It's Major!
College Major Selection & Success

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Outline of Presentation

- Brief Intro on College Major Choice and Persistence
  - Focus on STEM
- Major and the High School Perspective
- The Higher Education Perspective
- Major Persistence Research
- The Role of AP® in College Major Choice
- Questions

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Why we organized this session…

- There are ways to help students make informed major choice decisions that lead to their increased satisfaction and success within a major program.
  - Evidence from research is clear that uncertainty with regard to college major and career goals while in college leads to attrition, lower academic achievement, anxiety, and confusion with regard to one's identity.
- What does the research say on this topic? What do professionals in the field have to say on this topic?
- How can both research and practice inform each other moving forward to help students?

College Major Persistence Research

Patterns of Persistence in Intended College Major with a Focus on STEM Majors

- Published in a journal geared toward college-level academic advisors.
- Full citation: Shaw, E.J., & Barbuti, S. (2010). Patterns of persistence in intended college major with a focus on STEM majors. *NACADA Journal, 30*(2), 19-34.

Why Study Persistence in College Major?

(Allen & Robbins, 2008; Suhre, Janse, & Harskamp, 2006; Tinto, 1993)

- Major persistence is indicative of satisfaction with one's academic environment, and is associated with:
  - Retention
  - Timeliness of graduation
  - Positive study habits
  - Academic integration

- Students who *change* majors are more likely to take courses that are unnecessary for graduation, thereby extending the time it takes to graduate and becoming more at risk for dropping out of college.

Why Study Persistence in College Major? (cont.)

While the goal is not to ensure that students never switch majors, a more practical and worthwhile goal is to ensure that:

> Students are equipped with the most comprehensive information and proper guidance before selecting a major so that they can make the most appropriate decision with the greatest personal benefits.

Student Persistence in Intended Major

Shaw, E.J., & Barbuti, S. (2010). Patterns of persistence in intended college major with a focus on STEM majors. *NACADA Journal, 30*(2), 19-34.

- Examined patterns of persisting in and switching from an intended college major (chosen in high school) at the beginning of a student's third year of college.
- Focused on STEM major persistence because of the national effort to increase the number of individuals entering careers in STEM fields.
- Methodology was simplistic so that institutional researchers and/or various academic departments can replicate certain analyses for incoming students to target potential interventions for increasing STEM major persistence.

Sample

- The sample was taken from *the* College Board's *Higher Education Outcomes Database* from the national SAT Validity Study.
  - Four-year colleges and universities; data from beginning of 3rd year of college (from fall 2006 entering cohort).
- Institutional data were merged with College Board data (*SAT Questionnaire* and AP exam information.)
- The final sample (with all variables analyzed in the study) consisted of 28,390 students from 39 four-year institutions.
  - e.g. if a student did not provide their 1st choice major on the SAT Q, they could not be included in the study.
- Generalizable to broader cohort in Higher Education Outcomes Database, but more highly able than population of 2006 College Bound Seniors.

Persisters and Switchers

- ***Persister*** (41% of sample) = In the major field category from the SAT-Q matched the major field category indicated by the institution he or she is attending at the beginning of the 3rd year of college.
- ***Switcher*** (59% of sample)= those who, at the beginning of the 3rd year of college did not major in the choice expressed while in high school.

Rates of Switching by Major Selected in HS

Original Intended Major (CIP)	Switcher		Persister	
	n	%	*n*	%
Architecture & Related Services (04)	741	77	226	23
Biological & Biomedical Sciences (26 & 60)	1,454	64	832	36
Business, Management, & Marketing (52)	2,123	50	2,120	50
Communication (09 & 10)	738	57	558	43
Computer & Information Sciences (11)	728	61	461	39
Education (13)	1,333	60	899	40
Engineering & Technology (14, 15, & 29)	1,552	39	2,437	61
English Language & Literature/Letters (23)	391	66	204	34
Foreign Languages, Literatures, & Linguistics (16)	266	71	109	29
Health Professions & Related Clinical Sciences (51)	3,502	76	1,084	24
History (54)	237	69	106	31
Mathematics & Statistics (27)	242	79	66	21
Philosophy, Religion, & Theology (38 & 39)	98	81	23	19
Physical Sciences (40)	448	70	192	30
Psychology (42)	557	59	392	41
Public Administration & Social Services (44)	150	90	16	10
Security & Protective Services (43)	250	65	133	35
Social Sciences (45)	548	55	446	45
Visual & Performing Arts (50)	1,467	54	1,261	46

Note. Percentages may not sum to 100 due to rounding. CIP information from U.S. Department of Education, National Center for Education Statistics (2002).

Student Persistence and College Outcomes

Table 3. Academic characteristics of students in the total sample

	Switcher			Persister				Total		
Grade Point Averages	***n***	***M***	***SD***	***n***	***M***	***SD***	***d***	***N***	***M***	***SD***
High School GPA	16,825	3.65	.50	11,565	3.69	.48	-0.08	28,390	3.66	.49
First-Year GPA in College	16,825	3.02	.64	11,565	3.15	.60	-0.21	28,390	3.07	.63
Cumulative GPA in College	16,825	3.05	.60	11,565	3.15	.58	-0.17	28,390	3.09	.59

Note. Cohen's *d* was calculated by subtracting the mean GPA for persisters from the mean GPA for switchers and dividing by the pooled standard deviation.

- Students who persisted in their intended major had earned higher HSGPAs, FYGPAs, and cumGPAs (through the end 2nd year) than their peers.
- The largest difference for switchers and persisters was in FYGPA.
  - Low academic performance in the first year of college may function as an impetus to switch to a different or more appropriate academic major field.

Focus on STEM Major Persistence

Intended Major (CIP)

- Biological & Biomedical Sciences (26 & 60)
- Computer & Information Sciences (11)
- Engineering & Technology (14, 15, & 29)
- Mathematics & Statistics (27)
- Physical Sciences (40)

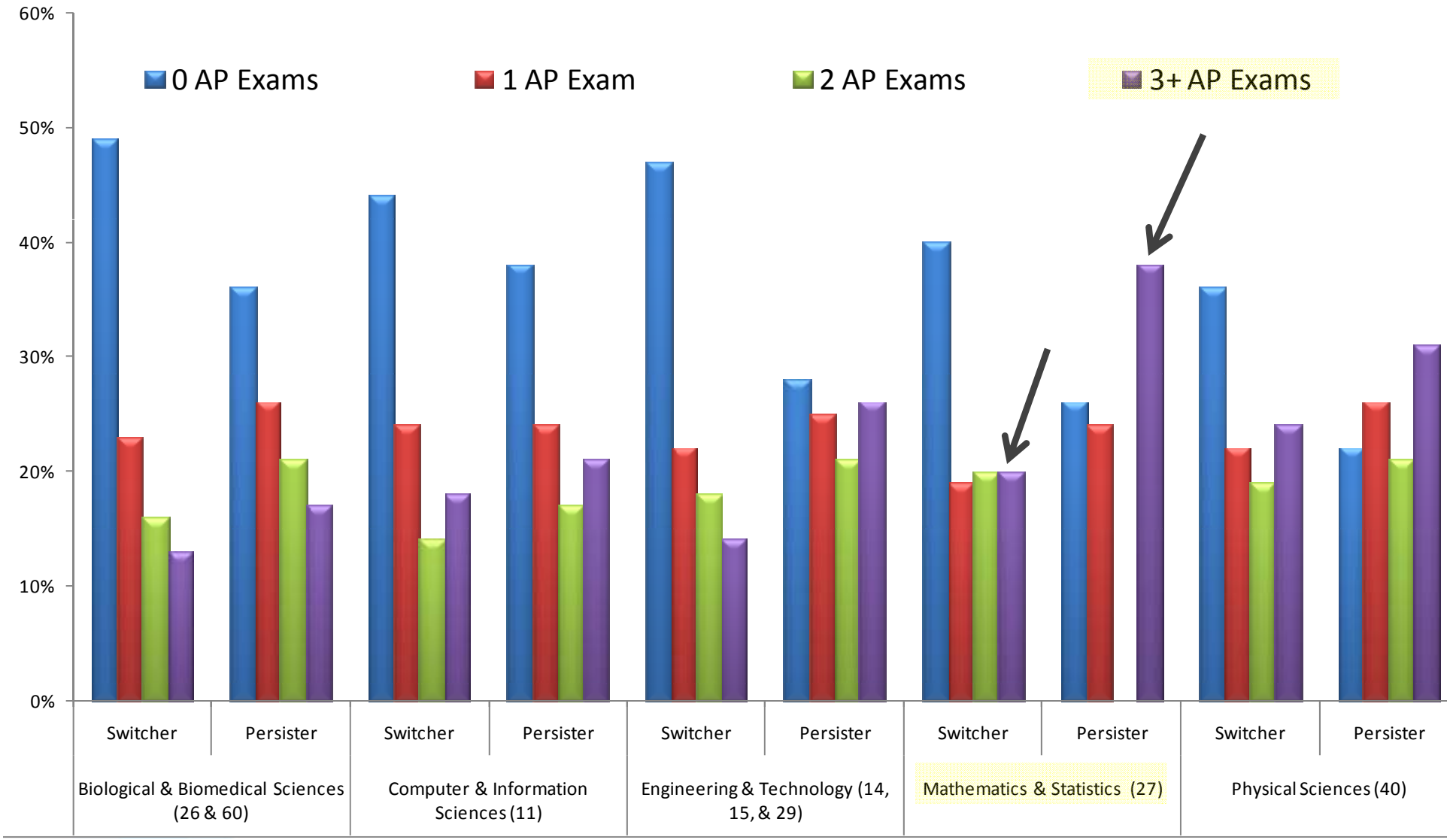
Demographic Info on STEM Switching

	Switcher		Persister	
	n	%	*n*	%
Gender				
Female	1,264	49	1,337	51
Male	1,862	32	3,949	68
Race/Ethnicity				
American Indian or Alaska Native	17	46	20	54
Asian, Asian Amer., or Pacific Islander	286	30	672	70
Black	212	44	271	56
Hispanic	279	48	301	52
White	2,178	37	3,701	63
Other	64	34	126	66
No Response	90	32	195	68
Parental Income				
<$35,000	325	40	482	60
$35-70,000	684	40	1,041	60
$70-100,000	613	38	1,020	63
>$100,000	628	35	1,176	65
No Response	876	36	1,567	64
First-Generation College Student				
No	2,287	36	4,124	64
Yes	723	44	931	56
No Response	116	33	231	67
Total	3,126	37	5,286	63

AP Exams & STEM Major Persistence

- Study found students taking 3+ AP exams in STEM were more likely to persist in STEM majors.
- Students who had not taken any AP exams in STEM were much more likely to switch from all of the STEM fields (except for computer and information sciences).
- Prior research has shown that even when controlling for student background characteristics, including prior ability, AP participation positively influences the pursuit of in-depth course work in the same domain as the AP course or exam.

% of STEM switchers and persisters taking 0, 1, 2, or 3 or more AP Exams



Science and Math HSGPA

- Students who switched from engineering and technology earned lower math and science HSGPAs than persisters.
- Students switching from the physical sciences had much lower math HSGPAs, but not substantially lower science HSGPAs.

Average High School GPA in Math

	Switcher			Persister			
Intended Major (CIP)	***n***	***M***	***SD***	***n***	***M***	***SD***	***d***
Biological & Biomedical Sciences (26 & 60)	1,349	3.53	0.60	764	3.64	0.53	-0.21
Computer & Information Sciences (11)	649	3.59	0.58	421	3.62	0.55	-0.06
Engineering & Technology (14, 15, & 29)	1,446	3.63	0.55	2,223	3.79	0.43	-0.30
Mathematics & Statistics (27)	226	3.90	0.30	61	3.95	0.22	-0.09
Physical Sciences (40)	419	3.64	0.55	184	3.78	0.42	-0.26
All STEM Students in Sample	4,089	3.61	0.57	3,653	3.74	0.47	-0.25

Average High School GPA in Science

	Switcher			Persister			
Intended Major (CIP)	***n***	***M***	***SD***	***n***	***M***	***SD***	***d***
Biological & Biomedical Sciences (26 & 60)	1,342	3.70	0.50	760	3.82	0.41	-0.25
Computer & Information Sciences (11)	644	3.60	0.53	415	3.61	0.53	-0.02
Engineering & Technology (14, 15, & 29)	1,439	3.65	0.53	2,215	3.79	0.43	-0.29
Mathematics & Statistics (27)	220	3.66	0.53	61	3.67	0.57	-0.02
Physical Sciences (40)	417	3.80	0.44	183	3.81	0.39	-0.02
All STEM Students in Sample	4,062	3.68	0.51	3,634	3.77	0.44	-0.19

Motivational Variables

Science Self-Efficacy

- Students persisting in biology and biomedical sciences, engineering and technology, physical sciences, and mathematics and statistics *all* had substantially higher science self-efficacy beliefs than students who switched.
  - We found no differences for switchers and persisters in Computer & Information Sciences.

Degree Goal Aspirations

- With exception of those in Computer & Information Sciences, students persisting in STEM majors were more likely to indicate a doctorate as their ultimate degree goal than students who switched to another field.
  - Most pronounced difference between persisters and switchers was for Physical Sciences persisters.

Conclusions

- These findings show that students intending to major in a STEM field are persisting in those majors at higher rates than other fields.
  - But subgroup differences in STEM persistence need to be addressed, as certain groups may be at a disadvantage in persisting in STEM.
  - And if we want more scientists, we should think more about the 37% who switch from STEM interest in high school to another field.
- HS performance in math and science, taking AP exams in STEM, articulating positive science self-efficacy beliefs, and professing a goal of obtaining a doctorate were related to persistence (in varied ways) across STEM majors.
  - Holds promise for interventions (via Institutional Research and Academic Advising offices).
- Students interested in computer and information sciences behave somewhat differently than students intending to pursue degrees in the other STEM fields.

It's Major! College Major Selection and Success

Jenny Byers, Director of College Counseling

The Harpeth Hall School

"Harpeth Hall educates young women to think critically, to lead confidently, and to live honorably."

Our Goals

- <u>Focus:</u> choice of major and retention within STEM majors

- Things to cover:

  Exposure to STEM fields

  Encouragement to pursue STEM fields

  Hands-on experiences in STEM

Harpeth Hall
STEM Initiatives

- Curriculum (Bio, Chem, Physics)
- Student Groups (IMAGINE, Women in Medicine)
- Mentors/Role Models – Alumnae speakers
- Winterim (research, STEM placements)
- Summer programs (example: VU RIP)

Harpeth Hall Initiatives (continued)

- STEM Think Tank (2008-2010) – teachers, department chairs
- STEM Consortium (2011) – corporations & higher education
- Online School for Girls (2009-present)
- Center for STEM Education for Girls

  - Director – seek out and promote STEM

Choosing a Major

- Student's interests, strengths, abilities; knowledge of options
- Curricular choices
- Parent's desires
- Encouragement from faculty
- Extracurricular interests and pursuits
- Role models

“Undecided”

- No clue
- Desire to explore
- Multiple interests
- Fear of commitment
- Student’s interest vs. Parent’s interest

Researching Colleges

- Freshman-entry program (Engineering, Nursing)
  - Conscious decision to apply to that program
  - Self-selecting
  - Seek out hands-on opportunities
  - Think about the field before entering college

Ways to Help Students

- Identify strengths, interests, and aptitudes
  - DWYA (Naviance)
  - StrengthsQuest

- Information about Majors
  - What's available and where to look

Experiential Learning

- Extracurriculars (JETS, Science Olympiad)
- Internship
- Research
- Academic Enrichment Program
- STEM Pre-College Program
- Online Class (OSG, Brown)

STEM Pre-College Programs for Girls

- U. Dayton (Women in Engineering Summer Camp)
- Purdue (Exciting Discoveries for Girls in Engineering)
- Smith (Summer Science & Engineering)
- Union (Educating Girls for Engineering)

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STEM Scholarships

- College-specific scholarship:

  Skidmore: Porter Pres. Sch. in Science & Math

- Outside scholarship:

  Intel Science Talent Search

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College Major Selection and Success

Robert Springall

Dean of Admissions

Bucknell UNIVERSITY

Bucknell University

- Located in Lewisburg, Pennsylvania
- Highly selective – 28% admission rate
- 3,500 undergrads, 920 in first-year class
- 150 grads (MA/MS only)
- Highly residential
- 99% of undergrad full-time
- Most degrees conferred are BA, but professional programs in
  - Engineering
  - Management
  - Education
  - Music

Bucknell UNIVERSITY

Verticals and Horizontals

	Arts, Humanities, Social Sciences	Natural and Physical Sciences	School of Management	College of Engineering
Total	**445**	**230**	**80**	**185**
Visual & Performing Arts				
Athletics				
Targeted Scholarships				
Campus Enrichment				
Friends of Bucknell				
Etc.				

Selection Process

- Shaping the class at intersections of
  - Verticals (academic programs)
  - Horizontal (campus enrichment, co-curricular interest, etc.)
- Maximizing usage of programs
- Achieving enrollment objectives
- Selecting students who will succeed, benefit, contribute

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“What does success look like?”

- Self-identifying education needs
- Finding sources to help meet needs
- Doing well in course work

- Understanding and integrating material
- Having a meaningful learning experience
  Appropriate career preparation
- Contributing to campus and larger communities

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What about the “Undecideds?”

- The good kind
  - Lots of sincere interests
  - Horizontally-oriented (industry or proclivity)
  - Vertically-oriented (discipline)
- The bad kind
  - Profoundly undecided
  - Prematurely decided or under-informed

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It’s not a question of if you will struggle in engineering*.

It’s when you will and how you will handle it.

* *Or medicine, architecture, physics, or most other fields.*

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“What else could go wrong?”

- “Four-year” programs
  - Major-specific preparation requirements in first-year
  - Necessary preparation for co-op, internship
- Program demand outstrips supply
  - Better off coming in to certain programs
  - High cut-offs for switching into programs
- And “greying” professions lack supply of able college graduates

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Promoting success

- Engineering 100
- Engineering Success Alliance
- TEAM mentor program
- Posse
- Partnerships in Philadelphia, Chicago, Houston, etc.
- Writing Center
- SWE/WIE/SHPE/NSBE

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Is AP Exam Participation and Performance Related to Choice of College Major?

Krista Mattern, Emily Shaw, & Maureen Ewing

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College Board Forum

New York, NY

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Why do we expect a relationship between AP and college major?

- Most of the existing models and extensive examinations of major choice incorporate the role of experience (positive or negative) with related coursework in the domain prior to choosing the major field.
- Krumboltz's (1979; 1996) social learning theory of career decision making particularly elevates the role of skill development through learning experiences such as course-taking.

Research Questions

- Are students who took an AP Exam in a certain content domain more likely to major in that content domain than students who had not taken an AP Exam in that content domain, controlling for relevant student characteristics?
- Additionally, unlike previous research, this study examined the relationship between AP performance as well as participation (and the interaction of the two) with the likelihood of majoring in that area.

Sample

- 39,440 students (53% female, 72% white) from 39 colleges categorized into 15 majors.
- Predictors – AP variables (coded into 6 content areas)
  - AP exam participation (count of number of courses in content domain)
  - AP exam performance (average AP grade in content domain)
- Outcome
  - Major (1 = Yes, majored in that domain, 0 = No, did not major in that domain)
- Control Variables
  - SAT performance, HSGPA, gender, race/ethnicity, highest parental education

Coding of AP exams into 6 content areas

AP Exam		Major Content Domain
Biology	Environmental Science	Biological & Biomedical Sciences
Computer Science A	Computer Science AB[1]	Computer & Information Science
French Language	French Literature[1]	Foreign Languages, Literatures, & Linguistics
German Language	Italian Language and Culture	
Latin Literature[1]	Latin: Vergil	
Spanish Language	Spanish Literature	
Art History	English Language and Composition	Humanities & Liberal Arts
English Literature and Composition	European History	
Government and Politics: Comparative	Government and Politics: United States	
Music Theory	Studio Art: 2-D Design	
Studio Art: 3-D Design	Studio Art: Drawing	
United States History	World History	
Calculus AB	Calculus BC	Mathematics & Statistics/Engineering/Physical Sciences
Chemistry	Physics B	
Physics C: Electricity and Magnetism	Physics C: Mechanics	
Statistics		
Human Geography	Psychology	Social Sciences
Macroeconomics	Microeconomics	

[1] AP Exams that have subsequently been retired.

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Descriptive Statistics

Major Category	Total	Biological Sciences	Computer Science	Foreign Lang	Humanities	Math/ Physical Sciences	Social Sciences	No AP
1. Agriculture/Natural Resources	1.3	1.8	0.1	0.9	1.1	1.0	0.5	1.5
2. Biological & Biomedical Sciences	8.4	20.3	6.5	9.9	9.7	11.1	9.4	6.1
3. Business, Mgmt, and Marketing	15.9	10.0	11.0	13.9	13.2	14.1	16.3	19.5
4. Communications/Journalism	6.6	3.7	1.9	5.2	6.5	4.1	5.9	7.9
5. Computer & Info Science	2.3	1.9	17.9	1.5	2.1	3.3	2.1	1.9
6. Education	5.4	2.7	0.9	3.1	3.8	2.8	3.2	8.3
7. Architecture	1.1	1.0	0.9	1.1	1.3	1.6	1.1	0.7
8. Foreign Lang., Lit., & Linguistics	1.5	1.2	0.8	5.1	1.9	1.4	1.6	1.1
9. Health Prof & Related Clinical Sciences	6.1	7.1	1.1	4.2	5.1	5.0	4.4	7.2
10. Humanities & Liberal Arts	13.3	10.8	4.7	13.4	15.1	8.8	12.0	13.0
11. Engineering/Math/Stats/Physical Sciences	16.2	17.8	44.5	15.6	18.4	29.1	19.9	9.6
12. Security & Protective Services	1.6	0.8	0.2	0.5	0.8	0.6	0.7	2.8
13. Social Sciences	14.0	16.2	6.7	20.2	16.0	12.7	18.1	12.1
14. Social Services & Public Adm.	0.7	0.3	0.2	0.3	0.6	0.4	0.5	0.9
15. Undeclared	5.6	4.4	2.7	5.1	4.4	4.2	4.4	7.4
Total	39,440	5,703	1,159	4,091	20,287	14,803	5,958	14,234

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AP Participation Results

	AP Participation by Content Area (Predictor)	College Major (outcome)	Odds Ratio (OR)
1	AP Biological Sciences Exam Count (0-2)	Biological & Biomedical Sciences (1=Yes, 0=No)	3.032**
2	AP Computer Sciences Exam Count (0-2)	Computer & Info Sciences (1=Yes, 0=No)	4.563**
3	AP Foreign Language Exam Count (0-8)	Foreign Lang., Lit., & Linguistics (1=Yes, 0=No)	2.592**
4	AP Humanities Exam Count (0-12)	Humanities & Liberal Arts (1=Yes, 0=No)	1.116**
5	AP Math/Physical Sciences Exam Count (0-7)	Engineering/Math/Stats/Physical Sciences(1=Yes, 0=No)	1.527**
6	AP Social Sciences Exam Count (0-4)	Social Sciences (1=Yes, 0=No)	1.282**
7	AP Participation (1=Yes, 0=No)	Undeclared (1=Yes, 0=No)	0.855*

Note. Each model also includes gender, ethnicity, highest parental education, SAT scores and HSGPA.
*$p < .01$, **$p < .001$.

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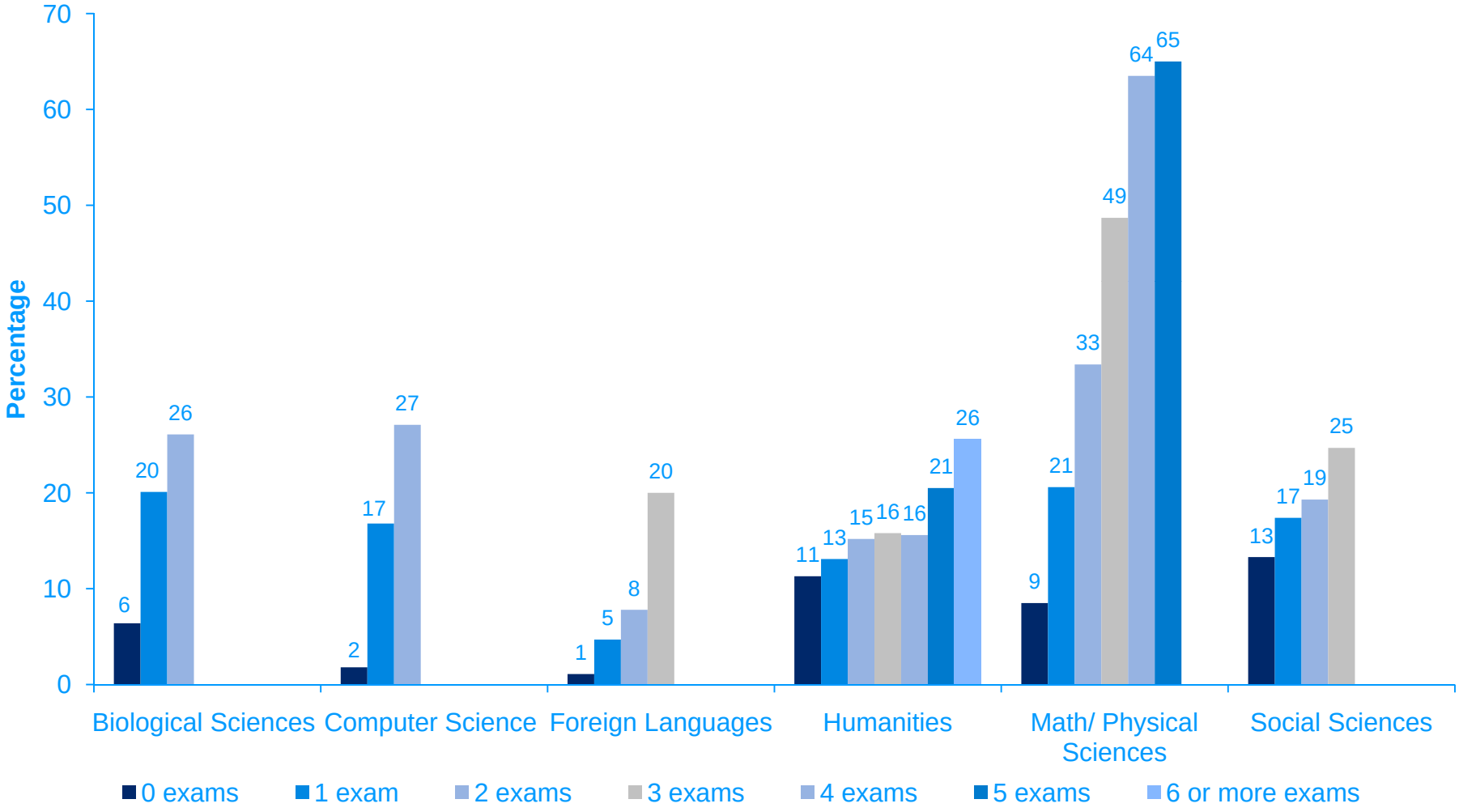
The Percentage of Students Majoring in a Specific Domain by the Number of AP Exams taken in that Domain



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AP Participation & Performance Results

	AP Content Area	College Major (outcome)	OR_{count}	OR_{score}	$OR_{interaction}$
1	AP Biological Sciences	Biological & Biomedical Sciences (1=Yes, 0=No)	1.697**	1.521**	0.727*
2	AP Computer Sciences	Computer & Info Sciences (1=Yes, 0=No)	1.420	1.510*	1.157
3	AP Foreign Language	Foreign Lang., Lit., & Linguistics (1=Yes, 0=No)	1.792*	1.431**	0.955
4	AP Humanities Exam	Humanities & Liberal Arts (1=Yes, 0=No)	1.127**	1.219**	0.983
5	AP Math/Physical Sciences	Engineering/Math/Stats/Physical Sciences(1=Yes, 0=No)	1.548**	1.365**	1.005
6	AP Social Sciences	Social Sciences (1=Yes, 0=No)	1.288**	1.137**	0.963

Note. Each model also includes gender, ethnicity, highest parental education, SAT scores and HSGPA.
*$p < .01$, **$p < .001$.

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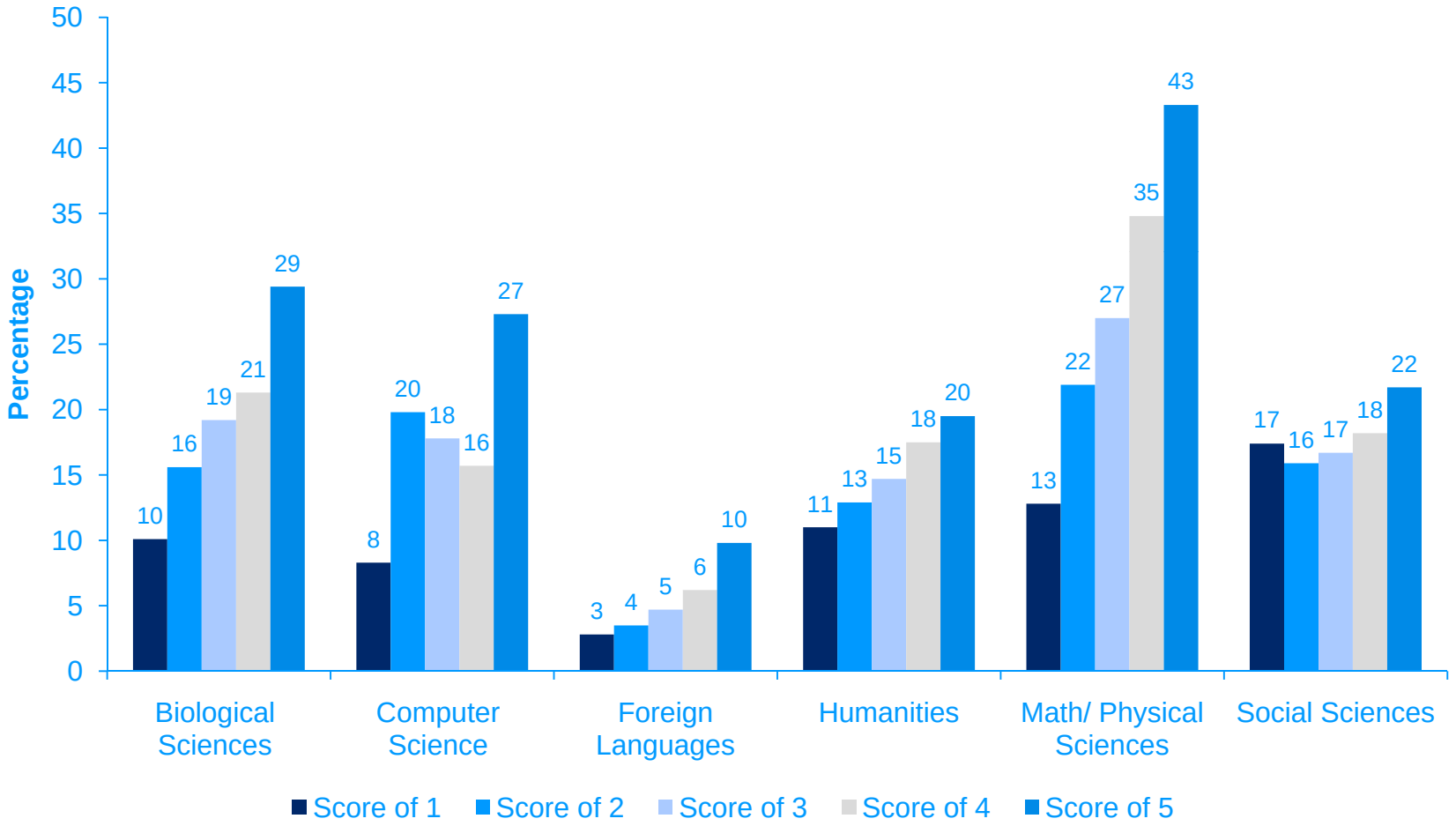
The Percentage of Students Majoring in a Specific Domain by their Average AP Score in that Domain



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Discussion

- Students who take an AP Exam in a particular content area are more likely to major in a related discipline in college, even when taking into account relevant student characteristics.
- Furthermore, of the subsample of students who took at least one AP Exam in a particular content domain, those with higher scores had an increased likelihood of majoring in that content area.

Discussion

- The relationship between AP participation and college major was stronger for some domains than others.
  - In particular, students who took an AP computer science exam(s) as well as students who took a math and/or physical science exam(s) were much more likely to major in a similar content domain.
  - The base rate of computer science majors was extremely low for the entire sample (2.3%); however, 27.1% of students who took both computer science exams majored in that domain.
  - Likewise, 16.2% of the sample majored in a STEM related field as compared to 65.5% of students who took 5 or more AP Exams in mathematics and/or physical sciences.

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Discussion

- Students taking no AP Exams were more likely to be undeclared by the beginning of their third year of college.
- Previous research has shown that third year students with undeclared majors:
  - have significantly lower GPAs (2.72) as compared to the total sample (3.10),
  - have significantly lower retention rates (70%) as compared to the total sample (91%),
  - and were underperforming based on their academic preparation in that SAT scores and HSGPA overpredicted their cumulative GPA. In other words, students with undeclared majors earned cumulatives GPAs that were lower than predicted based on their high school academic preparation.

Conclusion

- These results provide support for the AP program as a medium by which to expose students to advanced academic material in various content areas, potentially confirming or sparking interest in particular career paths.

Thank you!

- To access College Board research and reports and in upcoming weeks, a copy of this presentation:
  www.collegeboard.org/research

- Fee free to email with questions:
  Emily Shaw (eshaw@collegeboard.org)
  Krista Mattern (kmattern@collegeboard.org)

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