and mind.

NEUR 3084 Cognitive Neuroscience (3 credits)

Concepts in cognitive neuroscience. Methods available to study brain and nervous system function, theoretical and practical issues of relating mental functions to biological brain functions. Overview of current understanding of the neural bases of various mental functions (e.g., memory, attention, emotion, decision making).

NEUR 3144 Mechanisms of Learning and Memory (3 credits)

Foundation of social interactions in human and non-human: ability to learn and memorize locations, situations, individuals, facts and tasks forms. Cellular and molecular mechanism underlying learning and memory and model systems. Approaches to these processes along with diseases presenting with learning and memory deficits in humans.

NEUR 3234 The Artificial Brain (3 credits)

Introduction to brain-machine interactions and computer models of neural systems. Exploration of brain-computer interface applications, biophysically-based computational models of the brain, and computer neural networks in the context of artificial intelligence. Emphasis on the capabilities and limitations of neural networks and how they inform our understanding of the human brain. Discussion of societal impact and ethical considerations.

PHIL 2304 Global Ethics (3 credits)

Ethical issues in international context. Application of the principles of moral theory to such issues as the obligations of richer nations toward poorer ones, cultural and other forms of relativism, emigration and immigration, nationalism, war, deterrence, intervention, environmental degradation, preservation of natural diversity, and responsibilities toward future generations.

PHIL 3505-3506 Modern Logic and Its Development (3 credits)

Logic and logical theory and the history of its development. 3505: Validity of arguments. Syllogistic logic from Aristotle to modern times. Deductive methods in truth functional and quantificational logic through the theory of identity. Translation from English into symbolic form. 3506: Metalogic and the history and philosophy of modern logical theory. Decidability and undecidability, completeness and incompleteness of formal systems. Developments from Cantor to Goedel.

PSCI/IS 3104 Security Studies: Theories And Concepts (3 credits)

Introduces the various theoretical approaches to security. Examines key concepts in the field of Security Studies, such as uncertainty, polarity, war, coercion, terrorism, intelligence, genocide, crimes against humanity, ethnic conflict, and human security.

PSYC 2044 Psychology Of Learning (3 credits)

Survey of fundamental concepts, phenomena, and principles of learning, such as reinforcement/punishment, classical conditioning, and cognitive explanations of retention/forgetting. Traditional learning research, with particular emphasis on methodology and ethical considerations. The behaviorist perspective, and neurobiological and cognitive approaches to understanding learning. The ethical and responsible use of animal models in learning research, and practical applications of learning theory.

PSYC 2084 Social Psychology (3 credits)

Introduction to the social behavior of the individual and the group: social perception and forming judgements of others, attitude formation and change, interpersonal attraction, applied psychology. Cultural influences on attitudes toward diversity, prosocial behavior, prejudice, and aggression and conflict. Application of psychological theories and research to address current social problems.

PSYC 3094 Advanced Research Methods In Psychological Science (3 credits)

Advanced research and analytical methods. Emphasis on methods for specific research and/or practical questions, critical evaluation of research publications. Extended coverage of design and analysis principles and skills, selection and completion of appropriate statistical tests for given data sets. Student-driven empirical report including literature review, methods, analysis, interpretation, and implications for future research. PSYC majors only.

PSYC 4024 Industrial And Organizational Psychology (3 credits)

Overview of psychological theories, research findings, and methods relevant to studying the behavior of individuals in organizations. Topics covered may include prediction of job performance, personnel testing, training and development, and leadership.

PSYC 4054 Personality Research (3 credits)

Research techniques used in contemporary personality psychology: case histories, correlational methods, experimentation, archival studies, and psychobiography.

PSYC 4064 Physiological Psychology (3 credits)

Presentation of concepts important for the study of neuroscience and behavior with a special emphasis on the classic topics of physiological psychology: brain-behavior relations, sensory integration, physiological correlates of motivation and emotion.

PSYC 4074 Sensation and Perception (3 credits)

Overview of sensory and perceptual systems and their integration in influencing behavior. Emphasis on sensory receptor characteristics, neural structure, psychophysical data, perceptual phenomena and issues, theories about the human perceptual process.

PSYC 4084 Advanced Social Psychology (3 credits)

Examines social behavior from four major theoretical orientations: reinforcement, field theory, cognitive, and role theory. Topics may include social learning, social exchange theories, group processes, attitude, and person perception.

PSYC 4114 Cognitive Psychology (3 credits)

An experimentally-oriented survey of human cognitive processes which include attention, memory, and decision making. Role of individual difference variables in each area.

Restrictive Electives Theme II: Application of Decision Making**ACIS 1504 Introduction to Business Analytics & Business Intelligence (3 credits)**

Introduction to Business Information Systems with emphasis on the role of software applications as a tool to develop Business Intelligence to improve decision making. Design and development of spreadsheet and database solutions employing analytical techniques on large data sets to produce quality information. Ethical considerations of information management.

BMES 4134 Global, Societal, And Ethical Considerations In Biomedical Engineering (3 credits)

Overview of contemporary technological advances to improving human health. Comparison of healthcare systems, problems, and existing solutions throughout the developed and developing world. Consideration of legal and ethical issues associated with developing and implementing new medical technologies. Recognition and definition of gaps between medical needs and current methods and therapies between developed and developing countries. Conceptually design a novel technology.

ECON 1104: Economics of Gender (3 credits)

Economic approach to the causes and consequences of male/female gender differences in economic outcomes. Tools in microeconomic analysis and empirical work. Woman, family choices and labor markets. Gender gap in earnings. Employment and wage policies related to women.

ECON 3034: Economics of Poverty and Discrimination (3 credits)

Poverty and inequality in the United States and around the world. Sources of poverty. Antipoverty policies. Definition, empirical evidence, and causes of discrimination. Emphasis on ethical human behavior and policy analysis.

ECON 4044: Public Economics (3 credits)

Economic rationale of the public sector. Proper size and functions of government. Market failure, Cost-benefit analysis, public goods provision. Pricing of public enterprise services.

ECON 4404 Economics of Organizations (3 credits)

Economic theories of organization, with specific attention to their internal structure, and to design of incentive systems. Application to mergers, to the relationship between stockholders and managers, etc. Students with one year of economics, calculus and major in some other social science, by permission of the instructor.

ECON 4214 Economics of Health Care (3 credits)

Effects of medical care on health; cost and production of medical care; demand for medical care and its financing; structure of the health care industry; reorganization for efficiency.

ENGE 2094 Create!: Ideation & Innovation (3 credits)

Apply problem solving framing strategies as part of problem solving design processes. Consider cultural, economic, social, and other perspectives in customer discovery and design processes in order to ensure problem/solution fit. Ideate possible solutions or approaches to address open-ended problems using a variety of methods. Engage in iterative critiques of strategies, solutions and prototypes using methods drawn from industrial design, engineering and the arts.

Collaborate in interdisciplinary and diverse project teams. Communicate deliverables in multiple formats and for different audiences. Identify and address impacts of designed services and products through global perspectives, such as patterns of inclusion and exclusion and effects on localized ecosystems.

PSCI/IS 3134: Global Conflict and War (3 credits)

Focuses on the causes, legal and moral constraints, impacts, and consequences of conflict and war. Explores historical and contemporary cases of conflict and war and investigates the role of state and non-state actors in these conflicts. Examines the impact of technology, religion, culture and identity on the present and future of war.

PSYC 2014: Psychology of Social Interventions (3 credits)

An introduction to the psychological science that underlies behavioral interventions in non-clinical settings. Theories, methods, and applications as they relate to diverse domains such as health, education, prejudice reduction, and the environment. Methodological issues relating to intervention research in psychological science; understanding and limiting possible sources of bias. Relevance and limitations of psychological science for related public policy.

SOC 2034 Diversity and Community Engagement (3 credits)

Examination of patterns, meanings, and challenges of diversity and inclusion to improve social interactions and community engagement within a global society. Focus on diverse identities, social justice, power, and privilege, applying social science theories and concepts, to facilitate intercultural awareness. Community engagement projects employ research methods to connect course materials and service to community.

SOC/HIST/STS 2604 Introduction To Data in Social Context (3 credits)

Examines the use of data to identify, reveal, explain, and interpret patterns of human behavior, identity, ethics, diversity, and interactions. Explores the historical trajectories of data to ask how societies have increasingly identified numerical measures as meaningful categories of knowledge, as well as the persistent challenges to assumptions about the universality of categories reducible to numerical measures.

SPIA 4464: Data and the Art of Policy-Making and Planning (3 credits)

Critical examination of use of scientific and technical information in planning and policy-making, exploring issues and challenges through social science lens. Investigation of appropriate and responsible uses of data within collaborative and deliberative policy-making and planning processes. Presentation of data and underlying models in accessible and understandable formats.

Integrating all forms of knowledge into decision-making, including local and traditional knowledge.

STAT 1014 Data in Our Lives (3 credits)

Develop and practice the process of thinking critically with data in the context of real world problems. Import, manage, summarize, and visualize data using programmable, statistical software. Make data discoveries, make decisions, generate hypotheses, and/or communicate findings in data. Consider laws of probability and personal biases to weigh decisions. Recognize ethical issues and vulnerabilities in analyses when learning from data and extrapolating to large populations.