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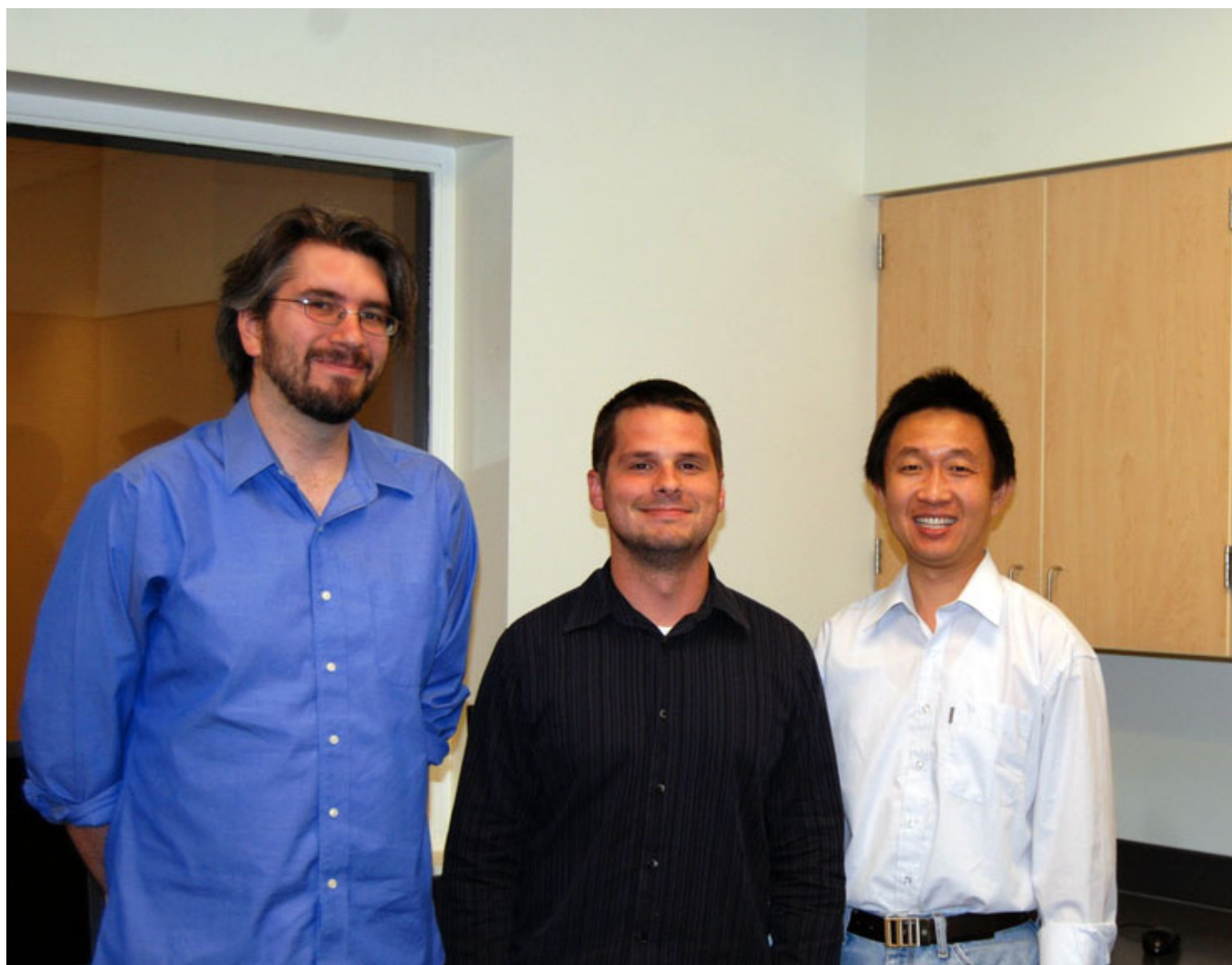
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The Quarterly Newsletter for the Center for Cognitive and Social Neuroscience | Summer 2011

The University of Chicago

Affiliate Lab Interview Wil Cunningham

Wil Cunningham, an affiliate of the CCSN, studies social neuroscience and the motivational processes underlying emotional responses with the Center for Cognitive and Behavioral Brain Imaging (CCBBI) and the Social Cognitive Lab at Ohio State University. In his research, Cunningham explores the way in which different goals and motivation change the way the brain works.



ABOVE (from left): Wil Cunningham, Associate Professor of Psychology; Nathan Arbuckle, graduate student; and Xiangrui Li, Ph.D., Lab Supervisor of the Center for Cognitive and Behavioral Brain Imaging at Ohio State University.

A PERSON'S GOAL CHANGES THE PROCESSING OF THE ENTIRE BRAIN. THIS CHALLENGES OUR IMPLICIT IDEA THAT THE MIND IS A BLANK SLATE.

WIL CUNNINGHAM

What is the current focus of your research?

In the last few years, our lab has shifted focus from attitudes to emotions. We have sought to answer the question, "What elements give rise to emotional states?" Emotion is complicated—generally, the word refers to subjective emotional experience, but we also study the antecedents and consequences of emotion. One of our lines of research looks at affective disorders. Recently, we have been looking at mania and anhedonia, and we are also interested in the connection between motivation and emotion.

What have you learned about mania?

In collaboration with June Gruber, an assistant professor of psychology at Yale University, and Tabitha Kirkland, a graduate student at Ohio State University, our lab began to explore the connection between mania and happiness. We wanted to determine whether or not mania was extreme happiness. In studying mania, researchers often refer to a continuum of emotional experience running from depression to sadness to happiness to mania. To better understand how mania fits into the emotional continuum, we have constructed a study using survey, interview and experience sampling data for three hundred participants. We plan to then bring back a subsample of these participants to collect fMRI data.

This research is in nascent stages, but the results may change our conventional understanding of mania.

WE HAVE SOUGHT TO ANSWER THE QUESTION, "WHAT ELEMENTS GIVE RISE TO EMOTIONAL STATES?"

WIL CUNNINGHAM

What methods and concepts do you employ to study motivation and emotion?

Our dominant line of research examines the way motivation and goals shape the dynamic processing of the brain. This is contrary to most people's conceptions of the brain at work—most people think that the brain creates a vertical representation of the world, and then uses information to form thoughts, emotions, decisions, and behaviors. For example, person would conceive of a stimulus as positive or negative, and presume a stimulus causes some degree of arousal, and then seek to determine where that stimulus' value is encoded in the brain.

In our research, we have looked to see how changing people's goals (e.g., making different stimuli important) changes an individual's brain. For example, the amygdala tends to be more active with negative than positive stimuli. But if you are in a situation where you are looking for positive attributes, the amygdala is sensitive to positive information. In this way, a person's goal changes the processing of the entire brain. Likewise, in looking at the visual cortex, when we vary the type of stimulus people are looking for, we find that event related potentials (ERPs) are altering as fast as one hundred milliseconds after stimulus presentation. This challenges the implicit idea that the mind is a blank slate. Our research indicates that the brain changes even before stimuli are presented. Because the mindset is altered before the stimulus, a person's first perceptions change in a goal relevant way.

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Affiliate Lab Interview *Continued*



ABOVE: Wil Cunningham, Associate Professor of Psychology at Ohio State University.

RIGHT: Wil Cunningham and collaborators in the CCBBI's brain imaging facility.

This is critical, because to control impulsive behavior, a person should not wait until he or she is at the brink. The mind can be prepared to respond in a certain way, so initial impulses that seem paramount may not be important.

In one experiment examining motivation, conducted with Jay Van Bavel, an assistant professor of psychology at New York University, participants are placed into groups. In one condition, each person is told he or she is a sentry, and in another condition, each person is told that he or she is a spy. There is a well-known memory bias for in-group members. Generally, in a later memory task, people remember members of an in-group more than members of an out-group. Surprisingly, in the spy condition of this experiment, people remember members of the out-group, producing an out-group memory effect.

The brain is not static. It is constantly changing, rewiring, reconnecting to deal with the challenges of everyday life. As we answer more of these questions—"What is the processing characteristic of the medial prefrontal cortex? Of the amygdala? How do they change in different situations and with different stimuli?"—we are learning that these brain areas might not be operating at the level of the words we use to describe them. The amygdala is not merely a threat detector. It is doing something that is helpful to us when looking for threats, but another explanation may be needed to more completely understand its function.

What is the role of computational social neuroscience in understanding these situations?

I have been influenced by the work of Randy O'Reilly, a professor of psychology and neuroscience at the University of Colorado, and Michael Frank, an assistant professor of neuroscience at Brown University. If we are to bridge the psychological, observational level of analysis with the neural level of analysis, we must carefully articulate these underlying processes. Computational neuroscience seeks to move toward the mathematical representations of these processes, to allow us to start thinking about inputs, transformations, and outputs of distributive systems. We need to move beyond the words, because the words are just heuristics. This computational layer between the imaging and the psychological level allows us to not correlate our words with brain activity, but correlate computations with brain activity.

O'Reilly and Frank have done work building neural, biological models of phenomena they would like to more accurately explain. From these models, different lesion patterns can be employed, and the models can be tested to see if their activity is similar to that of lesion patients. From here, we can start to better understand individual differences in structure and function.

These new concepts also add a level of falsifiability to social neuroscience data. With words, it is easy to inaccurately explain someone else's conclusions. Similarly, with imaging data, it is very easy to force your theory into the data you gathered. I love the idea of residual analysis, where you spend

time figuring out what your theory did not explain. There is so much in the neuroscience that suggests that we need to be rethinking our approaches. For example, a task may activate reward areas, but there are twelve different areas that are called reward areas, and they are not all activated every time. The question is not if activation is associated with reward, but which aspect is associated with reward? Computational approaches can help us access this understanding, and answering these questions will be very interesting.

What does the future hold?

I believe psychology is at the very beginning of a major revolution. It seems every thirty or forty years we rip apart all of our concepts and rebuild them. Many of our theoretical constructs are abstractions; they are shorthand for the real variables of interest. We are very attached to these shorthand descriptors, to the point of believing they are real. In the cognitive neurosciences, we are in the process of finding neural evidence for these abstractions, forgetting that they were abstractions in the first place. In this way, imaging may be used to reify the things we already believe to be true. Because there are so many voxels of activation in the brain, we can find the story that confirms our ideas, rather than looking for disconfirming evidence. This is problematic for many reasons.

Likewise, regarding psychological explanations, we need to be a level beneath the levels of categories we use. For example, we are used to talking about something like emotion versus cognition, but what are the fundamental computations that give rise to

REGARDING PSYCHOLOGICAL EXPLANATIONS, WE NEED TO BE A LEVEL BENEATH THE LEVELS OF CATEGORIES WE USE.

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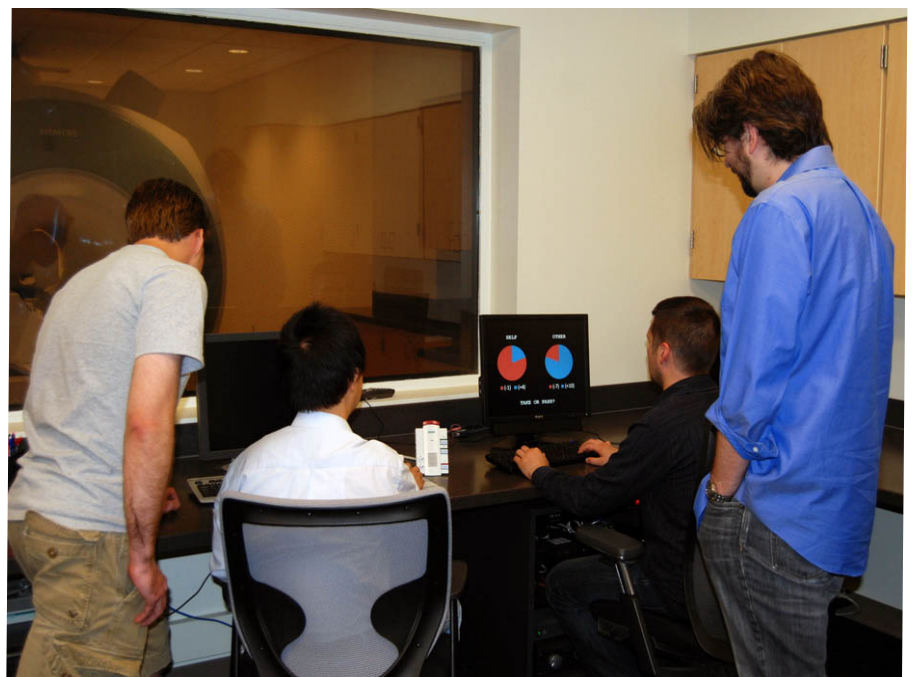
emotion? What is shared? What is different?

To offer an analogy, we need to move from a kind of science that functions like Microsoft Word, a self-contained program, to science where modules are shared across a variety of different platforms, like Word, Powerpoint, and Excel. There could be a whole new level of description that can link the neurosciences to emotion, memory, and other psychological constructs at a different level of analysis. This could be the future of cognitive affect and social neuroscience.

If we accept the premise that we are on the cusp of a revolution in the description of psychological constructs, it may be in our interest to invest in deeper levels of explanation of these concepts, rather than working to reify a temporary theory. ■

IN THE COGNITIVE NEUROSCIENCES, WE ARE IN THE PROCESS OF FINDING NEURAL EVIDENCE FOR THESE ABSTRACTIONS, FORGETTING THEY WERE ABSTRACTIONS IN THE FIRST PLACE.

WIL CUNNINGHAM



RECENT PUBLICATIONS BY WIL CUNNINGHAM

Gruber, J., Cunningham, W. A., Kirkland, T., & Hay, A. C. (in press).

Feeling stuck in the present? Mania proneness and history associated with present-oriented time perspective. *Emotion*.

Kesek, A., Cunningham, W. A., Packer, D. J., & Zelazo, P. D. (in press).

Indirect goal priming is more powerful than explicit instruction in children. *Developmental Science*.

Kirkland, T. & Cunningham, W. A. (in press).

Mapping emotions through time: How affective trajectories inform the language of emotion. *Emotion*.

Cunningham, W. A., Arbuckle, N. L., Jahn, A., Mowrer, S. M., & Abduljalil, A.M. (2010).

Aspects of neuroticism and the amygdala: Chronic tuning from motivational styles. *Neuropsychologia*, 48:3399-3404.

Cunningham, W. A., Van Bavel, J. J., & Johnsen, I. R. (2008).

Affective flexibility: Evaluative processing goals shape amygdala activity. *Psychological Science*, 19:152-160.

Van Bavel, J. J., Packer, D. J., & Cunningham, W. A. (2008).

The neural substrates of in-group bias: A functional magnetic resonance imaging investigation. *Psychological Science*, 11:1131-1139.

Cunningham, W. A., & Zelazo, P. D. (2007).

Attitudes and evaluations: A social cognitive neuroscience perspective. *TRENDS in Cognitive Sciences*, 11:97-104.



Center for Cognitive and Social Neuroscience: Member Profile

Emil Coccaro

Members of the CCSN conduct research related to cognitive and social neuroscience in their field of expertise and with their unique scholarly perspectives. Emil F. Coccaro, M.D., Chairman of the Department of Psychiatry and Director of Clinical Neuroscience and Psychopharmacology Research Unit (CNPRU), and the Ellen C. Manning Professor of Psychiatry at the University of Chicago, was interviewed about his work with impulsive aggression and its clinical form: Intermittent Explosive Disorder (IED).

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What is IED, and how did you come to study this disorder?

I began my career studying mood and anxiety, specifically investigating the biology of depression. Work on the relationship between endocrine function and neurotransmitters led to research looking at the connection between serotonin and aggression. This work showed a consistent inverse relationship between brain serotonin and aggression. Given that agents that increase brain serotonin can be used to treat depression and other psychiatric symptoms, I designed a clinical trial to determine if the serotonin selective reuptake inhibitor (SSRI) fluoxetine can reduce aggressive behavior. We found that taking fluoxetine did reduce aggressive behavior in most study participants. At this time, the early 1990s, there was no clear diagnosis for people with ongoing problems with aggression. The DSM (Diagnostic and Statistical Manual of Mental Disorders) had criteria under the diagnosis Intermittent Explosive Disorder, but the criteria required modification to better reflect the findings of

EVERYONE GETS UPSET... BUT IF YOU ARE EMOTIONALLY INTELLIGENT, YOU CAN THINK ABOUT YOUR EMOTIONS, UNDERSTAND THEM, AND REPAIR THEM.

EMIL F. COCCARO

biological and treatment studies. Likewise, the term aggression needed to be expanded beyond simply causing physical harm to include behaviors like violent outbursts, verbal threats, and other forms of aggressive reactivity. Today, IED is defined as a behavioral disorder of impulse control, characterized by clinically significant expressions of reactive, impulsive aggression disproportionate to the situation or provocation. Recent research on IED employs family studies and epidemiology to better understand the disorder.

What research is currently underway in your lab?

Much of our work looks at IED subjects as a group, and compares them to a control group. Some of this work employs fMRI (functional magnetic resonance imaging) and DTI (diffusion tensor imaging) techniques. In 2007, we published a paper looking at the amygdala response to angry faces, and found that for people diagnosed as having IED, the amygdala response to anger faces is elevated, when compared to that of the control group. In a recent study with John Csernansky and Lei Wang at Northwestern University, we measured the shape of the amygdala and hippocampus of individuals in these two groups and discovered there are differences in the shape of these two important limbic brain structures. With K. Luan Phan, a former University of Chicago colleague, now at the University of Michigan, we conducted a voxel-based morphometry (VBM) study looking at grey matter differences in IED patients versus controls. The results tell us that there is a reduction in grey matter in the orbitofrontal cortex of those with IED. This part of the brain is critical in inhibiting the amygdala. This means that those with IED may have fewer brain cells to inhibit the amygdala when provoked. This brain region is also heavily populated with serotonin neurons, the neurons that appear to function less well in people with problems with aggression.

Does IED relate to other psychological constructs?

One psychological construct critical to this line of inquiry is social and emotional information processing (SEIP). With regard to aggression, social information processing is important because people with IED have a hostile attribution bias, and they assume hostile intent on the part of others. Since this perception is highly correlated with anger, it is easy to see how people with IED are vulnerable to aggressive outbursts in the social contexts where there really is little threat. In assessing hostile attribution bias, a researcher presents a participant with a simple vignette where one character does another harm, and asks if the harm was intentional (hostile attribution), or accidental (benign), or instrumental (the harm done was to achieve some other end). Child and adolescent psychologists have found that hostile attribution bias was more common in patients who had suffered traumatic childhood abuse. Likewise, these children have difficulties with aggression and impulsivity as they get older. It turns out that the relationship between early childhood abuse, which also correlates with aggression, is mediated by deficits in social information processing and in emotional intelligence.

For our current research, we developed these vignettes into videos in order to look at brain activation. For example, in one ten-second vignette, a participant watches two people in a karate class sparring in an exhibition. In the 'hostile' experimental condition, one of the people in the match gets hit by the other, falls to the ground, and cries out in pain. After the participant has watched this vignette in the fMRI scanner, we ask them, "Did the character who hit the other do it intentionally, to hurt their sparring partner, or to make them look bad?" Their response helps us understand how they perceive potentially hostile situations.

We are just beginning to look at the data to determine which brain regions may be activated in this hostile condition, compared to



ABOVE: Emil F. Coccaro, Ellen C. Manning Professor of Psychiatry at the University of Chicago

more neutral conditions, and we see activation in the orbitofrontal region of the brain. We are looking to see what other areas may be activated, such as the dorsolateral prefrontal cortex, an area related to working memory, or the amygdala, but we are just at the beginning of this research.

Why is this research important?

Everyone gets upset about things from time to time, but if you are emotionally intelligent, you can think about your emotions, understand them, and repair them. Paying attention to emotions is important, and understanding how to repair your own hurt feelings is important, but these are both moderated by clearly understanding what you are feeling and why. If you are driving your car, and the engine light goes on, you can look at your engine light all you want, and you can worry about your engine all you want, but if you do not open the hood and see what is wrong with the engine, you cannot fix it. I look forward to better understanding how all of these different models and concepts fit together-- behavior, emotional intelligence, social information processing, and the neural and biological substrates of healthy people and of people with IED. ■

UPCOMING EVENTS

Research in Progress Seminars

The Center faculty also participate in workshops, brown bags, and research in progress seminars. To be added to the email list for announcements of talks and events, email Anna Gomberg, agomberg@uchicago.edu.

Support the CCSN

To make a donation to the Center for Cognitive and Social Neuroscience, please contact ccsn@uchicago.edu.

CCSN Workshops

The Center for Cognitive and Social Neuroscience offers workshops, lectures and other special events. Upcoming learning opportunities include:

7 October 2011
Beecher Hall, Room 102
3:00 pm

John-Stockton Irick, Engineer
Physiological Data Collection

This workshop will discuss the procedures associated with collecting EMG (electromyography), EDA (electrodermal activity), EEG (electroencephalography), ECG (electrocardiography), and eye-tracking data.

14 October 2011
Beecher Hall, Room 102
3:00 pm

John-Stockton Irick, Engineer
Stimuli Presentation

This workshop will discuss how stimuli are presented in the experimental chambers of the CCSN, available audio-visual options, different input methods, and correct timing practices.

Society for Social Neuroscience 2011 Annual Meeting

10-11 November 2011
Washington, D.C.

The second annual meeting of the Society for Social Neuroscience is approaching. To register for the meeting or to learn more about the Society, please visit www.s4sn.org.

Collaborative Research Reproducible Research

Ronald Thisted, Professor of Biostatistics and Chairman of the Department of Health Studies at the University of Chicago, works with colleagues to develop and implement practices that support research practices, including reproducible research.

“**R**esearch is not a single activity that takes place at a discrete point in time—it comprises a continuum of related activities involving a myriad of choices and decisions that evolve over a period of time. Much can happen from the point at which a research question is conceived to the point at which the results of that research have become embedded in the discipline. All too often, at the end of that process, it is impossible to answer the questions, ‘Where did that particular result come from? On what assumptions does this finding depend?’” explains Ron Thisted, offering some of the reasons behind the use of reproducible research practices.

Thisted and colleagues at the University of Chicago, including Phil Schumm, a biostatistician in the Department of Health Studies, are working to implement these practices in their own work.

Reproducible research practices are systems that seek to maintain clarity within datasets, and between datasets and manuscripts, such that at any point in a study or review process, the results of an analysis can be replicated, corrected, or modified.

In any experimental research, and particularly in the ongoing longitudinal studies conducted by many members of the

Center for Cognitive and Social Neuroscience (CCSN), datasets change frequently. Errors are corrected, new data are added, scales are defined and refined, and results are analyzed in different ways.

“Let’s say you have done research and you have analyzed your data. You have written a manuscript, and you have submitted it for publication. Then, several months later, the manuscript is returned to you, and the reviewer suggests that you conduct a different analysis, or exclude certain subjects, or include additional variables to see whether the results change. In order to do this, as a first step, you must be able to reconstruct what you actually did in the first place. Ideally, the numbers you get today should be the same as those in the manuscript you submitted several months ago. If you understand where those numbers came from, and all of the decisions on which they depend, you can also go forward with a further analysis. But this is not always the case,” explains Thisted.

The experimental results and the data presented in tables or figures embedded within a manuscript are the end result of computations performed by analytic computer programs. The typical manuscript will be based on hundreds of lines of program instructions—computer code—that embody decisions such as the correction of coding errors, treatment of outliers, transformations of variables, coding of categories, construction of models, and sensitivity analyses. This code executes



ABOVE: Ronald Thisted, Professor of Biostatistics and Chairman of the Department of Health Studies at the University of Chicago.

the commands performed on the dataset. Therefore, maintaining records of the specific version of the code used to obtain the results, as well as the specific version of the dataset used in the original analysis, is critical.

“It is very helpful to maintain an archived copy of the exact dataset used to create a manuscript, and the exact code that was executed to obtain the submitted results, starting from the original raw dataset, so that a researcher can know exactly where every number in the manuscript comes from. For example, a researcher looking at relationships may have run the same analysis on married and single people and compared the results. In the initial analysis, he may have included couples in his sample that were not formally married in the group of married people or in the group of single people, and this initial choice must be recorded. This allows us to reconstruct subtleties of an analysis that cannot

always be included in the finished manuscript,” explains Thisted. It also makes it possible for a new collaborator to build upon earlier work.

Often, the primary person who benefits from reproducible research is the original author. Matthias Schwab and Jon Claerbout, geophysicists from Stanford University who are credited with conceptualizing much of the contemporary approach to reproducible research, stated, “One of the main tenets of reproducible research is that time turns each one of us into another person. By making an effort to communicate with strangers; we help ourselves to communicate with our future selves.” (Schwab and Claerbout, Stanford SEP, *Making Research Reproducible*, 1996).

Thisted explains, “For me, this is the most important reason to structure our research practices in a reproducible way. If I have a figure in a paper, I would like to know how to get

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SCHWAB AND CLAERBOUT

FURTHER DISCUSSION OF REPRODUCIBLE RESEARCH



CTSPEDIA.ORG: Clinical and Translational Science

CTSpedia was created as a national effort to collect wisdom, tools, educational materials, and other items useful for clinical and translational researchers and to provide timely and useful advice to clinical and translational researchers with specific problems.

The CTSpedia working group on Reproducible Research (RR) holds annual teleconferences to develop resources and practices. More information can be found at www.ctspedia.org.

IMMEDIATELY, THIS TAKES A PIECE OF REAL SCIENTIFIC WORK AND MOVES IT INTO A MORE IDEALIZED VISION OF SCIENCE.

RON THISTED

that figure again. If I want to make a figure just like it, or if I need to update the figure with additional data, I know how to do it. Just communicating with my future self is enough reason to develop these tools and ways of working.”

The Mechanisms of Reproducible Research

A large part of doing reproducible research comes down to organizing work in a deliberate and systematic way. Workflow should proceed clearly from the raw data (i.e., as recorded in the lab, entered from a case report form or questionnaire, exported from a machine, or received from an archive) through the necessary data manipulations to analyses, with the raw data always preserved inviolate. The entire process should be broken down logically into distinct steps, with each step performed by a specific block of code or separate script(s). Concise but thorough documentation describing how to repeat the process (e.g., a simple README.txt file indicating which scripts to execute and in which order) should be created. Finally, all files (including the raw data) should be given informative names and stored together, using subdirectories as necessary for organization. As a quick check, a researcher could consider whether a colleague presented with the entire package could determine how to replicate the final results from the raw data, without additional assistance. These steps, properly executed, can help make research reproducible, and any researcher can use them without any additional software or expert knowledge.

Several software tools can facilitate reproducible research, especially in the collaborative setting. For example, consider multiple authors collaborating on a manuscript and making changes simultaneously. In this case, simply keeping track of which version

of the document is the most complete and up-to-date becomes difficult, even without the added difficulty of incorporating individual changes into one final manuscript. For example, consider the challenge for five co-authors revising a manuscript, with round-robin “tracked changes” in a Microsoft Word document. Fortunately, software tools known as version control systems used by software companies to manage and track their code can be used to manage this problem (Mercurial is Thisted’s current favorite, and is available for no cost). Such systems offer powerful tools for tracking and inspecting changes to files, and for sharing and merging together edits made by multiple people. In cases where the changes do not conflict, merging can often be accomplished automatically, and in cases where they do conflict, the software provides tools to facilitate resolving the conflicts. Thus, version control systems can make collaboration easier and more accurate, enhancing the reproducibility of the work in the end. Version control can also be applied to data files and analysis code, allowing a researcher to recreate the state of an entire project at any point in time, and thereby replicate intermediate results at any point in a project.

Other tools that support reproducible research make it possible to create flexible, multipurpose documents. These tools allow researchers to create multiple types of documents from one master version.

“If I write a set of exercises for class, I require several versions: one with solutions to the problems, and one without solutions,” explains Thisted. “I may also want an HTML version of the exercises to put on a website, or a PDF version for printing. Ideally, I should be able to create one master document from which I can easily generate the specific type of output I require. I should be able to use a few keystrokes

to generate an HTML version without answers, or a PDF version with the answers included, and so on. If this multipurpose document were sufficiently sophisticated, it could also be used to generate both a manuscript ready for submission and all of the computer code that was used to generate the figures, numbers, and tables in that manuscript.”

A software tool called Sweave facilitates the creation of such a document, using the R statistical programming language and LaTeX typesetting language. Thisted and colleagues are currently working on ways to extend this basic approach to make it easier to use, and to permit it to be used with various analytic packages (e.g., Stata, SPSS) and authoring environments. Researchers adopting this approach will find themselves able to create manuscripts that are immune to cutting and pasting errors, and that make it possible for independent scientists to understand and verify every result they contain.

“Baring one’s scientific soul in this way may be intimidating to an investigator,” Thisted explains, “but it should not be. If the process works, then this collection of code, data, and interpretive material—the glue that binds the pieces together in a finished manuscript—completely documents what was done and how to do it. Immediately, this takes a piece of real scientific work and moves it into our more idealized vision of science, where others can fully build on what we have done.”

The Importance of Reproducible Research

“In the best of all possible worlds, this is a part of transparency in science. Transparency is important for science because scientists are human. They make mistakes. They make choices, and sometimes those choices are bad. If it is impossible to discover errors or to identify all of the choices underlying scientific reports, one simply cannot tell whether the results presented are a consequence of good science or poor choices,” says Thisted.

In the competitive environment of contemporary scientific inquiry, full datasets may not be available for independent review.

However, to make rigorous peer review possible in settings where conclusions rely on nuanced statistical analysis, many major journals, including *Science*, *Nature*, the *Journal of the American Medical Association*, and the *Annals of Internal Medicine* require some access to datasets and analysis, to ensure that the results published are sound. In doing so, these journals hope to avoid the compromising situation of publishing erroneous or even fraudulent results.

Thisted is optimistic that these practices will continue to improve over time. As he explains, “Ideally, anyone should be able to recalculate all analyses performed in a study, starting from the original source data. Some think we will get there soon, but any steps we take to support reproducible research, even just mindfully aiding our future selves through better organization, are worth taking.” ■

BELOW: Phil Schumm, Biostatistician in the Department of Health Studies at the University of Chicago.



RECENT PUBLICATIONS FROM RON THISTED

Vanderweele, T.J., Hawkey, L.C., Thisted, R.A., & Cacioppo, J.T. (2011). A marginal structural model analysis for loneliness: Implications for intervention trials and clinical practice. *Journal of Consulting and Clinical Psychology*, 79(2):225-35.

Cacioppo, J.T., Hawkey, L.C., & Thisted, R.A. (2010). Perceived social isolation makes me sad: 5-year cross-lagged analyses of loneliness and depressive symptomatology in the Chicago Health, Aging, and Social Relations Study. *Psychology and Aging*, 25(2):453-63.

Hawkey, L.C., Thisted, R.A., Masi, C.M., & Cacioppo, J.T. (2010). Loneliness predicts increased blood pressure: Five-year cross-lagged analyses in middle-aged and older adults. *Psychology and Aging*, 25(1):132-141.

Luhrmann, T.M., Nusbaum, H., & Thisted, R. (2010). The absorption hypothesis: Learning to hear God in evangelical Christianity. *American Anthropologist*, 112(1):66-78.

Pioro, E.P., Brooks, B.R., Cummings, J., Schiffer, R., Thisted, R., Wynn, D., Hepner, A., & Kaye, R. (2010). Dextromethorphan plus ultra-low-dose quinidine reduces pseudobulbar affect. *Annals of Neurology*, 68(5):693-702.

Hawkey L.C., Thisted R.A., & Cacioppo, J.T. (2009). Loneliness predicts reduced physical activity: Cross-sectional & longitudinal analyses. *Health Psychology*, 28(3):354-63.

