

From saliva samples to the classroom and beyond

What college students are telling us about genetic and environmental influences on substance use and emotional health

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Abstract

In 2011, researchers at Virginia Commonwealth University launched “Spit for Science,” a large-scale longitudinal study in which nearly 9,900 undergraduate students are currently enrolled. Students will be followed across their college years and beyond to understand how genetic and environmental factors influence substance use and emotional health over time. This presentation highlights several facets of the project. A collaboration between a researcher and an interdisciplinary team of librarians demonstrates how the data are being integrated into the classroom to enhance undergraduate students’ understanding of the research process. We also discuss multidisciplinary collaborations that have evolved from the project as well as the DNA component, including work in progress and work that

remains. If replicated at other universities, this model holds promise for better understanding the associations between genes and substance use and mental health disorders.

Keywords

collaboration, research experiences for undergraduates, teaching, genetics, environment

What is Spit for Science?

Spit for Science (spit4science.vcu.edu) is a research project directed by Dr. Kenneth Kendler and Dr. Danielle Dick at Virginia Commonwealth University (VCU). The scientific goal of the project is to understand how genetic and environmental factors impact the development of substance use and behavioral and emotional health outcomes, particularly in an undergraduate population. Beginning with the freshmen entering VCU in 2011, students were invited to participate in a study investigating how genes and environments affect alcohol use, substance use, and emotional health outcomes across time in college students. Students who agreed to participate completed an online survey at the start of college, were invited to submit a saliva sample for DNA analysis, and have been invited to participate in follow-up surveys each subsequent spring (Dick et al., 2014).

Students who completed the survey received \$10 and a Spit for Science T-shirt, emblazoned with humorous statements, such as, "Actually give a Spit." Students received an additional \$10 for submitting a saliva sample and additional payments and T-shirts for participating in subsequent surveys.

The overarching goal of linking genetics with environmental pathways is a complicated question with many parts. Because multiple environmental and genetic factors are known or suspected of contributing to alcohol and illicit drug use and abuse, as well as mental health problems, the survey went well beyond asking only about alcohol, drugs, and mental health. It included questions about topics such as students' family histories, life events, social support, religiosity, and peer group deviance (Dick et al., 2014).

Spit for Science has been able to get close to a 70% participation rate among VCU students, with close to 97% of the 70% agreeing also submitting a saliva sample (Dick et al., 2014). In the four years of enrolling incoming freshmen (2011-2014), over 9,600 students participated (Dick & Hancock, 2015). For a web-based survey of students in the United States, typical participation is close to 40% (Cook, Heath, & Thompson, 2000).

Collaborations

Because of the large scale of the project, the Spit for Science researchers have worked with many other organizations from the start - university administrators to get approval, the Institutional Review Board to make sure students knew participation was optional and to address the privacy and other concerns, and the university Wellness Resource Center to develop information about alcohol use on campus to send to parents along with information about the study. Spit for Science has worked with student and local media to build awareness of the project and regularly has presented information about the research to student groups. VCU has a diverse student body, and African Americans often are underrepresented among the participants in this kind of research. To be successful in recruiting students and to be sensitive to research participant needs, in addition to its regular recruitment, an African American faculty member of the Spit for Science research team conducted focus groups with African American students, parents, and VCU employees (Dick et al., 2014).

Some of these collaborations have grown and evolved as the Spit for Science project has continued beyond its first couple years. For example, after the Wellness Resource Center

developed resources to send with the recruitment materials, Spit for Science provided the Wellness Resource Center with a “data dump” about the genetics of substance use that the Wellness Resource Center posted in the *Stall Seat Journal*, a single-page wellness newsletter posted on the inside of many of the bathroom stalls on campus.

That collaboration has grown into a more integrated collaboration between researchers and student services on campus (Dick & Hancock, 2015). Acknowledging these collaborations, VCU formally launched COBE: The College Behavioral and Emotional Health Institute (cobe.vcu.edu). COBE brings together the practitioners in health promotion, emotional / behavioral health and substance use with students who want to work in health careers or in creative media, researchers who are studying substance abuse and mental health across the university, clinicians and staff who work in relevant fields, and interested members of the community. Instead of working in isolation, the research going on at the university on behavioral and emotional health feeds into the programming and services for VCU students and vice versa (Dick & Hancock, 2015).

Although undergraduates were the main targets of the recruiting efforts of Spit for Science, because of the large scale of the publicity efforts from the research team, awareness of the Spit for Science project has extended much further. People unaffiliated with the project have seen the data dumps in the *Stall Seat Journal* and have seen students in the Spit for Science t-shirts. Dr. Dick regularly presents about her research to groups on campus and to community groups, such as Science Pub RVA and TEDxRVA.

Because the Spit for Science project is so high profile around campus and has such rich data about VCU students, people from many groups that were not associated with the initial development of the project have become aware and interested in it. Groups on and off campus realized that the rich Spit for Science survey data could potentially answer questions that they had about student substance use, health, and academic success.

One way that Spit for Science has addressed these questions is through the Spit for Science class.

Spit for Science class

The Spit for Science class incorporates these real-world questions in a research class for undergraduates. Developing research experiences for undergraduates (REUs) is a strategic priority for universities worldwide. Working closely with faculty mentors on authentic projects, students are socialized into a professional community of practice and become active stakeholders in scientific research. Through this apprenticeship model, students are encouraged to enroll in STEM graduate programs and build careers in research and (Healey and Jenkins, 2009; Hunter, Laursen, & Seymour, 2007; Zimbardi, K., & Myatt, 2014). The innovative Spit for Science research project at Virginia Commonwealth University exemplifies this model by involving students in all parts of the research process and by bringing data directly into the classroom to address questions posed by campus stakeholders and the larger community.

The Spit for Science course gives the students information to help them to gauge their own interest in research careers and in continuing with the Spit for Science research team. The course structure combines elements of mentoring and real-world experience that can be gained by working in a research lab with the formal structure of a traditional academic course. The Spit for Science class meets in person regularly and includes some didactic components that would be seen in a traditional classroom. Students in the Spit for Science course work on the ongoing education and recruitment projects for Spit for Science. They distribute t-shirts and create materials that Spit for Science uses in its educational programming and in its social media presence.

The bulk of the Spit for Science course, however, is a group project. Instead of the professor or the student generating the ideas for these projects, the ideas come from the questions raised by the partner organizations. Students use the Spit for Science dataset to

answer or at least illuminate these questions. For example, one group of students worked with VCU Residential Life and Housing -- the campus dormitories -- and examined the health outcomes in students living on versus off campus. Another group worked with VCU Recreational Sports and looked at alcohol use and its relationship with participation in exercise and sports. Off campus organizations, such as CARITAS -- a major provider of homeless services in the Richmond area -- have worked with Spit for Science students as well.

Initially the student groups meet with the partner organization to learn about its goals and what the organization would like to get from their research. The students use the library to examine research that has already been conducted that is relevant to the partner organization's question.

For several semesters, as outreach librarians in biology and behavioral and social sciences, coauthors Julie Arendt and Nita Bryant have been guest lecturers in a Spit for Science lab, PSYC 494 / BIOL 391, co-directed by Dr. Amy Adkins, a Spit for Science researcher and the course's faculty mentor. The librarians introduce students to discipline-specific databases appropriate to the research questions. Depending on the topic, the databases may be related to medicine, sports, psychology, or other areas. While we introduce these databases, we place as much, if not more, emphasis on the research process -- understanding different types of scholarly articles, reading research papers, and using a review matrix to organize the literature. While this seems like standard fare for university librarians, there is far more to this class than finding research articles.

Based on their literature searches and on the information from the partner organizations, the students examine the data dictionary of the Spit for Science project to find the relevant measures to see both what can be answered with the data they have and to operationalize the ideas that the partners want to know about. Students then decide what statistical tests they will use and what additional variables to include in their tests

that may moderate or interact with the main independent and dependent variables.

A graduate student or postdoc is paired with each group to assist them and guide them through the process. For example, after the students decide what parts of the large multi-year dataset they will use, the group mentors pull just the portions of the dataset the students will need to run the analysis.

After running their analyses and producing reports, students present their results at an end-of-semester event attended by the partner organizations and by the principal investigators of the Spit for Science Research project. Scholars Compass, the institutional repository provided by VCU Libraries, provides web hosting to provide long-term access to the research posters the Spit for Science students produce, including posters produced by independent study students and by students in the Spit for Science class.

Extensions

Quest Grant

The level of questions that students are able to answer in a one-semester class is not as detailed as the holistic view of what contributes to students' academic success and to students' health, of which the Spit for Science project is capable. To build this larger picture, Dr. Adkins applied for a local grant to bring this holistic view together. This year, her project, "Understanding Connections Between Behavioral and Emotional Health, Co-Curricular Engagement and Student Success," was awarded a grant from the VCU Quest Innovation Fund (McNeill, 2016). This grant brings together on-campus collaborators such as those in VCU's Division of Strategic Enrollment Management and Division of Student Affairs -- many of the same organizations that worked with the Spit for Science class. These units on campus will merge data from their respective divisions with the Spit for Science dataset to carry out a comprehensive study on the factors that contribute to behavioral and emotional health

and to academic success for VCU students. This research could contribute directly back to the university as well as to research publications.

Research extensions

In addition to the collaborations that evolved from the student Spit for Science projects, Spit for Science has numerous scientific research collaborations that have grown from the project. The PIs, and associated faculty and trainees, on the project have published multiple manuscripts (for example, see Kendler, Myers & Dick, 2015; Salvatore, Kendler & Dick, 2014; & Cooke et al., 2016). Spit for Science also has mechanisms for researchers to ask for and obtain access to the Spit for Science data for secondary data analysis to address their own research questions. Finally, it has mechanisms for spin-off projects to get permission and contact Spit for Science participants for additional data collection (Spit for Science, 2016).

Aside from the collaborations directly connected to the Spit for Science project, the genetic component may call for a different kind of collaboration. Even though approximately 9,900 participants in Spit for Science is large for a research project conducted on a single university campus, it is small relative to the number of participants needed to understand the multiple genetic and environmental factors that contribute to risk for substance use and mental health disorders.

With the exception of a handful of disorders, research into the genetics of mental and behavioral health problems generally has not produced clear association between a single gene and a disorder but instead has produced a collage of polygenic risk factors. If the genetic analysis component of Spit for Science goes well, it likely will contribute to a list of multiple genetic variants associated with disorders (e.g., Alcohol Use Disorder) and traits (e.g., impulsivity). Within the dataset, people who, for example, are high on impulsivity and people who have much lower impulsivity levels may carry different versions of one or more associated genes. Detecting these types of associations requires a large

amount of statistical power. Thus, the number of participants in Spit for Science is probably too small to produce a complete understanding on its own. To draw a parallel, to identify parts of the genome and environmental pathways for human height -- something commonly understood to involve genetic contributions from families and environmental contributions, like diet, the research involved studying samples from over 180,000 people (Lango Allen, 2010).

Large-scale global collaborations are discovering the genetic and environmental contributors to substance use and mental health disorders, and the individual research contributions also can separately contribute to meta-analyses that combine the results from multiple research studies. Another way to build the large amount of data would be for other researchers at other institutions to replicate the Spit for Science approach to data collection. Although each institution has its own culture and procedures for ensuring the privacy, security and other human subjects' protections for students who might participate in a project like Spit for Science, the Spit for Science team has developed an approach and worked through many of the complications and pitfalls, so they could provide guidance on how to conduct such a project effectively.

Why it matters

As academic librarians, we have an important role to play in research experiences for undergraduates. In the Spit for Science Labs, we focus less on tools and skills, placing greater emphasis on helping students understand and negotiate the culture and discourse of scientific research (Elmborg, 2006). Moreover, given the interdisciplinary nature of complex problems like drug abuse and mental health, interdisciplinary teams of librarians have much to offer. And as a result of our collaboration with Dr. Adkins, we have become far more aware of the potential and promise of this research project. Our hope is that members of SALIS and the Association of Mental Health Librarians will help

disseminate information about this research to others.

As research participants, approximately 9,900 undergraduate students have become stakeholders in an institution-wide study that will help researchers better understand how genetic and environmental factors come together over time to influence substance use and emotional health.

This data is being integrated into the classroom, providing authentic opportunities for undergraduates to conduct research that is personally relevant and important to the wider campus community. Findings are already informing policy and programming, and additional grants have been secured to

make the research more useful to students and the university. But the research has implications far beyond this institution.

One of the most significant outcomes of the Spit for Science project is a workable organizational model that can, and hopefully will, be replicated at other universities. In a recent article on the project, Dick et al. (2014) note, "If our efforts could be duplicated and expanded at other universities to create a series of projects of this sort, it could hold considerable promise for obtaining the very large numbers of subjects necessary to critically advance our understanding of genetic pathways."

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