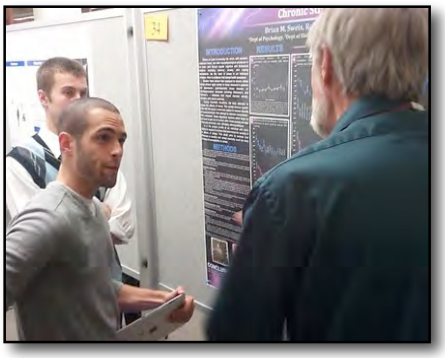
Morrison Probationary Review Document

I. Overview

Candidates are to provide a concise overview of their development as faculty members including their perception of their strengths and weaknesses and to comment on their contributions to the department.

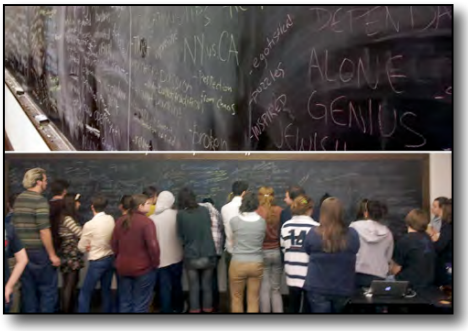
When I came to Loyola in the fall of 2009, Deans Fennell and Attoh charged me with developing a neuroscience program that engages undergraduate and graduate students and reaches across geographic bounds to include the Neuroscience Institute located at the Stritch School of Medicine in Maywood. During the last several years I have embraced this challenge and been greatly rewarded by the enthusiasm of Loyola's students for neuroscience. Following I highlight several of the things I've been able to begin since coming to Loyola and look forward to what, together with my students and colleagues we can accomplish in the future.

I believe teaching and research in higher education work together like the left and right sides of the body. Since coming to Loyola I have developed four new courses, three of which are new to Loyola. *Cognitive and Behavioral Neuroscience* (psyc 382) serves as a group A course in the psychology major and will be a required course for the soon to be implemented Neuroscience Major. The course provides a challenging introduction to one of the fastest growing areas in psychology. As you will see from their comments, the students have embraced the course and are using it as a gateway to experiential learning through conducting research. Several alumni of this course have already received Carbon and Provost Fellowships for Neuroscience related projects and several new alumni are applying this year. Likewise several of these students have presented their own work at the Cognitive Neuroscience Society and Society for Neuroscience annual meetings as well as at the St. Albert's Day celebration at the Stritch School of Medicine.



CANlab member and Carbon Scholar Brian Sweis shares his research with Neuroscience Graduate Program Director E.J. Neafsey at the St. Albert's Day Poster Session at the Stritch School of Medicine in Maywood.

I have also developed a companion graduate course, *Seminar in Cognitive Neuroscience* (psyc 435), which introduces graduate students to the methods of cognitive neuroscience (e.g., cognitive neuropsychology, structural and functional neuroimaging, and neurogenetics) using the primary literature from developmental, social, and clinical psychology. Students in the course are required to write an NRSA proposal that integrates their own research interest and at least one cognitive neuroscience method. One such proposal has already resulted in a funded multidisciplinary grant. We anticipate the submission of three NRSA proposals from course alumni this summer. Thanks to my role on the Neuroscience Institute Executive Committee, I was able to make connections with the medical school's Neuroscience Graduate Program, and this course is now a requirement for their program as well. Thus, graduate students from Maywood and Lakeshore campuses are now meeting regularly to expand their research methods repertoire and build relationships.



Student groups brainstorming topics for their group project in Psychology of Creativity.

I have also developed a new honors course, *Psychology of Creativity* (Hon 204) that I am teaching for the second time this spring. This prerequisite-free course introduces students from across the College of Arts and Sciences to methods in experimental psychology and also case-based approaches in the study of creativity. The course seeks to dispel the common belief that there are intrinsically creative disciplines, and rather argues that creativity involves the use of a set of mental processes to solve problems in novel ways. We also address, socio-affective factors that tend to bias certain people towards engaging these processes more than others. The

course is based around a set of active learning assignments, which require students either individually or in small groups to critically evaluate creative products and the people who made them and present these to the class or broader community in non-traditional ways including blogs (whatscreativeluc.blogspot.com) or through class presentations which include theatre and film. Students from this course have engaged me with research ideas and have formed a "creativity work group" in my lab. This group, currently made up of three undergraduate students, a post-baccalaureate student, and a philosophy graduate student are currently working on a project to understand the role of working memory in insight and incubation in creative problem solving.

Lastly, I developed a curriculum for *Laboratory in Experimental Psychology: Cognition* (Psyc 314) which weds a survey of methods in cognitive psychology with a scaffolded curriculum intended to build basic skills in Microsoft Excel, what I consider to be an essential element of any experimental scientist's data management toolbox. I believe that an essential part of higher education is to not only teach students about their discipline, but also to build practical skills that they can use after school, regardless of their chosen career path. I believe this course reaches that goal. Perhaps the greatest complement I've received is from a student who had this course during its inaugural run and who ran up to me a year later to tell me how valuable what she had learned in the class was in the work she was doing in another psychology faculty member's lab. I've likewise had students who have headed onto jobs in business who now have the Excel skills they need to be effective in their jobs.

Research has long been my passion and I have been delighted to find so many willing collaborators here at Loyola. With Dr. Rebecca Silton, I have been able to set up the Cognitive and Affective Neuroscience Lab (canlab.org) in the lower level of Coffey Hall. This is a state-of-the-art laboratory allowing for multiple physiological recording methods including scalp electroencephalography (EEG) during computer-controlled tasks. I am also an active member of the Cognitive Neurology and Alzheimer's Disease Center at the Feinberg School of Medicine (Northwestern University) which gives me access to a clinical core including Alzheimer's and Mild Cognitive Impairment patients as well as longitudinally tracked older adults. I have received multiple extra and intramural grants since I began at Loyola and have an aggressive plan in place for major awards from the NIH, NSF and the Alzheimer's Association. While it took two years to set up my laboratory because of the timing in moving from Damen to Coffey I minimized disruption through taking students to Northwestern University on nights and weekends to continue to collect EEG data. This has resulted in some delay in publication for several studies, but has provided us with a steady stream of new publishable data which is expanding rapidly. I'm also pleased that three Loyola graduate students from our laboratory intend to submit NRSA fellowship applications this summer.

EEG chamber, control and data analysis rooms in the CAN Lab on the lower level of Coffey Hall. More details on the lab can be found at canlab.org.

One of the greatest joys of my time here at Loyola, has been my role as the faculty mentor of the Neuroscience Society, a Loyola Student Activities funded group here on campus. This group made of many of the undergraduates in the Interdisciplinary Neuroscience Minor organizes biweekly meetings during the school year, hosts an annual banquet (this year featuring Harvard University professor Dr. Dan Schacter), special speakers (e.g., Dean Buonomono from UCLA and Marsel Mesulam and Ken Paller from Northwestern University), special activities for Brain Awareness Week, and a team in the annual Walk to End Alzheimers (a fund raiser sponsored by the Alzheimer's Association). The student's enthusiasm for Neuroscience is absolutely infectious, and the group provides great opportunities for students to meet faculty mentors and hear about different career options for people

interested in Neuroscience. The group also fuels the rapidly growing Interdisciplinary Neuroscience Minor.

Members of the Neuroscience Society and the CANlab at the 2011 Walk to End Alzheimer's where we raised over $2000 to help care for people with Alzheimer's disease and their families.

In summary, I believe that I have fully embraced the challenge offered by Deans Fennel and Attoh and assisted in the development of neuroscience at Loyola and helped to begin the process of connecting our program to the neuroscience community at the medical school. I have established an effect classroom and experiental-learning program that has been recognized by two years of nominations for the Loyola Undergraduate Research Opportunities Program Distinguished Mentor Award, repeated internal funding for my student's research projects and most recently a nomination for the Sujack Award for Teaching Excellence. My scholarship has been recognized through receiving extramural research funding, serving on the program committee of a major international conference, and serving as the co-editor of the definitive volumes in the field of thinking and reasoning (Holyoak & Morrison, 2005, 2012). I look forward to building on this strong start in future years and am delighted to be a part of this learning community.

II. Scholarship demonstrated in Teaching

A. Summary of Teaching Activities

1. Classes taught semester by semester

Fall 2009 (Start-up teaching release)
Psyc 314 Laboratory in Experimental Psychology: Cognition

Spring 2010
Psyc 314 Laboratory in Experimental Psychology: Cognition
Psyc 435 Information Processing (graduate)

Fall 2010 (Start-up teaching release)
Psyc 398 Cognitive and Behavioral Neuroscience

Spring 2011
Psyc 314 Laboratory in Experimental Psychology: Cognition
Hon 204 Science and Society: Psychology of Creativity

Fall 2011 (Grant sponsored teaching release)
Psyc 382 Cognitive and Behavioral Neuroscience

Spring 2012
Psyc 435 Seminar in Cognitive Neuroscience (graduate)
Hon 204 Science and Society: Psychology of Creativity

2. Independent Readings and Research (list topics and student names)

I have mentored the following students during my first three years at Loyola.

Loyola Graduate

1. **Valerie Flores** (Developmental Psychology) – *Development of the Neural Correlates of Relational Reasoning.* Currently working on her masters degree. Coauthored poster presented at the Cognitive Development Society.
2. **Stephanie Hare** (Philosophy) – *Insight in Problem Solving*. Currently applying for graduate studies in Cognitive Science. Coauthored manuscript in preparation.
3. **Dane Wendell**, M.A. (Political Science) – *Neural Correlates of Political Ideology*. Preparing to propose his dissertation. Coauthored conference presentations accepted for presentation.
4. **Vanessa Raschke**, M.A. (Developmental Psychology) – *Neural Correlates of Executive Function in Bilingualism.* Currently completing her dissertation.

Post- Baccalaureate

1. **Dan Cunningham** (2010-2011) – *Neural Correlates of Verbal Analogical Reasoning*. Currently doctoral student at Kirksville College of Osteopathic Medicine.
2. **Sean McCarthy** (2011-2012) -- *Insight in Problem Solving*. 2000 graduate. Applied for graduate studies in Cognitive Science. Coauthored manuscript in preparation.
3. **Slava Nikitin** (2010-2011) -- *Neural Correlates of Visual Analogical Reasoning*. Coauthored manuscript in preparation. 2010 graduate. Currently PhD student in Cognitive Neuroscience at Ohio State University.

4. **Kalen Flynn** (2011 – 2012) – *Neural Correlates of Political Ideology*. Currently enrolled in the Biology Post-Baccalaureate Program at Loyola.

Loyola Undergraduate

1. **Dan Cunninghan** (2009-2010; Psyc 389/Neuroscience 302 Mentor) – *Neural Correlates of Verbal Analogical Reasoning.* 2010 Graduate. Currently doctoral student at Kirksville College of Osteopathic Medicine.
2. **Krishna Bharani** (2009-2011; Carbon Scholar, Psyc 389/Neuroscience 302) – *Electrophysiology of Category Learning in Older Adults.* Coauthored poster at International Conference on Alzheimer's disease and Cognitive Neuroscience Society. Several coauthored manuscripts in preparation. Currently Lab Manager of the CAN lab Loyola Department of Psychology and preparing applications for MD/PhD programs.
3. **Kelly Brandstatt** (2010-2012; Psyc 399) – Insight in Problem Solving. Coauthored poster at Cognitive Neuroscience Science. Currently a senior.
4. **Dietta Chihade** (2010-2011; Biol 396)-- Electrophysiology of Category Learning in Older Adults. Coauthored poster at International Conference on Alzheimer's disease. 2011 graduate. Currently seeking employment as a research assistant.
5. **Miraj Chokshi** (2009-2012; Psyc 399, Psyc 397, 2-year Provost Fellow) – Neural Correlates of Relational Similarity. Currently a senior.
6. **Andrew Cirt**, (2009-2011) – Neural correlates of age related memory changes. Currently a junior.
7. **Elise Gagnon** (2011-2012), -- *Development of the Neural Correlates of Relational Reasoning.* Currently a sophomore.
8. **Mirinda James** (2009-2010) -- Neural correlates of age related memory changes. Coauthored poster at Cognitive Neuroscience Society. 2011 graduate.
9. **Matt Kmiecik**[3,7] (2010-2012, Psyc 399; Provost Fellow) -- *Neural Correlates of Verbal Analogical Reasoning.* Coauthored poster at Cognitive Neuroscience Society. Currently a junior.
10. **John Molony** (2011-2012, Psyc 399) – *Insight in Problem Solving*. Coauthored poster at Cognitive Neuroscience Society. Currently a senior.
11. **Kevin Nuechterlein** (2010-2011, Psyc 389/Neuroscience 302) -- *Neural correlates of age related memory changes.* 2011 graduate. Coauthored poster at Cognitive Neuroscience Society.
12. **Slava Nikitin** (2009-2010, Psyc 389/Neuroscience 302) --*Neural Correlates of Visual Analogical Reasoning*. 2010 graduate. Coauthored poster at Cognitive Neuroscience Society. Coauthored manuscript in preparation. Currently PhD student in Cognitive Neuroscience at Ohio State University.
13. **Nirav Patel** (2010-2012, Psyc 399, Provost Fellow) – *Neural Correlates of Political Ideology.* Currently a junior.
14. **Puja Patel** (2010, Psyc 399) -- *Effect of Personal Perceived Power on Relational Processing*. 2010 graduate.
15. **Izabelle Rymut** (2011-2012) – *Neurocomputational Explanations of Visual Analogical Reasoning*. Currently a sophomore.
16. **Rebecca Shukhman** (2011-2012, Psyc 399) – *Neural correlates of age related memory changes.* Currently a junior.

17. **Leonidas Skiadopoulos** (2011-2012, Psyc 399) – *Insight in Problem Solving.* Coauthored poster at Cognitive Neuroscience Society. Currently a junior.
18. **Brian Sweis** (2009-2012, Carbon Scholar, Psyc 369, 370) – *The Behavioral and Neurochemical Analysis of the Effects of Chronic Stress on Mental Health* (with Louis Lucas); *Neural Correlates of Visual Analogical Reasoning.* Coauthored student at Cognitive Neuroscience Society.

3. Thesis and Dissertation Committees

1. Sandra Vargas (Developmental)
2. Dane Wendell (Political Science)
3. Donna Bridge (Northwestern University Interdisciplinary Neuroscience Program)

B. Discussions and Teaching Philosophy

1. How has the candidate's teaching philosophy developed and changed over the years as a faculty member?

2. How is this philosophy reflected in the courses taught and research directed?

Items 1 and 2 are addressed together in the following statement.

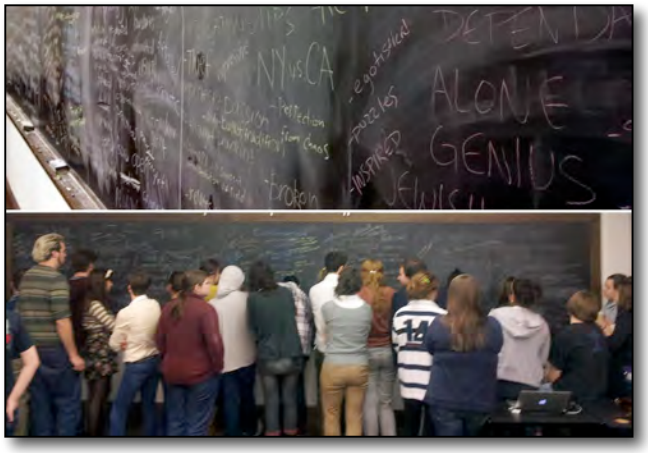
In my view higher education has three essential roles: 1) fostering a spirit of inquiry that empowers them with the critical thinking skills necessary to become life-long learners, 2) helping students discover their passion that propels them in the direction of a fulfilling career, and 3) helping students gain the skills necessary for their future careers. Psychology is an excellent domain within which to create such a critical learning environment given its use of the scientific method to explore questions of enduring significance and great personal relevance. If successful this is a transformative education experience, a central focus of Loyola's mission.

Learning by Teaching

During my years both as a liberal arts student and teaching assistant at Wheaton College, as well as during my various graduate and faculty teaching appointments, I have repeatedly been impressed by the power of "learning by teaching". In this pedagogy, the instructor structures active-learning projects and encourages students to "teach each other" in order to deeply learn content as well as improve their communication and reasoning skills. Making students responsible for not only their own learning, but also the learning of others helps to build motivation for learning, teamwork and also deep conceptual understanding (e.g., Stigler & Hiebert, 1999).

Implementation:

In my *Psychology of Creativity* (Hon 204) course, students work in small groups to become experts on a particular eminent creative person from the modern period. Working together they create a novel way to share their expertise with the class. Past projects have included an episode of a food network TV show to learn how to bake up an Einstein (including video infomercials on the discovers from his greatest year of discoveries) and Freud undergoing psychoanalysis from a class member to share how his childhood shaped him as a creative person. The students also identify and interview a creative person in the Chicagoland area and likewise build a case study on the person and similarly share their learning with the class though a second creative presentation. Throughout the experience both student teachers and audience members exhibit an unrivaled level of engagement and subsequent class discussions are insightful and FUN!



Student groups brainstorming topics for their group project in Hon 204

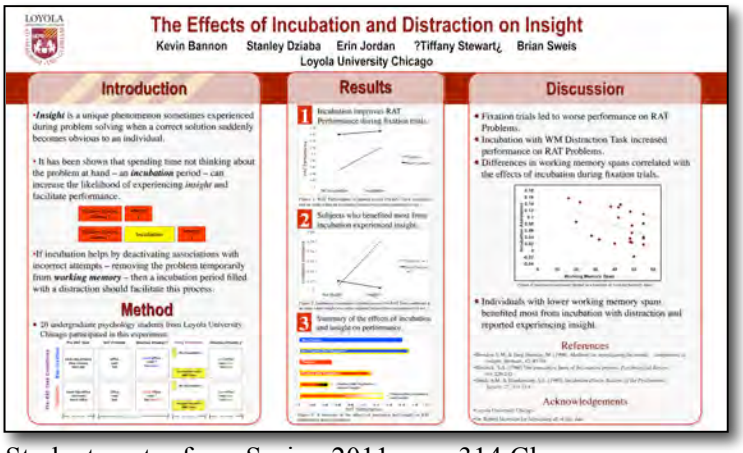
In another assignment, students develop blog entries (whatscreativeluc.blogspot.com) around the theme, What's Creative? Students develop their own operational definition of creativity and use it to identify specific creative products and analyze the creative process of the person who created it. The intent of the assignment is to apply course material to think critically about creativity in the world and share this with a broad audience beyond just the class or even the university community.

In my undergraduate *Cognitive and Behavioral Neuroscience* (psyc 398/382) course, students blog (brainpoints.blogspot.com) about cognitive neuroscience news items and comment on each other's

blog entries. The intent of the assignment is to apply course material to think critically about science and share this with a broad audience beyond just the class or even the university community.

In another assignment students create Hollywood style short films to share their research on a particular neurological disorder (see more detail in the following section). I recently presented this assignment at the Spring 2012 Focus on Teaching and Learning.

In my undergraduate *Laboratory in Experimental Psychology: Cognition* (psyc 314) course, students work in small groups to develop one of the course projects into a conference poster, which each student is responsible for orally presenting to the class. This gives students practice communicating about research questions and methodology including fielding questions from the class.



Student poster from Spring 2011 psyc 314 Class

In my graduate *Cognitive Neuroscience Seminar* (psyc 435) students are responsible for presenting two papers from the primary literature to the remainder of the class and leading a discussion about these papers. They are also responsible for developing a grant proposal integrating their research interests with course material. As a part of this project they give an oral presentation to present their research idea and to solicit feedback from the course. They then write an NRSA grant proposal with their research idea. Both assignments serve as teaching opportunities for the students and provide them with opportunities to integrate course learning with research.

The Power of Story to Engage, Remind and Apply

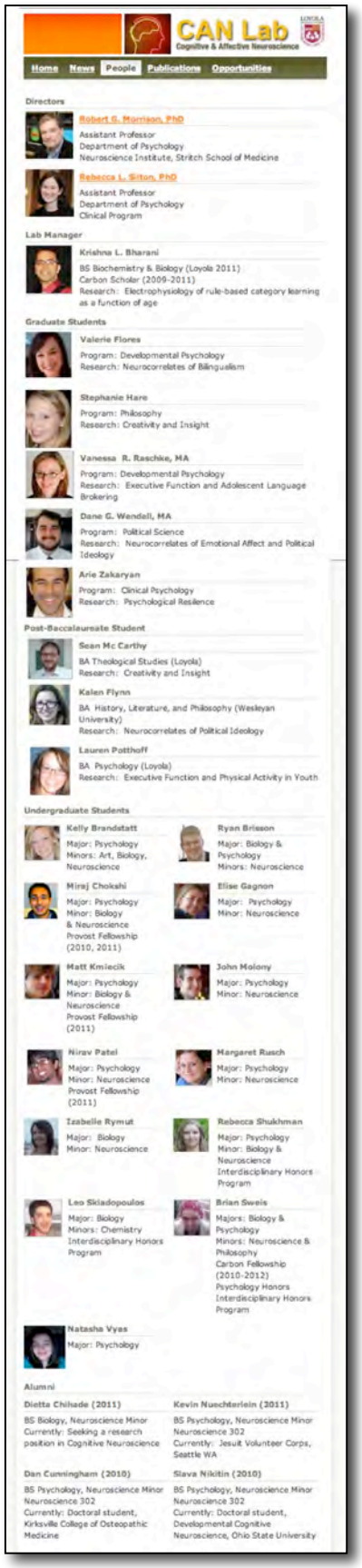
Story has been a principle means of teaching for most of human history. I believe the arts provide a natural way to engage students in compelling stories, which can serve as a scaffold for further learning in the sciences. Specifically I believe stories can catalyze students to ask important questions about psychological content, and help them to apply course content to analyze or solve real-world problems in their own lives and the lives of others (see Morrison & Bergman, 2005). As an example, prior to coming to Loyola I produced a short narrative film about the fallibility of human memory ("Retrieval"; see APS observer articles for more information). Retrieval engages the students in a story they can relate to so that as see the workings of false memory in the story and learn about the concepts governing this process, they are drawn to reflect on how these processes may be at work in their own lives.

Implementation:

I make extensive use of film for this purpose. In my undergraduate *Cognitive and Behavioral Neuroscience* (psyc 398/382) course, students work in small groups to develop a film on a neurologic disorder frequently not covered during the course (see also Morrison et al., 2012, January). Some create episodes of "House", while others use various Hollywood films like "Memento" as analogues. In the assignment students apply concepts they have learned in the course to construct novel ways to share their learning.

Two student made films as seen posted in YouTube

As described in the previous section, in my *Psychology of Creativity* (Hon 204)



Screen capture from canlab.org showing lab personnel during Spring 2012

course, students work in small groups to become experts on a particular eminent creative person from the modern era and once again on a contemporary Chicago creator that they identify. They work together to build a creative way to share their expertise with the class.

Experiential Learning

Many years ago I was infected with a pernicious virus. Retroviruses are fascinating things, when they infect a cell they inject their genetic material into the host and take over its metabolic machinery. Keith, John, Barbara, Bob and Ken (my own mentors) knew they were contagious, but took no precautions and infected me during the countless hours we have spent working together. They inoculated me with their passion and their ideas slipped into me without my notice. Once spliced into my own thoughts, their memes replicated within, becoming integral parts of my own. I never knew I was a host at the time, I just knew that I loved what I did more and more—I was more engaged and more passionate. I cared deeply for what I did. Insidious!

Now I too am contagious. I seek my hosts amongst the willing Loyola students. We spend many hours, days, nights, weekends, doing research, talking about ideas, life, and our futures. Whether in the lab or at conferences, I see it--clear signs of transmission--devotion, passion, and curiosity—late night texts with research ideas! Most rewarding is when they infect their friends--more students every month show up at the lab door.

Neuroscience is an intrinsically interdisciplinary and collaborative discipline, and there is no greater joy than to work together with my student collaborators as we strive to understand the human mind and brain together. I can't imagine anything more fulfilling than walking with them as their passion builds and their paths emerge, as they become successful scholars on their own.

C. Participation in Workshops and Other Advanced Training to Enhance Teaching Skills

Morrison, R.G., Flores, V., Chokshi, M., Gagnon, M., Kmiecik, M., Patel, N.,& Sweis, B. (2012, January). *Student made Films as a Means to Deep Learning*. Presentation given at Spring 2012 Focus on Teaching and Learning Conference.

See supplemental materials in portfolio under teaching>presentations.

D. Evidence of Teaching Effectiveness

Course Evaluations

Course	Semester	Size	Instructor Enrollment (#TCEs)		Course Mean	Course Median	GPA Mean	Median
Psyc314*	Fall (2009)	22 (20)	3.9	4	4	4	2.9	
Psyc314	Spring (2010)	20 (14)	4.64	5	4.64	5	3.1	
Psyc435*	Spring (2010)	16 (15)	3.67	4	3.73	4	3.7	
Psyc399*†	Fall (2010)	19 (17)	4.12	4	3.88	4	2.9	
Psyc314	Spring (2011)	21(18)	4.3	4	4.1	4	3.1	
Hon204*	Spring (2011)	33	3.6/4	4/4			3.7	
Psyc382	Fall (2011)	28(27)	4.0	4	4.1	4	2.9	

* New Prep
† Psyc399 will now be called Psyc382

Comments on Teaching from Course Evaluations

<u>Cognitive and Behavioral Neuroscience</u>
(psyc 398 – Fall 2010 – new prep/382 – Fall 2011)

Dr Morrison's knowledge of the subject was the best part…Everything from methods to attention, it was a great class

This class was vey interesting and provide thorough information about many different topics…Dr Morrison is friendly and enthusiastic

Really well done, interesting and definitely a good introduction to cognitive neuroscience

Dr Morrison is OBVIOUSLY passionate about the subject matter and he brings real world experience. He is willing to help with difficulties and is very professional

Dr. Morrison is very knowledgeable and has extensive research experience which I think is very important for this course since a lot of neuro has to do with research findings

Very interesting material and professor obviously engaged in the material. Great use of examples/connection to the real world

Good use of technology and instructor has in depth knowledge of material

…helpful and made time for students outside of class

Sacks – great perspective. Keep it. I loved it. May even have changed my life.

Lots of info covered but did it in a manner that was easily followed. fun video project

One of the best courses I've taken. Great subject, well presented material, professor makes it interesting

Professor is enthusiastic and well prepared…the wealth of knowledge, professionalism and preparation was outstanding

The combination of textbook material + current/important studies provided a well rounded course.

Dr Morrison is very knowledgeable on the subject. He is an amazing scholar on Neuroscience

Very detailed lectures and power point but also very descriptive when someone is confused

Professor Morrison was very knowledgeable and prepared. His assignments were interesting and rewarding.

Lots of opportunities to learn more outside class (banquet talks)

The project in the end (movie) makes looking into these disorders really interesting and makes you apply what you learn to "real" life

<u>Psychology of Creativity</u>
(Hon 204 – Spring 2011 – new prep)

Very passionate about what he teaches and clearly knows what he is talking about.

This class was very interesting and fun- I enjoyed learning about many different creative individuals and analyzing how we view and characterize creativity.

I really enjoyed and looked forward to going to this class every week.

Great course and professor!

Extraordinarily knowledgeable and able to bring in other material and information pertinent to our topics as our discussions diverged.

Dr. Morrison did a fantastic job with this course! Easily my favorite honors course to date.

Bob was amazing, his passion for this subject really resonated with his students and it made us want to work hard for him!

<u>Laboratory in Experimental Psychology: Cognition</u>
(psyc 314 – Fall 2009 – new prep, Spring 2010, Spring 2011)

Thank you for a great semester. I really enjoyed the course and feel like I got some very good insight about how research is conducted in the field of cognitive psychology. I

think that even the small tips you would give when sharing your previous experiences in research with the class can go a long way for those students who are pursuing a

career in research. I'm glad I was able to take two courses with an instructor so knowledgeable, experienced, and enthusiastic about their work. Also I would like to thank

you for your extra help with my Psyc 318 course, if you remember! It was very helpful!

- great teacher…help always available…lectures good

The lectures and various readings were insightful and engaging

Strongly organized…tight as a drum

Well organized…helpful…listened to students feedback…good instruction

The experiments done were very interesting

Dr Morrison and Meghan were very clear and helpful when asked for help

One of my hardest but favorite classes

This has been one of my favorite and best class experiences…Dr Morrison is definitely on top of his game.

The constant stream of work and use of multiple lab work formats definitely prepares students for real world work experience.

The teacher and TA were very reachable for help outside and inside the classroom. There was a good amount of work for each assignment and time to do it.

Very well organized. I really liked the design – write different APA sections of different exp's – then finish 1 off into a paper and/or a poster

Info presented well. Feedback very helpful

<u>Seminar in Cognitive Neuroscience (Information Processing)</u>
(psyc 435 – Spring 2010 – new prep)

I was very glad this class was offered. Dr Morrison taught the subject with a great deal of enthusiasm

Interesting topic, great instructor. Good balance between learning, discussion and testing

This course sparked my interest in neuro psych and made me exciting to possibly do research in this area one day

Teaching Awards

2011 Loyola Undergraduate Research Opportunities Program Distinguished Mentor Award Honorable Mention

2012 Nominated for the Loyola Undergraduate Research Opportunities Program Distinguished Mentor Award

2012 Nominated for the Sujack Award for Teaching Excellence, College of Arts and Science, Loyola University Chicago

Teaching Innovation

Morrison, R.G., Flores, V., Chokshi, M., Gagnon, M., Kmiecik, M., Patel, N.,& Sweis, B. (2012, January). *Student made Films as a Means to Deep Learning*. Presentation given at Spring 2012 Focus on Teaching and Learning Conference.

A fundamental challenge for higher education is to connect abstract concept learning with the lives of students thereby improving retention and increasing accessibility of learned information in relevant contexts. Active learning exercises attempt to facilitate this process. Herein we describe an assignment from Psychology 382 Cognitive and Behavioral Neuroscience, which asks students to work in small groups to write, direct, film and edit short films about neurologic disabilities. In the films, students act as patients, friends and family, and science and medical experts to bring these disabilities, their diagnosis and treatment, to life. Frequently using humor the short firms connect to contemporary media familiar to the students. Thus, students move from mere consumers of information to disseminators, with videos posted on youtube.com to enable a much greater audience for their work. Students will present excerpts from several of their films and describe their learning from the process.

III. Scholarship Demonstrated in Research

A. Bibliography (Always give complete citation including all co-authors)

Recent peer-reviewed publications, book chapters, conference proceedings, posters, and manuscripts under review may be found in the supplemental materials portfolio.

1. Research published in edited journals

1. **Morrison, R.G.,** Doumas, L.A.A., & Richland, L.E. (2011). A computational account of children's analogical reasoning: Balancing inhibitory control in working memory and relational representation. *Developmental Science, 14*(3), 516-529. doi:10.1111/j.1467-7687.2010.00999.x

2. Richland L.E., Chan, T-K., **Morrison, R.G.,** & Au, T.K-F. (2010). Young children's analogical reasoning across cultures: Similarities and differences. *Journal of Experimental Child Psychology, 105,* 146-153.

3. Richland, L.E., & **Morrison, R.G.** (2010). Is analogical reasoning just another measure of executive functioning? *Frontiers in Human Neuroscience, 4*, 180.

Prior to Loyola

4. **Morrison, R.G.**, & Cho, S. (2008). Neurocognitive process constraints on analogy: What changes to allow children to reason like adults? *Behavioral and Brain Sciences*, *31,* 391-392. PMID: 18662450

5. Krawczyk, D. C., **Morrison, R. G.**, Viskontas, I., Holyoak, K. J., Chow, T. W., Mendez, M., Miller, B.L., & Knowlton, B. J. (2008). Distraction during relational reasoning: The role of prefrontal cortex in interference control. *Neuropsychologia, 46,* 2020-2032. PMID: 18355881

6. Lu, H., **Morrison, R.G.**, Hummel, J.E., & Holyoak, K.J. (2006). Role of gamma-band synchronization in priming of form discrimination for multi-object displays. *Journal of Experimental Psychology: Human Perception and Performance, 32,* 610-617. PMID: 16822127

7. Richland, L.E., **Morrison, R.G.**, & Holyoak, K.J. (2006). Children's development of analogical reasoning: Insights from scene analogy problems. *Journal of Experimental Child Psychology*, *94*, 249–273. PMID: 16620867

8. **Morrison, R.G.**, Krawczyk, D., Holyoak, K.J., Hummel, J.E., Chow, T., Miller, B., & Knowlton, B.J. (2004). A neurocomputational model of analogical reasoning and its breakdown in frontotemporal lobar degeneration. *Journal of Cognitive Neuroscience, 16,* 260-271. doi:10.1162/089892904322984553

9. Viskontas, I.V., **Morrison, R.G.**, Holyoak, K.J., Hummel, J.E., & Knowlton, B.J., (2004) Relational integration, inhibition and analogical reasoning in older adults. *Psychology and Aging, 19,* 581-591. doi:10.1037/0882-7974.19.4.581

10. **Morrison, R.G.**, & Wallace, B. (2001). Imagery vividness, creativity, and the visual arts. *Journal of Mental Imagery, 25,* 135-152.

11. Spellman, B.A., Holyoak, K.J., & **Morrison, R.G.** (2001). Analogical priming via semantic relations. *Memory & Cognition, 29,* 383-393. PMID: 11407415

2. Chapters and books

1. **Morrison, R.G.** (in press). Analogical reasoning: Models of development. In H. Pashler (Ed.), *Encyclopedia of the mind*. Thousand Oaks, CA: Sage Publications.

2. **Morrison, R. G.** (in press). Problem solving. In M. Aminoff & R. Daroff (Eds.), *The encyclopedia of the neurological sciences (2nd Edition)*. San Diego: Academic Press.

3. Holyoak, K.J., & **Morrison, R.G.** (Eds.) (2012). *Oxford Handbook of Thinking and Reasoning*. New York, NY: Oxford University Press.
4. Holyoak, K.J., & **Morrison, R.G.** (2012). Thinking and reasoning: A reader's guide. In K.J. Holyoak & **R.G. Morrison** (Eds.), *Oxford Handbook of Thinking and Reasoning.* New York: Oxford University Press.
5. **Morrison, R.G.,** & Knowlton, B.J. (2012). Cognitive neuroscience of higher cognition. In K.J. Holyoak & **R.G. Morrison** (Eds.), *Oxford Handbook of Thinking and Reasoning.* New York: Oxford University Press.

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6. **Morrison, R.G.** (2005). Thinking in working memory. In K.J. Holyoak & R.G. Morrison (Eds.), *Cambridge Handbook of Thinking and Reasoning* (pp. 457-473). New York, NY: Cambridge University Press.

7. Holyoak, K.J., & **Morrison, R.G.** (2005). Thinking and reasoning: A readers guide. In K.J. Holyoak & R.G. Morrison (Eds.), *Cambridge Handbook of Thinking and Reasoning*. (pp. 1-9). New York, NY: Cambridge University Press.

8. Holyoak, K.J., & **Morrison, R.G.** (Eds.) (2005). *Cambridge Handbook of Thinking and Reasoning*. New York, NY: Cambridge University Press.

9. **Morrison, R. G.**, & Holyoak, K. J. (2003). Problem solving. In M. Aminoff & R. Daroff (Eds.), *The encyclopedia of the neurological sciences* (Vol. 1, pp. 60-62). San Diego: Academic Press.

3. Published Conference Proceedings

1. **Morrison, R.G.,** Bharani, K., Chihade, D., Nuechterlein, K., Weintraub, S., Reber, P.J., & Paller, K.A. (2011). Category learning brain potentials as neurocognitive markers for pathologic aging. *Alzheimer's & Dementia, 7*(4), S32-33.
2. **Morrison, R.G.,** Bharani, K., Chihade, D., Nuechterlein, K., Weintraub, S., Reber, P.J., & Paller, K.A. (2011). Category learning brain potentials as neurocognitive markers for pathologic aging. *Alzheimer's & Dementia, 7*(4), S216.
3. Doumas, L. A. A., **Morrison, R. G.**, & Richland, L. E. (2010). Differences in development of analogy across cultures: A computational account. *Proceedings of the Thirty-Second Annual Conference of the Cognitive Science Society*.
4. Doumas, L.A.A., **Morrison, R.G.,** & Richland, L.E. (2009). The development of analogy: Task learning and individual differences. *Proceedings of the Thirty-First Annual Conference of the Cognitive Science Society* (pp. 3133-3138). Mahwah, NJ: Erlbaum.
5. **Morrison, R.G.,** Reber, P., & Paller, K.A. (2009). Dissociation of category-learning mechanisms via brain potentials. *Proceedings of the Thirty-First Annual Conference of the Cognitive Science Society* (pp. 3076-3081). Mahwah, NJ: Erlbaum.

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6. **Morrison, R.G.**, Doumas, L.A.A., & Richland, L.E. (2006). The development of analogical reasoning in children: A computational account. *Proceedings of the Twenty-eighth Annual Conference of the Cognitive Science Society* (pp. 603-608). Mahwah, NJ: Erlbaum.
7. Thompson, G., **Morrison, R.G.**, Holyoak, K.J., & Clark, T.K. (2006). Evaluation of an online analogical patient simulation program. *Proceedings of the Nineteenth IEEE International Symposium on Computer-Based Medical Systems* (pp. 623-628). Los Alamitos, CA: IEEE Computer Society.

8. Richland, L.E., **Morrison, R.G.**, & Holyoak, K.J. (2004). Developmental Change in Analogical Reasoning: Evidence from a Picture-Mapping Task. *Proceedings of the Twenty-seventh Annual Conference of the Cognitive Science Society* (pp. 1149-1154). Mahwah, NJ: Erlbaum.

9. **Morrison, R.G.**, Krawczyk, D., Knowlton, B.J., Holyoak, K.J., Boone, K.B., Chow, T., & Mishkin, F.S. (2001). Relational reasoning and semantic inhibition in human prefrontal cortex. *Brain & Cognition, 47,* 292-296.

10. **Morrison, R.G.**, Holyoak, K.J., & Truong, B. (2001). Working memory modularity in analogical reasoning. *Proceedings of the Twenty-fourth Annual Conference of the Cognitive Science Society* (pp. 663-668). Mahwah, NJ: Erlbaum.

11. **Morrison, R.G.**, Holyoak, K.J., & Spellman, B.A. (2000). Analogical priming in a word naming task. *Proceedings of the Twenty-second Annual Conference of the Cognitive Science Society* (pp. 1045). Mahwah, NJ: Erlbaum.

4. Presentations

1. Doumas, A., **Morrison, R.G.,** & Richland, L.E. (2012, August). *Computational perspectives on the role of comparison in structure learning: Developmental, learning science, and computational perspectives*. Symposium proposal for the 34th Annual Cognitive Science Society, Sapporo, Japan.

2. Sweis, B.M., Bharani, K.L. & **Morrison, R.G**. (2012, August). *The time course of inhibition in analogical reasoning: An event-related potential approach.* Paper submitted for the 34th Annual Cognitive Science Society, Sapporo, Japan.

3. Wendell, D.G., Matland, R.E., & **Morrison, R.G.** (2012, August). *Inhibitory response in the political brain*. Paper proposal submitted for annual meeting of American Political Science Association. New Orleans, LA.

4. **Morrison, R.G.,** (2012, July). *Processing dynamics in analogical reasoning: Developmental, neuropsychological, neuroimaging, and computational evidence*. Talk to be presented at the 6th International Conference on Thinking, London, England.

5. **Morrison, R.G.,** (2012, July). *Analogical reasoning*. Symposium organized for the 6th International Conference on Thinking, London, England.

6. Wendell, D.G., Matland, R.E., & **Morrison, R.G.** (2012, July). *Using electroencephalography to measure inhibition in political ideologues.* Paper proposal submitted for annual meeting of International Society of Political Psychology. Chicago, IL.

7. Wendell, D.G., Matland, R.E., & **Morrison, R.G.** (2012, April). *Neural correlates of political ideology and self-regulation*. Paper to be presented at annual meeting of Midwest Political Science Association. Chicago, IL.

8. Hare, S., Molony, J., McCarthy, S., Brandstatt, K., Skiadopoulos, L., Bharani, K.L. & **Morrison, R.G.** (2012, March). *Insight follows incubation in the Remote Associates Test*. Poster accepted for the Cognitive Neuroscience Society Annual Meeting, Chicago IL.

9. **Morrison, R.G.**, Kmiecik, M., & Bharani, K.L. (2012, April). *When analogy is like priming: The N400 in verbal analogical reasoning.* Poster accepted for the Cognitive Neuroscience Society Annual Meeting, Chicago IL.

10. Sweis, B.M., Bharani, K.L. & **Morrison, R.G.** (2012, April). *Relational complexity and relational distraction modulate response-locked event-related potentials in analogical reasoning.* Poster accepted for the Cognitive Neuroscience Society Annual Meeting, Chicago IL.

11. Bharani, K., Weintraub, S., Reber, P.J., Paller, K.A., & **Morrison, R.G.,** (2012, March). *Category learning brain potentials as neurocognitive markers for pathologic aging.* Poster to be presented at the Chicago Area Undergraduate Research Symposium, Chicago, IL.

12. Molony, J., Brandstatt, K., Skiadopoulos, L., Hare, S., McCarthy, S., Bharani, K.L. & **Morrison, R.G.** (2012, March). *Insight follows incubation in the Remote Associates Test*. Poster to be presented at the Chicago Area Undergraduate Research Symposium, Chicago, IL.

13. Kmiecik, M., Bharani, K.L., & **Morrison, R.G.** (2012, March). *When analogy is like priming: The N400 in verbal analogical reasoning.* Poster to be presented at the Chicago Area Undergraduate Research Symposium, Chicago, IL.

14. Sweis, B.M., Veverka, K.K., Bawa, G.S., Dhillon, E.S., **Morrison, R.G.,** Lucas, L.R. (2012, March). *Individual differences in the effects of chronic stress on memory: Neuropeptide Y and anxiety as biobehavioral correlates of resiliency*. Poster to be presented at the Chicago Area Undergraduate Research Symposium, Chicago, IL.

15. Sweis, B.M, Bawa, G.S., Veverka, K.K., Dhillon, E.S., **Morrison, R.G.,** & Lucas, L.R. (2011, October). *Repeated stress impairs or enhances spatial memory depending on individual coping differences in stress reactivity and anxiety*. Poster submitted for the Society for Neuroscience Annual Meeting, Washington D.C.

16. **Morrison, R.G.,** Doumas, L.A.A., Flores, V. & Richland, L.E. (2011, October). Individual differences in executive functions explain longitudinal development trends In analogical reasoning. *Poster to be presented at the Cognitive Development Society*. Philadelphia, PA.

17. **Morrison, R.G.,** Bharani, K., Chihade, D., Nuechterlein, K., Weintraub, S., Reber, P.J., & Paller, K.A. (2011, July). *Category learning brain potentials as neurocognitive markers for pathologic aging.* Poster presented at the Alzheimer's Imaging Consortium, Paris, France.

18. **Morrison, R.G.,** Bharani, K., Chihade, D., Nuechterlein, K., Weintraub, S., Reber, P.J., & Paller, K.A. (2011, July). *Category learning brain potentials as neurocognitive markers for pathologic aging.* Poster presented at the International Conference on Alzheimer's Disease, Paris, France.

19. Bharani, K., Chihade, D., Nuechterlein, K., Weintraub, S., Paller, K.A., Reber, P.J., & **Morrison, R.G.** (2011, April). *Electrophysiology of rule-based category learning as a function of age.* Abstract submitted for presentation at the 17th Annual Alzheimer Day at Northwestern University's Cognitive Neurology and Alzheimer's Disease Center, Chicago, IL.

20. Bharani, K., Chihade, D., Nuechterlein, K., Weintraub, S., Paller, K.A., Reber, P.J., & **Morrison, R.G.** (2011, April). *Electrophysiology of rule-based category learning as a function of age.* Poster presented at the Cognitive Neuroscience Society Annual Meeting, San Francisco, CA.

21. Nikitin, S., & **Morrison, R.G.** (2011, April). *Analogical Reasoning in Human Prefrontal Cortex: An Event-Related Potential Approach.* Poster presented at the Cognitive Neuroscience Society Annual Meeting, San Francisco, CA.

22. Doumas, L. A. A., **Morrison, R. G.**, & Richland, L. E. (2010, August). *Differences in development of analogy across cultures: A computational account.* Poster presented at the Thirty-Second Annual Conference of the Cognitive Science Society. Portland, Oregon.

23. **Morrison, R.G.,** Lucas H., Florczak, S., James' M., Wingo' J., & Paller' K.A. (2010, April). *Brain Potentials Reflect Changes in Memory with Age.* Poster presented at the Cognitive Neuroscience Society Annual Meeting, Montreal, Canada.

24. **Morrison, R.G.**, Reber, P., & Paller, K.A. (2009, October). *Brain potentials dissociate category-learning mechanisms.* Poster presented at the Society for Neuroscience, Chicago, IL.

25. Doumas, L.A.A., **Morrison, R.G.,** & Richland, L.E. (2009). *The development of analogy: Task learning and individual differences. Poster presented at the Thirty-First Annual Conference of the Cognitive Science Society*. Amsterdam, Netherlands.

26. **Morrison, R.G.,** Reber, P., & Paller, K.A. (2009). Dissociation of category-learning mechanisms via brain potentials. *Poster presented at the Thirty-First Annual Conference of the Cognitive Science Society*. Amsterdam, Netherlands.

27. **Morrison, R.G.** (2009, July). *Implementing analogy in the brain: A computational approach to Neuropsychological Results.* Talk presented at the 2nd International Analogy Conference, Central and East European Center for Cognitive Science, New Bulgarian University, Sofia, Bulgaria.

28. Richland, L.E., Doumas, L.A.A., & **Morrison, R.G.** (2009, July). *Implementing.* Talk presented at the 2nd International Analogy Conference, Central and East European Center for Cognitive Science, New Bulgarian University, Sofia, Bulgaria.

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29. **Morrison, R.G.**, Reber, P., & Paller, K.A. (2009, April). *Electrophysiological decomposition of category-learning mechanisms.* Poster accepted for presentation at the Fifteenth International Congress on Event-Related Potentials of the Brain, Bloomington, Indiana.

30. **Morrison, R.G.**, Reber, P., & Paller, K.A. (2009, March). *Electrophysiological dissociation of category learning mechanisms.* Poster presented at the Cognitive Neuroscience Society Annual Meeting, San Francisco, California

31. **Morrison, R.G.**, & Reber, P.J., & Paller, K.A. (2008, November). Neurophysiological dissociation of rule-based and information integration category learning mechanisms. Poster presented at the 49th Annual Meeting of the Psychonomic Society, Chicago, IL.

32. Doumas, L.A.A., & **Morrison, R.G.**, & Richland, L.E. (2008, November). A computational account of the development of structured thought. Poster presented at the 49th Annual Meeting of the Psychonomic Society, Chicago, IL.

33. Thompson, G., **Morrison, R.G.**, Milne, C. & Holyoak, K.J. (2008, July). *Multi-faceted E-learning: Comparison of methods study #2.* Poster and Talk presented at the International Association of Medical Science Educators, Salt Lake City, UT.

34. **Morrison, R.G.**, Reber, P., & Paller, K.A. (2008, May). *Using event-related potentials to dissociate category-learning mechanisms.* Poster presented at the Association for Psychological Science 20th Annual Convention, Chicago, IL.

35. **Morrison, R.G.**, Reber, P., & Paller, K.A. (2008, May). *Dissociation of rule-based and information integration category learning: An event-related potential approach*. Poster presented at the Cognitive Neurology & Alzheimer's Disease Center's Alzheimer's Day Poster Session, Chicago, IL.

36. **Morrison, R.G.**, Reber, P., & Paller, K.A. (2008, April). *Dissociation of rule-based and implicit category learning: An electrophysiological approach.* Poster presented at the Cognitive Neuroscience Society, San Francisco, California.

37. Doumas, L.A.A., & **Morrison, R.G.** (2007, November). *Modeling process differences in implicit and explicit category learning: A symbolic-connectionist approach.* Poster presented at the 48th Annual Meeting of the Psychonomic Society, Long Beach, California.

38. **Morrison, R.G.**, Doumas, L.A.A., & Richland, L. (2007, November). *Cross Cultural Cognitive Differences in Analogical Reasoning: A Computational Account.* Poster presented at the 48th Annual Meeting of the Psychonomic Society, Long Beach, California.

39. **Morrison, R.G.**, Doumas, L.A.A., & Richland, L. (2007, November). *Inhibition vs. Relational Knowledge constraints in Children's Analogical Reasoning: A symbolic-connectionist approach.* Poster presented at the Fifth Biennial Meeting of the Cognitive Development Society, Santa Fe, New Mexico.

40. **Morrison, R.G.** (2006, November). *Beyond the passive video experience: Challenges for research on new approaches in video for psychology education*. Paper presented 36th Meeting of the Society for Computers in Psychology, Houston, Texas.

41. **Morrison, R.G.**, Doumas, L.A.A., & Richland, L.E. (2006, July). *The development of analogical*

reasoning in children: A computational account. Paper presented at the Twenty-ninth Annual Conference of the Cognitive Science Society, Vancouver, Canada.

42. Thompson, G., **Morrison, R.G.**, Holyoak, K.J. & (2006, June). *Evaluation of an Online Analogical Patient Simulation Program.* Paper presented at the IEEE International Symposium on Computer-Based Medical Systems: Advances in Medical Simulation, Salt Lake City, Utah.
43. **Morrison, R.G.**, Lu, H., Holyoak, K.J., & Hummel, J.E. (2005, November). *Asynchronous priming in the gamma band facilitates discrimination of Kanizsa-type forms.* Poster presented at the 46th Annual Meeting of the Psychonomic Society, Toronto, Canada.
44. Thompson, G., **Morrison, R.G.**, & Holyoak, K.J. (2005, June). *Medulator™ analogical reasoning study: Evaluation of an online case-based learning tool.* Talk presented by Gregory Thompson at the Slice of Life conference sponsored by the Academy of American Medical Colleges), Portland, OR.
45. **Morrison, R.G.** (2005, May). *Retrieval.* Invited presentation at the 17th Annual American Psychological Society Conference, Los Angeles, CA.
46. **Morrison, R.G.,** & Bergman, C.E. (2005, May). *Analogy into the world: Cuing learning in everyday life using narrative film.* Poster presented at the Teaching Institute of the 17th Annual American Psychological Society Conference, Los Angeles, CA.
47. Richland, L.E., **Morrison, R.G.**, & Holyoak, K.J. (2004, November). *Development of Analogical Reasoning: Inhibitory Control and Working Memory.* Poster presented at the 45th Annual Meeting of the Psychonomic Society, Minneapolis, MN.
48. Richland, L.E., **Morrison, R.G.**, & Holyoak, K.J. (2004, August). *Developmental Change in Analogical Reasoning: Evidence from a Picture-Mapping Task.* Talk read by Lindsey Richland at the Twenty-seventh Annual Conference of the Cognitive Science Society, Chicago, IL.
49. Richland, L.E., **Morrison, R.G.**, & Holyoak, K.J. (2003, October). Working memory and inhibition constraints on children's analogical reasoning. Poster presented at the 3rd Annual Meeting of the Cognitive Development Society, Park City, UT.
50. **Morrison, R.G.**, Viskontas, I., & Hummel, J. (2003, April). *A computational account of working memory and inhibition changes in analogical reasoning during normal aging.* Poster presented at the Cognitive Neuroscience Society Annual Meeting, New York, NY.
51. Krawczyk, D., **Morrison, R.G.**, Holyoak, K.J., Chow, T.W., Mendez M., & Knowlton, B.J., (2003, April*). The role of prefrontal cortex in inhibiting competing perceptual and semantic information in relational reasoning.* Poster presented at the Cognitive Neuroscience Society Annual Meeting, New York, NY.
52. **Morrison, R.G.**, Holyoak, K.J., Ash, A., & Erickson, E. (2002, November). *The role of working memory in analogical reasoning.* Talk read by Keith Holyoak at the Annual Meeting of the Psychonomic Society, Kansas City, MO.
53. Stevens, G., **Morrison, R.G.**, & Stark, R. (2002, November). *Neural-network model of a directed forgetting working memory task.* Poster presented at the Annual Meeting of the Psychonomic Society, Kansas City, MO.
54. **Morrison, R.G.**, Hummel, J., & Holyoak, J. (2002, April). *A computational account of working memory and inhibition in analogical reasoning.* Poster presented at the Cognitive Neuroscience Society Annual Meeting, San Francisco, California.
55. Krawczyk, D., **Morrison, R.G.**, Holyoak, K.J., Chow, T.W., Miller, Bruce L., & Knowlton, B.J., (2002, April*). Analogical reasoning and inhibition in prefrontal cortex.* Poster presented at the Cognitive Neuroscience Society Annual Meeting, San Francisco, California.
56. **Morrison, R.G.**, Macdonald, J.W., & Bjork, R.A. (2001, November). *Active suppression in the*

management of working memory. Poster presented at the Annual Meeting of the Psychonomic Society, Orlando, FL.

57. **Morrison, R.G.**, Holyoak, K.J., & Truong, B. (2001, August). *Working memory modularity in analogical reasoning.* Talk delivered at the Twenty-third Annual Conference of the Cognitive Science Society, Edinburgh, UK.

58. Krawczyk, D., **Morrison, R.G.**, Holyoak, K.J., Chow, T.W., Miller, Bruce L., & Knowlton, B.J., (2001, March*). Reasoning about picture analogies in prefrontal cortex.* Poster presented at the Cognitive Neuroscience Society Annual Meeting, New York, NY.

59. **Morrison, R.G.**, Krawczyk, D., Holyoak, K.J., Chow, T.W., Miller, Bruce L., & Knowlton, B.J., (2001, March). *Semantic inhibition and analogical reasoning in human prefrontal cortex*. Poster presented at the Cognitive Neuroscience Society Annual Meeting, New York, NY.

60. **Morrison, R.G.**, Holyoak, K.J., & Spellman, B.A. (2000, August). Analogical priming in a word naming task. Poster presented at the Twenty-second Annual Conference of the Cognitive Science Society, Philadelphia, PA.

61. **Morrison, R.G.**, Krawczyk, D., Knowlton, B.J., Holyoak, K.J., Boone, K.B., Chow, T., & Mishkin, F.S. (2000, March*). Relational reasoning and semantic inhibition in human prefrontal cortex.* Poster presented at the 10th Annual Rotman Research Institute Conference, Toronto, Ontario.

62. Allen, P.A., Pickle, J., Lien, M-C, Groth, K., & **Morrison, R.G.** (1997, November). *A Three-Stream Model of Visual Word Recognition.* Paper presented at the Annual Meeting of the Psychonomic Society, Philadelphia, PA.

B. Grant Activity

1. Grants received

	Source	Title	Role	Amount
1.	Illinois Department of Public Health/ Alzheimer's Disease Research Fund	*Electrophysiology of category learning in Alzheimer's Disease*	PI	$34,958
2.	Loyola University – Summer Stipend	*Electrophysiology of Category Learning in Super Agers*	PI	$7,000
3.	Alzheimer's Association – International Conference on Alzheimer's Disease Travel Award	*Category learning brain potentials as neurocognitive markers for pathologic aging*	Recipient	$2,000
4.	Rosalinde and Arthur Gilbert Foundation/American Federation of Aging Research – New Investigator in Alzheimer's Disease Award	*Electrophysiology of Category Learning in Mild Cognitive Impairment*	PI	$99,988
5.	Loyola Undergraduate Research Opportunities Program – Provost Fellowship – Nirav Patel	*The Role of Inhibition in Determining Political Ideology*	Mentor	$1,900
6.	Loyola Undergraduate Research Opportunities Program– Provost Fellowship – Miraj Chokshi	*Neurocorrelates of Relational and Featural Similarity Processing*	Mentor	$1,500

7.	Loyola Undergraduate Research Opportunities Program – Provost Fellowship – Matthew Kmiecik	*Electrophysiology of Verbal Analogical Reasoning*	Mentor	$1,900
8.	Loyola University – Multidisciplinary Development Grant	*Is political ideology hardwired? Testing political variables in the brain*	Co-PI	$25,000
9.	Loyola Undergraduate Research Opportunities Program– Provost Fellowship – Miraj Chokshi	*The Effect of Personal Perceived Power on Reasoning Strategy Selection*	Mentor	$2,000
10.	Carbon Undergraduate Research Fellowship Program – Carbon Fellowship – Brian Sweis	*The Behavioral and Neurochemical Analysis of the Effects of Chronic Stress on Mental Health*	Co-Mentor	$15,000

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11.	Illinois Department of Public Health/ Alzheimer's Disease Research Fund	*Electrophysiology of category learning in Alzheimer's Disease*	PI	$30,000
12.	National Institute of Aging, Northwestern Alzheimer's Disease Core Center – Declined because of institution change	*Electrophysiological of Category Learning in Patients with Mild Cognitive Impairment*	PI	$28,000
13.	National Institute of Mental Health – Training Award	*Yearly Workshop in the Event-Related Potential Technique at University of California, Davis*	Recipient	
14.	T32AG020506 – National Institute of Aging – National Research Service Award	*Mechanisms of Aging and Dementia*	Fellow	$100,000
14.	SBIR OSD03-DH07 Office of Naval Research	*Medical Training for Force Mobilization and Disaster Response*	Consultant	$25,000
15.	SBIR OSD01-CR11 Office of Naval Research	*An Intelligent System for Case-Based Instruction*	Consultant	$25,000
16.	F31MH064244-01A1 – National Institute of Mental Health – National Research Service Award	*Working Memory and Inhibition in Analogical Reasoning*	Trainee	$70,000
17.	T32MH019926-05 – National Institute of Mental Health – National Research Service Award	*Developmental Cognitive Science*	Trainee	$30,000

2. Unfunded grant proposals (Loyola only)

Source	Title	Role	Amount
Templeton Foundation	*The influence of affective disorders on the neural correlates of cognitive creativity*	PI	$400,000
Loyola University – President's Intercampus Collaborative Research Simulation Awards	*The Impact of Cognitive Training on Older Adults and Individuals with Traumatic Brain Injury as Influenced by Stress*	PI	$85,000

Plans for Continued Research Productivity

1. Material under consideration

Doumas, L.A.A., **Morrison, R.G.,** & Richland, L.E. (2012). *Individual differences in relational learning and analogical reasoning over time: A computational approach.* Manuscript under review.

Sweis, B.M., Bharani, K.L. & **Morrison, R.G.** (2012). *The time course of inhibition in analogical reasoning: An event-related potential approach.* Manuscript under review.

2. Material in preparation (specify degree of completion and projected completion date)

Bharani, K., Weintraub, S., Reber, P.J., Paller, K.A., & **Morrison, R.G.** (2012). *Electrophysiology of rule-based category learning as a function of age.* Manuscript in preparation. – 80% -- June 2012

Knowlton, B.J., **Morrison, R.G.,** Hummel, J.E., & Holyoak, K.J. (2012). *The neural basis of human thought.* Manuscript invited for submission to *Trends in Cognitive Science*. -- 80% -- March 2012

Morrison, R.G., Kmiecik, M., Bharani, K.L. (2012). *When analogy is like priming: The N400 in verbal analogy.* Manuscript in preparation. – 30% -- August 2012

Morrison, R.G., Nikitin, V. & Bharani, K.L. (2012). *Neurocorrelates of analogical reasoning: An event-related potential approach..* Manuscript in preparation. -- 80% -- March 2012

Morrison, R.G., Bharani, K., Reber, P., & Paller, K.A. (2012). *Neural dissociations in category learning: An electrophysiological approach.* Manuscript in preparation. -- 80% -- March 2012

3. Future research plans and description of research program

Following are descriptions of several major areas of inquiry that characterize my research program.

Neurocognitive Mechanisms of Relational Reasoning

Relational thinking is ubiquitous in human learning and thought. We decide whether a law is unconstitutional by comparing it to previous cases, "guess" at the ending of a movie or television show based on schemas developed from watching similar films in the past, or even decide whether to try a new ingredient in the dish we are preparing for dinner by comparing the current recipe to other recipes in the past which used that same ingredient. Many of the great scientific discoveries such as models of atomic structure and the theory of evolution are the result of the ability to form and manipulate explicit relational representations, a capacity closely related to the size and complexity of the prefrontal cortex (PFC) and believed to be a relatively recent evolutionary development. This capacity is not just of

phylogenic interest by also of ontogenic, in that the ability to explicitly reason changes dramatically during the lifespan.

Central to understanding how humans learn and reason is a theory of how relational information is represented in the brain's distributed network of neurons and in turn how these representations allow the type of flexibility characteristic of human higher cognition. One possible solution to this problem is to hypothesize conjunctive coding of information in a distributed network representation in long-term memory and dynamic binding of this information into relational structures through the use of attention in working memory. For instance, if you were trying to appreciate the relational structure "Bob is taller than Jim" [i.e., *taller* (Bob,Jim)], you may have specific height information about Bob and Jim each stored in long-term memory, and then when you think about "Bob is taller than Jim" you systematically fire these representations in working memory in such a way that it is clear that Bob *is taller* than Jim. Note that the propositional statement Bob is taller than Jim is not stored in long-term memory, rather it is constructed when necessary from its parts. This allows for the flexibility characteristic of relational reasoning. For instance, if we know that Bob is taller than Jim and Jim is taller than John we can infer that Bob is taller than John, without any prior experience with the comparative height of Bob and John. Hummel and Holyoak (1997, 2003) have implemented such a theory of relational reasoning in a neutrally-plausible computational model (Learning and Inference with Schemas and Analogy, LISA) that is cable of simulating human performance in a broad range of relational reasoning tasks.

Currently, my collaborators and I (Knowlton, Morrison, Hummel, & Holyoak, in prep) are attempting to offer a detailed explanation of how LISA operates in the brain. We believe that neurons in PFC are responsible for systematically firing neurons in posterior areas of the cortex responsible for coding the information being reasoned about. Some evidence for this type of interaction has already been shown in humans (Canolty & Knight, 2010) using electrocortigraphy (ECOG) in patients preparing for brain surgery. Using scalp EEG we hope to be able to show this type of cross-frequency coupling and demonstrate differences based on the modality of analogy problems being solved. We also intend to look at how this neural circuit is modulated in the face of featural and relational distraction, an important aspect of analogy that has been the focus of my work for the last ten years (e.g., Morrison et al., 2004; Krawczyk et al., 2008; Richland et al., 2006; Morrison et al., 2011; Sweis, Bharani, & Morrison, under review).

A predoctoral NRSA award, from the NIMH, funded early work on this project. One of my undergraduate students is currently applying for a Carbon Scholarship to fund his work on this project. During 2012-2013 I also anticipate preparing a grant proposal to be submitted to the NSF for additional funding for this line of research.

The Development of Analogical Reasoning in Children

While it seems clear that frontal patients' executive deficits (i.e., inhibitory control and working memory) are the cause of their problems in analogical reasoning (Morrison et al., 2004; Krawyczk, Morrison, et al., 2008) there is disagreement if this same explanation is appropriate for a similar pattern of performance in young children. A counter explanation for the pattern of results in children posits that children show deficits in analogy because of inadequate relational knowledge rather than deficits in executive functions (see Richland, Morrison, & Holyoak, 2006). For instance (see Figure 1), a child may be more familiar with the relation *hit-by* (nail, hammer) or *looks-like* (hammer, gavel) than with the relational response *kept-in* (hammer, toolbox). While analogy tasks finding deficits in processing distractors in children (e.g., Richland et al., 2006; Richland, Cho, Morrison, & Au, 2010) have been careful to use only relations familiar to children, it is possible in situations that are particularly

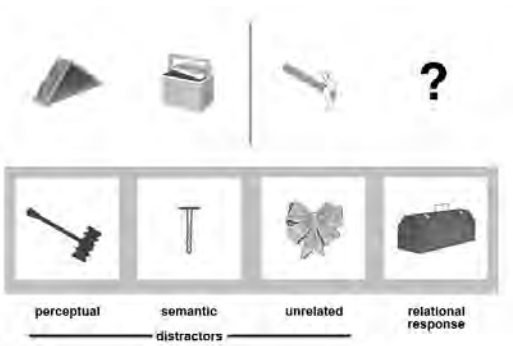


Figure 1. Example problem from Krawczyk et al. (2008)

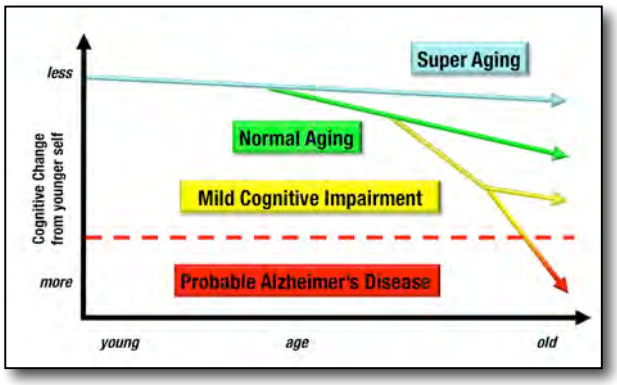
executively demanding (i.e., relationally complex or featurally distracting analogies), additional familiarity with relations may assist in processing. To study this issue my collaborators (Lindsey Richland--University of Chicago and Alex Doumas,--University of Hawaii) and I use experimental and computational methods to address how relational knowledge and executive function interact to enable development of analogical reasoning and other forms of structured thought (e.g., Morrison, Doumas, & Richland, 2011; Doumas, Morrison, & Richland, under review).

Extending this line of inquiry, I have begun a project to look at how the brain changes during development to support the patterns of behavior we have already documented. Recently, Dumontheil et al. (2010) has provided evidence that areas of the brain responsible for analogical reasoning show cortical thinning during adolescence, and that this thinning correlates with improvement in analogy performance during development. This study, however, does not establish a mechanism by which changes in the brain support changes in analogy. We intend to use both visual (like Dumenthiel et al., and Morrison, Nikitin, & Bharani (in prep)) and verbal analogy paradigms (Morrison, Kmiecik, & Bharani (in prep)) with simultaneous EEG to address this issue. Our plan involves recruiting 10 to 14 year old girls from several area Catholic schools to be a part of a study run in the CAN lab. Specifically we will use EEG time frequency analysis to look for evidence of increases in neural efficiency between PFC and specific areas responsible for processing task-related information (occipital/parietal lobe for visual task and left temporal lobe for verbal task). This would provide direct evidence for why cortical thinning aids in the development of analogy. We will look at these measures both in the girls as well as female college students.

A training grant from the NICD and a predoctoral NRSA award, from the NIMH, funded early work on this project. One of my undergraduate students is currently applying for a Carbon/Johnson Scholarship to fund her work on this project. During 2012-2013 I also anticipate preparing a grant proposal to be submitted to the NICD for additional funding for this line of research.

Neurocognitive Biomarkers for Pathologic- and Super-Aging

One characteristic of cognitive aging is an increase in variability for cognitive tasks with age. This has resulted in efforts to exam older adults exhibiting sub-standard performance for signs of pathology including amnestic Mild Cognitive Impairment (aMCI) or Alzheimer's disease (AD). Early detection would allow for behavioral or pharmacological intervention prior to the debilitating pathology associated with the diseases.



For the last several years my laboratory has been exploring the use of rule-based category learning with EEG monitoring for this purpose. The ability to learn and use categories is a fundamental property of the human memory system. Past functional Magnetic Resonance Imaging (fMRI) studies have suggested that rule-based category learning is critically dependent on prefrontal cortex and medial temporal lobe, two brain regions associated with aMCI and probable AD. Past neuropsychological studies have suggested that executive function in MCI patients predicts which patients go on to convert to a diagnosis of probable AD. Thus, rule-based category learning may be an excellent paradigm to detect and track MCI and possibly even predict which normal adults convert to aMCI diagnoses. Using behavioral and EEG methods in older adults with normal neuropsychological profiles, we have found a marked individual difference in both the ability to perform the task and awareness for task learning (Morrison et al. 2011). We believe that these differences may be related to anterior cingulate (ACC) functions and thus we are exploring additional tasks that recruit this brain area for which we can also collect behavioral and functional neuroimaging data. We are currently preparing a manuscript with the results from our first category

learning study with normally aging adults and beginning data collection with both aMCI and AD patients.

All of the participants in our studies are registered in the clinical core of the Cognitive Neurology and Alzheimer's Disease Center (CNADC) at Northwestern University. As a part of this registry they have agreed to brain donation and have yearly neuropsychological evaluations. Most participants have also been tested for genetic markers for Alzheimer's disease and had their brains analyzed for volumetric changes. We have access to all of this data and will longitudinally track participants to understand how these various factors predict pathologic aging.

This work has been funded by several grants from the Illinois Department of Public Health's Alzherimer's Disease Research Fund, a New Investigator in Alzheimer's Disease Award from the Rosalinde and Arthur Gilbert Foundation/ American Federation of Aging Research, and a travel award from the Alzheimer's Association.

An alternative route to understanding the changes which can result in pathologic aging is to investigate the neural correlates of successful aging. One model of successful aging seeks to identify elderly people older than 80 years old who have the long-term memory abilities of the average 50 year old person. The CNADC has described these people as Super-Agers (SA). Identification of SAs provide an opportunity to study the genetic, lifestyle, or cognitive habits which may contribute to successful aging. Like the other participants at the CNADC the SAs have agreed to brain donation and have yearly neuropsychological evaluations. They have also been tested for genetic markers for Alzheimer's disease and had their brains analyzed for volumetric changes. A recent finding using structural MRI to analyze cortical thickness found that one dramatic difference between SAs and their age-matched controls involves the thickness of the ACC, an area frequently associated with conflict monitoring. We intend to test these patients using our rule-based category learning task with EEG monitoring and also in a recently developed ACC intensive task, also with EEG monitoring. We will also run age-matched controls from the clinical core. We anticipate that these participants will perform like younger controls, including showing preserved ACC function. This will provide additional validation for our method of gauging pathologic aging.

This work has recently been funded through a Loyola University Summer Stipend and a proposal has been submitted to the Gannon Center's WISER Summer Research Program to fund several students during Summer 2012. In addition, one of my undergraduate students is currently applying for a Carbon/Johnson Scholarship to fund her work on this project.

Topics in Cognitive and Affective Neuroscience

Funding priorities and jobs in contemporary psychology are now dominated by opportunities utilizing neuroscience methods. In order to assist Loyola graduate students in preparing for the job market that awaits them, I have broadened my research focus to mentor a number of graduate and undergraduate students interested in learning these methods to apply to their own research interests. This has resulted in several different projects described below.

Neural Correlates of Political Ideology

This project is a collaboration with Rick Matland (professor in political science), Dane Wendell (graduate student in political science), Nirav Patel (undergraduate student in psychology), and Rebecca Silton (assistant professor in psychology).

In this project we seek to understand the neural correlates of political behavior. We propose that political orientation is influenced by the cognitive processes responsible for self-regulation. Prior studies have suggested that the ACC may be critical for monitoring these processes. In this study we will use several cognitive tasks along with EEG monitoring to characterize ACC function in a stratified sample of strong liberals and conservatives. We will also measure differences in resting state EEG believed to be related to individual differences in approach and avoidance. This study builds on previous work by Amodio, Jost, Master, and Yee (2007), but measures ideology in a multidimensional

way and uses a non-student sample that we believe will much more adequately appraise political behavior.

This project has been funded by a Multidisciplinary Grant from the Dean of the Graduate School, and a Provost Scholarship to Nirav Patel.

Insight in Problem Solving

This project grew out of my Psychology of Creativity and Cognitive Lab classes and is a collaboration with Stephanie Hare (graduate student in Philosophy), Sean McCarthy (Loyola Alum volunteering in the lab), and undergraduate students Kelly Brandstadt, John Molony, and Leonidas Skiadopoulos.

The Gestalt psychologists first began describing the phenomenon of insight in experimental contexts and hypothesized that insight differed from other problem-solving strategies in that it did not utilize traditional trial-and-error testing. The subjective experience of insight can be described as a sudden awareness of the answer accompanied by a sense of confidence that this is the correct answer. Smith and Blankenship (1991) suggested that when individuals are solving a problem, they often reach an impass and suggested that a time period away from the problem (i.e., incubation), could help overcome problem fixation. Our intent in this study is to understand how individual differences in inhibitory control in working memory relate to the subjective experience of insight. Currently we are completing an experiment using Remote Associate problems to study the impact blocking has on subjective insight with and without incubation. This paradigm will then use a variety of approaches for looking at how individual differences in inhibitory control/working memory interact with incubation and the experience of insight.

Executive Function in Bilinguals

This project is a collaboration with Valerie Flores, Vanessa Raschke (Developmental Psychology Graduate Students) and Rebecca Silton (Assistant Professor of Psychology).

A number of studies have now suggested that bilinguals show advantages in executive function across development. Executive function (EF) is a term used to describe cognitive processing which directs thought and action in the midst of contradictory information. While EF is necessary for everyday living, strengths in these areas have been positively linked with school readiness during the preschool years as well as negatively associated with mild cognitive impairment during late adulthood. The current study employs scalp electroencephalography (EEG) methods to measure neural responses during EF tasks in Loyola students who are language brokers—students who during their childhood regularly served as translators in their family. The goals of the current study are to assess (1) differences in brain activity involved in both verbal and non-verbal versions of executive function tasks, (2) differences in brain activity when accounting for language brokering experience across development, and (3) differences in performance and reaction times on the executive function tasks between language groups (i.e., monolinguals, bilingual brokers, bilingual non-brokers).

C. Evidence of the Quality of One's Research

My research has been published in several of the top journals in cognitive (neuro)science. Below is a list of the journals where my work has appeared with some statistics describing both the impact of the journals and the papers.

					Web of Science	
Reference	Publication Year	Journal	DOI	5-year Journal Impact Factor (JCR 2010)	citations	citations per year
Spellman, Holyoak, & Morrison	2001	Memory & Cognition	10.3758/BF03196389	2.452	26	2.6
Morrison et al.	2004	Journal of Cognitive Neuroscience	10.1162/089892904322984553	6.28	41	5.9
Viskontas, Morrison, et al.	2004	Psychology and Aging	10.1037/0882-7974.19.4.581	3.983	26	3.7
Richland, Morrison, & Holyoak	2006	Journal of Experimental Child Psychology	10.1016/j.jecp.2006.02.002	2.734	46	9.2
Lu, Morrison, Hummel, & Holyoak	2006	Journal of Experimental Psychology: Human Perception and Performance	10.1037/0096-1523.32.3.610	3.716	4	0.8
Krawczyk, Morrison, et al.	2008	Neuropsychogia	10.1016/j.neuropsychologia.2008.02.001	4.739	16	5.3
Morrison & Cho	2008	Behavioral and Brain Sciences	10.1017/S0140525X08004615	24.509	3	1.0
Richland & Morrison	2010	Frontiers in Human Neuroscience	10.3389/fnhum.2010.00180	2.083	1	1.0
Richland, Chan, Morrison, & Au	2010	Journal of Experimental Child Psychology	10.1016/j.jecp.2009.08.003	2.734	2	2.0
Morrison, Doumas, & Richland	2011	Developmental Science	10.1111/j.1467-7687.2010.00999.x	4.403	0	0.0

III. Service

Provide the approximate time commitments per month and point out those services which were provided without charge.

A. Service to the Discipline of Psychology and the Profession of University Teaching

Possible examples include: manuscript reviews, editorial boards, association committee work, offices held, published letters to the editor of professional publications, editorial consultation to text book publishers.

Holyoak, K.J., & **Morrison, R.G.** (Eds.) (2012). *Oxford Handbook of Thinking and Reasoning*. New York, NY: Oxford University Press.

Holyoak, K.J., & **Morrison, R.G.** (Eds.) (2005). *Cambridge Handbook of Thinking and Reasoning*. Cambridge, UK: Cambridge University Press.

Ad Hoc Reviewer or Commentator for the following peer-reviewed publications (pro bono):
Behavioral and Brain Sciences
Brain Research
Cambridge University Press (Books)
Cognitive Psychology
Human Brain Mapping
Journal of Cognitive Neuroscience
Journal of Experimental Child Psychology
Journal of Experimental Psychology: General
Journal of Experimental Psychology: Learning, Memory, & Cognition
Memory & Cognition
Neuropsychologia
Neuroscience
Oxford University Press (Books)
Proceedings of the Cognitive Science Society
Thinking & Reasoning

2012	Grant Selection Committee—Alzheimer's Disease Reaseach Fund—Illinois Department of Health (pro bono)
2012	Keynote address and hosted faculty roundtable at the Chicago Area Undergraduate Research Symposium -- www.caurs.com (pro bono)
2012	Symposium proposal for the 34th Annual Cognitive Science Society, Sapporo, Japan.
2011-2012	Program Committee 6th International Conference on Thinking, University of London, Birkbeck College -- www.ict2012.bbk.ac.uk (pro bono)
2011	Symposium organized on Analogical Reasoning at the Society for Research in Child Development

B. Service to the Institution

1. Psychology Department and Programs

2011-2012	Executive Committee – Department of Psychology
2011	Monday meetings for redesign of graduate program – provided research on graduate course utilization
2010-2011	Executive Committee – Department of Psychology

2009-2010 Executive Committee – Department of Psychology

2. Arts and Sciences Collage

2011-2012 Search Committee – Neuroscience

2009-2010 Search Committee – Pediatric Neuropsychology, Clinical Psychology Program

2009-2012 Guest lecturer in Neurosci 300 and Psyc 514.

3. Loyola University

2011-2012 Faculty Advisor – Loyola University Chicago Neuroscience Society

2011-2012 Neuroscience Institute Retreat Committee – Stritch School of Medicine

2011-2012 Executive Committee – Neuroscience Institute, Stritch School of Medicine

2011 Ad Hoc Classroom Technology Consultant to the Associate Provost

2010-2011 Executive Committee – Neuroscience Institute, Stritch School of Medicine

C. Service to The Community

2012 Keynote address and hosted faculty roundtable at the Chicago Area Undergraduate Research Symposium -- www.caurs.com

2011 Testified on behalf of the Illinois Department of Public Health for the General Assembly's Health & Healthcare Disparities Committee