

## ARTICLE

# “Social” Neuroscience: Leveraging Social Media to Increase Student Engagement and Public Understanding of Neuroscience

Alissa Valentine<sup>1</sup>, & Jake Kurczek<sup>2,3</sup>

<sup>1</sup>Neuroscience Department, Haverford College, Haverford, PA 19041; <sup>2</sup>Psychology Program; <sup>3</sup>Neuroscience Program, Loras College, Dubuque, IA 52001.

Neuroscience is young and still developing. It is quickly adapting to a number of emerging changes in science and education. Not only have neuroscientists been at the forefront of the open access publishing movement, but many prominent neuroscientists continue to push towards making science more accessible and understandable to the broader public. Social media is a global phenomenon that is changing the way that we talk about research and education. Researchers, students, and the public alike can leverage social media to find updates in research and higher education. Social media also provides pathways to connect with experts and non-experts in a way never been

seen before. Two major trends are appearing in education and social media: 1) providing more engaging teaching activities, and 2) providing opportunities for community engagement using teaching activities that leverage social media. In this article, we describe a semester long teaching activity that challenged students to use social media in their learning process. We provide initial evaluation and feedback from the students on their social media experience in class, and suggestions for how to improve the project in future implementations.

*Key words: social media; student engagement; community engagement; neuroscience; education*

Higher education is facing a number of problems; among these problems, two stand out, how much are students actually learning and what impact will their learning have later in life (Arum and Roska, 2011). Many college educators are moving past the traditional college lecture to create more active learning experiences in the classroom (Bonwell and Eison, 1991). Of these educators, some look towards technology to revolutionize teaching (Collins and Halverson, 2010).

Technology is an almost ubiquitous aspect of college as most students have digital devices, and most colleges provide internet and computer access (Hawkins and Rudy, 2008, Salaway and Caruso, 2008). However, how students use their access to technology may not be conducive to the learning experience. Many students have laptops and cell phones they bring to class (McCoy, 2013; Sana et al., 2013). However, laptops are not always solely used for class note-taking. Fried (2008) found that students who brought laptops to class engaged in a number of non-academic activities including checking email, instant messaging, surfing the net, and playing games. Laptops can also be distracting to other students in a class. Sana et al. (2013) found that both students who multitasked during class and their peers who had a direct view of a multitasker performed worse on a test than students who did not multitask or observe others multitasking. Yet, the main finding is that the students using more social media in class report lower performance on tests and ultimately on their overall GPAs (Jacobsen and Forste, 2011). Outside of the classroom, it has been difficult to quantify computer, cell-phone and social media usage. Students self-reported average daily use of cellphones and computers that ranged between 2.5 hours (Jacobsen and Forste, 2011) and just over 8 hours (Roberts et al., 2014). This time spent on social media,

between 2.5 and 8 hours, is interesting when compared to the student reports of 5.5 hours per day of time spent on studying, being in class, or participating in other academic activities (Jacobsen and Forste, 2011). With distraction, an increased potential for cheating, and negative effects on test scores and overall GPA, it is understandable that the average professor sees technology and social media use as a negative, and doesn't allow electronic devices in their classroom. However, perhaps we can flip technology and social media use on its head and harness it for active teaching and learning rather than just for distraction.

While some college professors stick with traditional college lectures (Johnson and Kurczek, 2014), there is a move towards more active learning strategies to increase the quality of student learning (Sivan et al., 2000). Previously we reported on a collaborative teaching implementation in which students and the professor learned a new topic together and found that students felt that they learned more in an active learning course and enjoyed the collaborative learning experience (Johnson and Kurczek, 2014).

As students look for more engaging teaching methods within the classroom, there is also a simultaneous increase in the push towards engagement with their communities both local and abroad (Jacoby, 2009). Publically engaged learning was once a cornerstone of higher education with the founding of many public universities connected to three acts (the Morrill Act of 1862, the Hatch Act of 1887 and the Smith-Lever Act of 1914), which tasked universities with creating citizens in a strong democratic society. One particularly engaged aspect of these acts was the creation of extension learning in which the universities worked to inform the public about current developments in the subjects taught at land grant institutions. In fact, American education pioneer John Dewey saw education as bringing

thought and action together in both real-life and in the classroom (Dewey, 1938). While the degree to which higher education and community partnerships has ebbed and flowed over the years in response to various social, political and economic demands, the recent resurgence of these partnerships may be tied to an increased demand from communities that universities be more responsive to their communities both local and global (Boyer, 1990).

So while the focus on community engagement within higher education has waned at times, overwhelmingly research appears to support the benefits of engaged scholarship in the community. In practice, community-based engaged learning has three criteria: that it is relevant and meaningful within the community, that it enhances academic learning, and that it is purposeful (Howard, 2001). Community-based engaged learning can take many different forms depending on the course it is incorporated into. For example, marketing students could work with local small business on shopping local campaigns, GIS students could work with local conservation groups to map out watershed areas, or psychology students could work with local traumatic brain injury groups on advocacy efforts. The response from communities to academic engagement has been overwhelmingly positive. Vernon and Ward (1999) found that 92% of community partners viewed an engaged university positively, while 77% thought that the students were effective in helping community agencies meet their goals. Others have also reported positive views from community members about both the impact of the university and from their students engaged in public scholarship (Ferrari and Worrall, 2000; Schmidt and Robby, 2002).

Beyond the benefits to the community, engaged learning has provided benefits to student learning. In a randomized control-group study, Markus and colleagues (1993) found that students in engaged community scholarship sections had higher academic achievement, rated their course more positively, and had higher belief in and value of both their service to the community and community itself. Other research has demonstrated a positive impact of engaged scholarship on academic, personal, moral, social, and cognitive measures of students (Boss, 1994; Bringle and Kremer, 1993; Cohen and Kinsey, 1994; Giles and Eyler, 1994; Stukas et al., 1999; Moely et al., 2002). In fact, two recent meta-analyses of the impact of engaged-scholarship on these measures found the greatest impact on academic outcomes (motivation, attitude, knowledge and GPA), with moderate effect sizes, with smaller impacts on personal, social, and citizenship measures (Conway et al., 2009; Yorio and Ye, 2012). To summarize the evidence for the benefits of community-based engaged learning, there are net positives across the community and student levels. Focusing more closely on the individual, through the lens of neuroscience we can better understand the cognitive benefits of engaged and learning.

How can we best connect with the public? Many publicly engaged projects from college classes are one-to-one matches of students with one particular (or a few) non-

governmental organizations and/or non-profit organizations. Perhaps through other types of engagement we can reach wider audiences to impact a greater part of society. Social media and content aggregating sites are some of the most visited websites on the internet (Table 1), and thus provide access to hundreds, thousands, and perhaps millions of people. Advocacy organizers are already using social media to promote civic engagement. In a survey of advocacy groups, respondents believed that social media enabled them to accomplish their goals efficiently (Obar et al., 2012). With advocacy groups using social media to engage with the public at large, perhaps college classrooms could use social media to engage students with the material and encourage student engagement with the public (Rheingold, 2008).

The use of social media by academia has started to increase. One recent study found that 65.7% of surveyed academics used twitter in some capacity (e.g., information seeking, organizing events, updating status and networking) (Knight and Kaye, 2014). However, while these professors were using twitter for social and scholarship purposes, no academic in the survey had used Twitter for support of an assignment or as part of a structured debate (Knight and Kaye, 2014). In other studies, some professors have started to incorporate social media into their classes. A recent study showed that most professors were aware of the most prevalent social media sites and over 75% use social media in their professional work. Yet, only 40% used social media in the classroom, with the primary concerns being privacy and integrity of the academic experience, the thought being that social media use is not a serious academic pursuit (Moran et al., 2011). However, 58% of faculty in the same study agreed that social media could be helpful for collaborative learning (Moran et al., 2011).

In two recent studies at universities in Europe, researchers explored the use of Twitter on student engagement in the course material and collaboration with other students (Junco et al., 2011; Junco, et al., 2013). Twitter use in the class ranged across a number of activities from offering an outlet for students to ask questions to responding to and supporting other students' questions, receiving class reminders, and helping students connect with each other and the professor. Some specific assignments on twitter included asking and answering questions, reacting to statements from readings, posting responses to other students' reactions, and discussing their experiences from a service project in the course (Junco et al., 2013). In the first study, students in a first year seminar course who were required to use Twitter had increased levels of engagement than the students from the control group who had no Twitter interaction. Further, the overall GPA from their first semester for the Twitter students was also significantly higher than the students not using Twitter (Junco et al., 2013). In the second study, the students were simply told they could choose to use Twitter. At the end of the semester, there was no significant difference between students who used Twitter and those who did not when comparing their semester GPA or

engagement in the class. Together, these two studies demonstrate the importance of outlining how to use social media, like Twitter, when students are able to interact with their professor and discuss or collaborate with other students. This strategy of actively incorporating social media into a class is extremely important and cannot be overlooked; when social media is used in the right way, it can have positive effects.

### “SOCIAL” NEUROSCIENCE PROJECTS

The “social” neuroscience project was developed in order to work within higher education and respond to the following trends: the proliferation of technology in the classroom, the ubiquity of social media use, the push for more engaging activities, and the push towards

engagement with the broader community through our classes. The project was inspired after seeing several educational BuzzFeed listicles, and infographics shared on social media. A common theme among these infotainment pieces, however, was that they often did not represent the concept that they were trying to explain very accurately. For example, one of the most easily recognizable neuroscience related infographics portrays hemispheric specialization with the strict delineation of readers as either, “left-brained” or “right-brained.” So instead of understanding the brain as working as a whole with integrated specialization, lay readers only understand one of their hemisphere to work well, or in another, related misrepresentation, understand that only 10% of their brain works.

Outlet	Uses	Public Interaction	Comments	Close Analogs	Alexa Rank
<a href="#">Twitter</a>	Microblogging, aggregator	Personal Professional Public	Allows 140 characters to share, thoughts, links and messages. With hashtags you can curate your output and reach beyond your follower base	<a href="#">Tumblr</a>	10
<a href="#">Facebook</a>	General - photos, videos, blogs, apps	Personal Professional Public	World's largest social media network. You can create groups for people with similar interests to join and share messages, links and photos.	<a href="#">Google+</a>	3
<a href="#">Imgur</a>	Photo, gif	Public	Image sharing network. It is tightly linked with social news and network platform Reddit. Users can upvote and downvote content with highly upvoted content shown to more users.	<a href="#">Flickr</a>	47
<a href="#">YouTube</a>	Video	Public	It is probably the first page people looking for videos on the internet turn to.	<a href="#">vimeo</a>	2
<a href="#">Tumblr</a>	Blogging, aggregator	Public	At the forefront of short-form and multimedia blogging. Blog posts generally include little text with information conveyed through pictures, gifs, emojis and videos.	<a href="#">Wordpress</a>	46
<a href="#">Buzzfeed</a>	Social News and Entertainment	Public	It is best known for its quizzes and listicles about pop culture, however it has started to make a push towards legitimate journalism. Registered users can also create and share content.	<a href="#">Upworthy</a>	129
<a href="#">Reddit</a>	Social News and Entertainment	Personal Public	A registered community submits content (posts, links, videos, images) which is then upvoted or downvoted and commented on by other users. Allows for either named or anonymous interaction with other users. Many scientists use it for advocacy and engagement with the public (e.g., PLoS's science Wednesday on r/science).	<a href="#">voat</a>	30

*Table 1.* Social Media Sites. Public Interaction = how the social media site is generally used, whether it's personal = with friends, professional = with colleagues or public = with individuals you generally don't know; Alexa Rank provides web analytics and information web traffic and ranks the most visited web sites up to May 2016.

Historically, science communication has used the “deficit” model of interacting with the public to a more engaged model (Polman and Gebre, 2015). The deficit model assumes that the public knows little about science and thus is unable to participate in public discussion of science and decision-making around science. So scientists must fill gaps in knowledge by communicating their work to the public. The recent push towards public engagement sees scientific communication as a two-way interaction in which the public and scientists work to co-create communication of science. Therefore, in order to explore our role as scientists communicating information about complicated topics, the “social neuroscience projects” were developed to communicate research to the public and leverage social media in order to reach the broader public.

## PROJECT OBJECTIVES AND IMPLEMENTATION

An aim of the Psychology Department at Haverford College is to provide students with an understanding of human behavior and for the students to add to scientific knowledge. The Cognitive Neuroscience course at Haverford College is described in the catalog as follows:

“Cognitive neuroscience examines the neural basis of higher mental functions, including brain systems supporting perception, attention, memory, spatial functions, language, emotion and decision-making. Major themes include mind/brain relationships, localization of function, and plasticity of the brain. Material will include studies of people with focal brain damage as well as neuroimaging studies of neurologically normal people. Cognitive neuroscience approaches to clinical conditions will also be explored.”

The course had the following general goals:

1. To provide an opportunity to work through scientific controversies by analyzing, comparing and contrasting theories and research
2. To provide an opportunity to work through the scientific process through writing a research paper
3. To practice and improve student analysis (of what?), writing and presentation skills

The objectives of the “social” neuroscience research paper project progression were rooted in two understandings of engagement. In the first, we focused on engagement in the learning process. By choosing their own topic, students were studying something that was personally relevant. This has been shown to be an important aspect of effective learning (Sibthorp and Arthur-Banning, 2004). Another aspect of engagement in the learning process was to encourage creative thinking, which has been demonstrated to contribute to post-college success (Armbruster et al., 2009, Corso and Robinson, 2013).

The second view of “engagement” focused on promoting outreach and interaction with the broader community, in particular connecting with the community online. An essential characteristic of a liberal arts education is to prepare students as citizens of their communities. By making the projects public, we looked to engage with non-

experts in neuroscience to help teach others about neuroscience and do so in an interesting way to spark curiosity in the discipline.

Our creation of entertaining neuroscience information also allowed us to analyze and reflect on “neuromyths.” As a new field, neuroscience is still undergoing growing pains; as much of what we know is continually being revised. This has led to a growing number of “neuromyths” that include information that is old, outdated, or misinterpreted and applied too broadly. Many times with “viral” or entertaining pieces about neuroscience we see a lot of misinformation (e.g., the bigger your brain the smarter you are infographics and quizzes). Therefore, a conflict we explored throughout the class was the balance between providing the correct information while also being entertaining. Returning to the themes that inspired the project, the goals of the project were:

- 1) Encourage students to engage with and create using new technologies. By pushing students to use these technologies, the hope is that students will experiment with other new outlets using more complex and advanced technologies.
- 2) Encourage students to view and use social media in a professional sense, curating their online experience. After the course students have two professional artifacts online that are attached to their identity (i.e., the podcast with a professor and an informative infographic). Learning how to curate and manage their online presence early can help as students enter the job market or higher education after college.
- 3) Encourage students to take control of their own learning experience and work on developing their creativity and self-directed work.
- 4) Encourage students to engage with a broader public community by posting and releasing content on social media, and attempting to engage with the public about neuroscience topics.

During the spring semester of 2016 (Figure 1) in our Cognitive Neuroscience, a second level course with a prerequisite of either completion of an introductory course in psychology or a Psychology AP score greater than 4 ‘with consent of the instructor,’ students were asked to create two projects (creative midterm and podcast) as check points, leading to a traditional final paper. In order to remove some of the anxiety surrounding these new projects students were graded on a simple participation grade that was a small portion of their overall class grade.

Students were expected to have at least 10 resources to be used in their final paper and incorporated into their midterm project. The podcasts (more detail in Appendix A) took place about halfway between the midterm and the final. These allowed the instructor to check in on the progress of the paper, and the students to talk through their findings in an informal setting and practice different way of orally presenting information. The podcast, in contrast to a formal presentation, did not require that the students produce slides or practice. The advantage of the informal podcast was that it allowed students to explain their topic in a conversation and respond live to lines of

questioning that may not have fully considered or prepared for before the meeting. Anecdotally, many students reported that although they were nervous before hand, they liked the podcast presentation format better than a traditional presentation even though it was unpredictable and required them to answer questions about their topic that they may not have thought about before the meeting.

Generally, in science outreach, the product for experts (i.e., research paper) is created first and then translated to the lay public (e.g., blog post, website, infographic, etc.). By requiring the public products first, the goal was to encourage mastery of the material before requiring the final, traditional research paper. This follows Bloom's taxonomy of learning and concept mastery (Bloom, 1956), by creating and translating the material first, students should have had a better grasp on the final product.

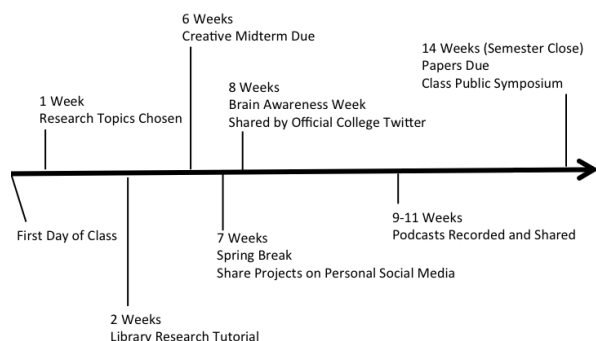


Figure 1. "Social" neuroscience project timeline.

Students were allowed freedom to pursue topics and projects with the only requirement that the topic be explored through a cognitive neuroscience framework. They were provided with some information (Appendix B) on how to create different types of projects and for the most part followed the instructions of particular tools from Appendix C, or followed online instructions on how to create content.

## PROJECT OUTCOME AND FEEDBACK

Our Cognitive Neuroscience class had 26 students who created 4 videos, 8 infographics, 11 BuzzFeed Listicles and 3 BuzzFeed Quizzes for the midterm project. Each student participated in one podcast. As of September 1st, 2016 our podcasts were streamed a total of 795 times (an average of 30.6 streams per podcast), and our creative midterm videos and infographics viewed 1,480 times (these counts are according to analytics on our aggregator pages – infographics posted to personal accounts are not included). These counts likely underestimate the reach of our projects since we have not included anything posted to BuzzFeed). Further, measuring community impact is fairly difficult since each student had shared their projects on their personal accounts. BuzzFeed Listicles and Quizzes do not provide public view counts on the page, and viewing of content on social media sites like Facebook and Twitter do not add to analytics on the source page such as Imgur for infographics, or videos uploaded as Facebook videos. Anecdotally, students reported that each of their posts on

Twitter and Facebook received anywhere from a few likes, re-tweets and comments, to a few dozen. Therefore, it is likely that our impact and community was on the order of a few thousand individuals with just 52 projects and podcasts.

Students were asked to provide feedback (Appendix D, E) about their experiences after both the midterm project and podcast through comparing these new types of assignments to more traditional assignments (e.g., a midterm paper and in-class presentation), with positive ratings indicated a preference for the creative midterm and podcast. One sample t-tests corrected for multiple comparisons across all ratings for the midterm project and podcast were significant (Table 2). This indicates that these projects were preferred to their respective alternatives (e.g., midterm paper and in-class presentation).

Category	Project	Rating	t-value	p-value
Learning Public	Midterm	2.41 (5.58)	2.12	<0.001
	Podcast	6.33 (3.19)	9.74	<0.001
Meaningful Public	Midterm	3.75 (5.13)	3.58	<0.001
	Podcast	7.67 (1.74)	21.63	<0.001
Appreciation Public	Midterm	5.46 (4.04)	6.61	<0.001
	Podcast	7.58 (2.64)	14.09	<0.001
Effective Teaching	Midterm	5.58 (3.83)	7.14	<0.001
	Podcast	5.88 (4.07)	7.08	<0.001
Time Spent	Midterm	5.58 (3.45)	7.93	<0.001
	Podcast	2.51 (3.90)	3.15	<0.001
Critical Readings	Midterm	4.25 (4.13)	5.04	<0.001
	Podcast	5.38 (4.30)	6.12	<0.001
Make Work Useful	Midterm	7.25 (2.33)	15.27	<0.001
	Podcast	7.67 (2.83)	13.23	<0.001
Write Read Effective	Midterm	4.33 (3.58)	5.92	<0.001
	Podcast	5.08 (4.36)	5.71	<0.001
Translate	Midterm	8.42 (2.10)	19.59	<0.001
	Podcast	7.83 (2.21)	17.28	<0.001

Table 2. Ratings of Midterm and Podcast. Positive ratings indicate a preference for the non-traditional assignments used in this course.

We also investigated the above ratings averaged across the projects for general attitudes towards: producing meaningful work, making a difference with their education, preference for skill learning, the importance of translating

research, the importance of learning social media skills, the desire to pursue similar projects in the future, and the desire to release their work on social media in the future. We found only a few statistically significant relationships between students' general attitudes and their ratings of the projects. There were no statistically significant correlations between a preference to learn skills and students' ratings of the projects. There were also no statistically significant correlations between ratings of their desire to release their work public and their project ratings. There were statistically significant relationships between attitudes towards the importance of learning social media skills and students' preference for the course projects for making their work meaningful,  $r(24) = 0.505$ ,  $p = 0.049$ , and making their work useful,  $r(24) = 0.562$ ,  $p = 0.049$ , meaning that students who had more favorable attitudes towards social media had a more favorable opinion of the projects used in the course (Table 3). There were two significant correlations between students' desire to have their work mean something and how highly they rated the course projects for wanting to make their learning public,  $r(24) = 0.483$ ,  $p = 0.049$ , and appreciating that the public learns from their work,  $r(24) = 0.478$ ,  $p = 0.049$ . The final significant correlation was between a desire to pursue creative learning activities and student's ratings that the course projects were meaningful for the public,  $r(24) = 0.514$ ,  $p = 0.049$ . To summarize these correlations, students who had favorable attitudes towards creative projects, social media and community engagement rated the course projects more favorably.

Attitude	Project Ratings	<i>r</i>	<i>p</i>
Social Media Skills	Learning Public	0.319	0.156
	Meaningful Public	<b>0.505</b>	<b>0.049</b>
	Appreciation Public	<b>0.562</b>	<b>0.049</b>
	Make Work Useful	0.131	0.587
Work Mean Something	Translate	0.442	0.054
	Learning Public	<b>0.483</b>	<b>0.049</b>
	Meaningful Public	0.455	0.054
	Appreciation Public	<b>0.478</b>	<b>0.049</b>
Prefer to learn Skills	Make Work Useful	0.162	0.513
	Translate	0.252	0.276
	Effective Teaching	0.121	0.588
	Make Work Useful	-0.108	0.600
Pursue Creative	Write Read Effective	0.397	0.089
	Translate	0.443	0.054
	Learning Public	0.388	0.090
Release Public	Meaningful Public	<b>0.514</b>	<b>0.049</b>
	Learning Public	0.371	0.101
	Meaningful Public	0.330	0.150

Table 3. Correlations between general attitudes and perception of the impact across creative midterm and podcast projects.  $Df = 24$ ,  $p$  values corrected for multiple comparisons. Bolded lines are significant at  $p < 0.05$ .

## DISCUSSION AND FUTURE DIRECTIONS

Both creative midterm and podcast projects were preferred by students to traditional projects. In particular, the projects appeared to be the most useful to students who want to learn social media skills and for their work to have value (outside of a grade for a course). At the end of the semester, students were asked to rate their attitude towards pursuing creative projects in the future (7.63,  $SD = 2.6$ ) and releasing them publically (7.29,  $SD = 3.0$ ). While both questions received highly positive ratings, more impressively, all but three students gave positive ratings to those questions, which hopefully indicates a long lasting pursuit of creative work and attempting to reach out to the wider public. Our work reached thousands of people, and (hopefully) taught them something about neuroscience. Anecdotally, a number of students described friends and family thanking them for the informative posts. It should be noted, however, that while many of the ratings are quite positive across all of the questions, there were a few students across the questions who found the projects less helpful than traditional projects. This was verified in our correlation analyses that showed that students who like creative and public work found these projects to be better than traditional assignments.

The project also prepares students for recent trends in neuroscience as Illes and colleagues (2010) noted that communicating science (in particular neuroscience) is difficult, and they give three recommendations: recognizing the importance public outreach, developing neuroscience communication experts, and studying the public communication of science. Developing proficient communicators in neuroscience is especially important (Racine et al., 2010) because the public is very interested in the brain and neuroscience related discoveries. However, there are a number of challenges reporting neuroscience in the general media. This project addresses the problems of translating neuroscience findings in two ways: developing researchers that are better able to communicate future findings, and creating content that provides understandable information about neuroscience to the public. This results in a more informed public that can parse additional complicated issues in the future.

There are some limitations to the implementation of social media in the classroom. As social media continues to grow, the use of varying social media platforms can fluctuate depending on what is new, and most interesting to use (e.g., Snapchat is a recent example of a new tool that is popular among high school and college students). As studies evaluate current usage and implementation of these platforms, the populace is already adapting to and using new and different platforms. So while this project focused on using Twitter and Facebook to share our work, and Buzzfeed, YouTube, and Imgur were used to host content, and lastly Tumblr was used to aggregate content from the hosts, these platforms could quickly become obsolete.

Additionally, with a project that is housed online, we have to consider and discuss issues of ownership and privacy of online publications. In another iteration of the projection there will be lectures and information available to

discuss online privacy, the use of pseudonyms, how to use copyrighted material, and how to make sure that our on-line work is credited back to us.

Going forward, future iterations of the project could be much improved. In particular, we could better engage the public with our projects. Here we simply posted the projects to our personal social media (e.g., Facebook, Twitter, BuzzFeed Community, Tumblr, and YouTube) and thus had limited interactions with friends and family members. We did little to reach a much wider public (although the official Haverford College social media account did tweet out projects once per day for BAW). So we don't know if these projects are actually reaching a wider public. We should have taken better advantage of the overlap with BAW and reached out to the public through a live Twitter chat and used a hashtag affiliated with BAW. In the future we could try one or multiple "AMA" – ask me anything - meetings on Reddit in order to communicate with individuals who have questions about our topics. Further, we could have used a better aggregator website like a WordPress blog or a dedicated website where we could have looked at more advanced web analytics (e.g., how many site visits to pages, where people were searching from, etc.)

A conflict that we faced throughout the project was balancing information and entertainment. While entertaining material can also be informative, we wanted to avoid the issues of past infotainment where correct information came at a cost to increased entertainment. Students' informal reflections on their work gave the general consensus that as they tried to make their projects more informative, their content became less entertaining. This is a problem because there is no real way to force the information onto the public without making it entertaining and perhaps "dramatic." Students tried to make projects more understandable and more widely read through the use of basic vocabulary and understandable terminology that basic educated people (or people who weren't experts in the field) could comprehend. However, without the nuance and specific terminology, we increase the chances that we may have mistranslated or incorrectly communicated some difficult concepts. Or, in other words, our lack of nuance and specific terminology may be more easily misinterpreted by the public. We worked to prevent mistranslating and miscommunicating our work by peer-reviewing work before sending it out to the public.

Returning to the issue of "neuromyths" and the increasing ubiquity of the "neuro" prefix, we explored neuroeducation and neurolaw during two debates (arguing for or against the benefits of using insights from neuroscience to guide decisions in education and law respectively). While the debates were informative, a more integrated experience may have been to explore, reflect on, and critically analyze the student's own projects in order to evaluate the (potential) contribution of their own work to neuromyths. Those reflections may also be a time to consider whether placing our work on sites like BuzzFeed and Imgur is useful or not. Depending on how the public is using social media, it may be the place they turn to be entertained and not the place they turn to in order to learn.

So if we assume that we are actually reaching the public on these social media sites at best we may be reaching an apathetic public (skipping over educational material for entertaining material) and at worst a cynical public (who question the educational value of the information entirely – or who use the heuristic that anything on those media is just entertaining and not of educational value). Just because we've placed something on the internet, it may be a big assumption that people are actually interacting with the material. Looking to current examples of successful neuroscience infotainment, like Neuroscience for Kids (<https://faculty.washington.edu/chudler/newslet.html>) and KnowingNeurons (<http://knowingneurons.com/>), future attempts and science communication in neuroscience could use those examples as guides for good quality and entertaining neuroscience information (interestingly, both have dedicated websites and KnowingNeurons uses a wordpress site).

Perhaps an approach to better engage with the public could be to develop public partnerships ahead of time. We could work with schools and build websites for kids that are very simple to understand but explain the basics of various topics, similar to the work of Frontiers for Young Minds (<http://kids.frontiersin.org/>), Neuroscience for Kids and KnowingNeurons. Further, we could look to other examples from this journal and try to expand service learning and advocacy throughout our program and curriculum (Fox, 2015). Or maybe there will always exist a conflict between mass communication with limited engagement, and small local communication with greater engagement. While each has its benefits, it may be better for students at primarily undergraduate institutions to focus on small local engagement in order to better work with and understand their local community.

A final change to future iterations would be to provide better guidance and assessment opportunities with the progression of these projects. As noted earlier, students were provided freedom to plan, pursue and create their projects, however, while some students may appreciate the opportunity to be creative, others may prefer more rigid guidance and instruction. Instead of the low stakes participatory grading employed here, students could be evaluated on the amount of information that they translate, the understandability of that information, how entertaining their project was, and how well they work to engage with the public.

Social media is likely here to stay. An important, but easily overlooked aspect of the assignment was to show students that they can bridge their in-class and out-of-class activities. Instead of learning only taking place within the brick walls of colleges and universities, we can extend learning to our everyday experiences outside the classroom. We can also look towards technology and instead of viewing it as strictly an entertainment device, see that it can be used for good, as in connecting with people and teaching and learning with others. Breaking down false barriers that we've constructed between our in- and out- of class activities, we can aim to shift social media and internet use from celebrity gossip to a tool to connect with and help others.

Overall, beyond the immediate impact on the community and individual students during this course, the benefits of real-life experience during learning may be beneficial later. Learning how to communicate complicated information in understandable and entertaining ways will translate across professions. Further, the “soft skills” of social media management, curating an online presence, and communicating in digital formats provide skills that are becoming required in the 21st century job market. As higher education continues to adapt to the dynamic demands of both students and the workforce, it should remain mindful of the pedagogies which best prepare students for their future endeavors.

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**APPENDIX A. Podcast Questions and Editing**

*Sample Topic/Research Questions*

- What got you interested in the topic?
- What are some of the most interesting findings in your research so far?
- Are there any aspects of your topic that are confusing to the public?
- What has been the public response to your video, infographic, Buzzfeed?
- Going forward are there any new or developing areas of research?
- Is there one really important thing that you want to mention or communicate about your research?

*Sample Wrap-Up Questions*

- What genre of music do you enjoy?
- Anything you'd like to promote?
- Anything, fad, product that you've come across recently and found interesting?

**Editing and Assembly**

Each Podcast had the following parts:

1. A made-up advertisement generally related to the topic
  2. Music Interlude (based on student's preferred genre)
  3. An introduction providing background to the topic
  4. Music Interlude
  5. Conversation with Student
  6. Music Interlude
  7. Wrap-up and conclusion
  8. Music Outro
- 1) Podcasts were recorded with the Sony Zoom H1 Digital Recorder
  - 2) Imported into Audacity and mixed together
  - 3) Exported MP3 files were imported into Apple iMovie and combined with an image.
  - 4) Movies were saved, exported and then uploaded to YouTube.

**APPENDIX B. Brief Assignment Instructions.**

This semester in Cognitive Neuroscience at Haverford College we're exploring the role of neuroscience in society. You will choose a topic in cognitive neuroscience to explore in a paper due at the end of the semester. As a midterm check-in you will produce viral content on your topic that is both entertaining and informative. Once we get back from spring break we'll discuss the impact of our work and what it meant or did for the public. Some questions to think about: In the act of translating research to be entertaining did we lose anything? Is it the responsibility of scientists to make work approachable or for the public to work to try to understand science at a high-school or college level?

Project	Instructions
Creative Midterm	For the midterm project, I'd like you to create shareable content about your topic informed by at least 10 primary scientific sources. This assignment could most easily take the form of a Buzzfeed listicle or quiz about your topic that is submitted to Buzzfeed Community. However, it could also be a YouTube/vimeo video, a list posted to Listverse, or an infographic (uploaded to Imgur). As a class, I ask that we share our content across our social networks (Facebook, Twitter, Reddit) and at the end of March we'll check to see our class's impact in terms of the number of shares, likes and other social interactions with our products. (11.5% of overall grade)
Podcast	I'd like you to join me for a ~10 minute conversation about your final paper topic. The form of the podcast will be like when Shankar Vedantam of the Hidden Brain Podcast < <a href="http://www.npr.org/series/423302056/hidden-brain">http://www.npr.org/series/423302056/hidden-brain</a> > visits NPR to talk about a new finding in science. I'll prepare some general questions, but we may talk about more specific things depending on your topic. It may be most helpful to you to have two recent articles about your topic that you can discuss. (5.7% of overall grade)
Final Paper	The major project for this course is a 10-15 page research paper (this limit does not include Title Page, Abstract or References). Your final paper will be a literature review and analysis of a topic in cognitive neuroscience. In such a small paper an exhaustive literature review is not required, so your topic should be specific enough to allow the 10-15 pages of review and analysis. The paper should be in APA style. (19.5% of overall grade)

**APPENDIX C. Midterm Project Help**

Category	Project	Example
Outlets	Blogs/Listicles	<a href="#">Listverse</a> <a href="#">BrainBlogger</a> <a href="#">Buzzfeed Community</a>
	Infographics	<a href="#">Imgur</a>
	Videos	<a href="#">YouTube</a> <a href="#">Vimeo</a>
Tools	Infographics	<a href="#">Canva</a> - Free Sign-up required <a href="#">Easel.ly</a> - Templates Available. Free Sign-up Required <a href="#">Sway</a> - Free Sign-up Required <a href="#">Piktochart</a> - Templates Available. Free Sign-Up Required <a href="#">Vengage</a> - Free Sign-Up Required <a href="#">Visme</a> - Free Sign-Up Required <a href="#">Tiki-Toki</a> - Interactive Timelines. Free Sign-up required
	Video	<a href="#">Powtoon</a> - Animated Explainer Video <a href="#">Bitable</a> - Animated Explainer Video
Free Images		<a href="#">Flickr</a> <a href="#">GettyImages</a> <a href="#">Shutterstock</a> <a href="#">Wikimedia</a>

**APPENDIX D. Post-midterm questionnaire.**

Please use the scale below for the following questions.

-10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10  
 Less than (Worse than) Disagree      More than (Better than) (Agree)

1. Do you think that you learned more about the material because of the creativity involved (as opposed to a traditional assignment)?
2. Do you think that you learned more about the material because of the public aspect of the assignment (as opposed to no one seeing your work)?
3. Do you think that your work was more meaningful because of its public aspect?
4. Give you an appreciation of your work and learning with the goal of creating understanding in the public (as opposed to a traditional assignment)?
5. This midterm project is an effective teaching assessment (as opposed to no one seeing your work)?
6. How much time did you spend on the assignment compared to a traditional small project?
7. Compared to a traditional assignment how does this assignment compare on helping you:
  - Read the literature critically?
  - Make your work useful to the public?
  - Write/Read effectively?

In general, do you:

- Want the time you invest and work you do to mean something?
- Make a difference with your education?
- Prefer to learn skills (critical thinking, presenting, distilling information) rather than just concepts?
- Do you think training in translating research to be more understandable is helpful?
- Are social media skills an important thing to learn?

**APPENDIX E. Post-podcast questionnaire.**

-10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10  
 Less than (Worse than) Disagree      More than (Better than) (Agree)

Thinking of the podcast...

1. Do you think that you learned more about the material because of the public aspect of the assignment (as opposed to no one seeing your work)?
2. Do you think that your work was more meaningful because of its public aspect?
3. Did the experience give you an appreciation of your work and learning with the goal of creating understanding in the public (as opposed to a traditional assignment)?
4. This podcast project is an effective teaching assessment (as opposed to a traditional in class presentation)?
5. How much time did you spend on the assignment compared to a traditional presentation?
6. Compared to a traditional presentation how does this presentation compare on helping you:
  - Read the literature critically?
  - Make your work useful to the public?
  - Write/Read effectively?

After this course, if a future course asked you to do the following, how would you feel:

-10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10  
 Negative      Positive

1. Translate work for the public?
2. Release work on social media?
3. Pursue a creative project?

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Address correspondence to: Dr. Jake Kurczek, Psychology and Neuroscience Programs, 1450 Alta Vista Street, Dubuque, IA 52001. Email: jake.kurczek@loras.edu