NSF Highlights

Search terms: 2010, SBE/BCS, Directorate approved,
AC/GPA Version displayed.

69 records found.

Understanding Children's Pragmatic Inferencing Abilities

Highlight ID: 20202, Version: AC/GPA

Professors Julie Sedivy and David Sobel of Brown University are uncovering the complex pragmatic inferences that children are capable of making. Their NSF-funded research shows that 3- and 4-year olds robustly interpret novel words as referring to new objects but they can also take into account the reliability of the speaker in performing this task.

Young children show a strong "mutual exclusivity" bias in regularly interpreting novel words as referring to unfamiliar objects rather than known objects. In one study confirming this, children interacted with two speakers during a familiarization phase. A "reliable" speaker always provided the correct, familiar label for everyday objects (e.g. ball, shoe) whereas an "unreliable" speaker either provided a familiar but incorrect name (e.g. calling a shoe a bottle), or a novel name (e.g. wug, ganzer) for familiar objects. During testing, each speaker used a novel word and had the child choose between a known or unfamiliar object. Children displayed a robust mutual exclusivity bias, choosing the novel object for the novel word nearly all of the time regardless of the speaker's reliability. In a more complex experiment however, children showed sensitivity to speaker reliability. The children were confronted with two known objects and a third unknown object, which was sometimes hidden from the child in a "secret place." In order to choose the unfamiliar object in this scenario, the child might have to reject the two visible objects as possible referents of the new word. In this more difficult task, children selected the unfamiliar object significantly more often with reliable speakers than with unreliable ones. The research thus shows that children have a strong mutual exclusivity bias regarding the interpretation of novel words but it can be modulated by speaker-specific expectations. Children are capable of making pragmatic inferences that take into account non-linguistic factors in the discourse--such as speaker reliability.

The developmental work has direct implications for clinical psychology, particularly the study of autistic populations, where an understanding of language and intention is crucial to understanding the disorder. The project has provided hands-on research opportunities for several undergraduate students under the mentorship of the researchers.

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Undergraduate Education and Undergraduate Student Research

What is the intellectual merit of this activity?

The research shows that children have a strong mutual exclusivity bias regarding the interpretation of novel words but it can be modulated by speaker-specific expectations. Children are thus capable of making pragmatic inferences that take into account non-linguistic factors in the discourse--such as speaker reliability.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *What may be the benefits of the proposed activity to society?*
- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*

The developmental work has direct implications for clinical psychology, particularly the study of autistic populations, where an understanding of language and intention is crucial to understanding the disorder. The project has provided hands-on research opportunities for several undergraduate students under the mentorship of the researchers.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008* *and* *Important Notice 130: Transformative Research*

No

SBE/BCS 2010

Program Officer: Eric Potsdam

NSF Award Numbers:

0744898

Award Title:	Variability in Pragmatic Inferencing
Start Date:	04/15/2008
Expires:	03/31/2010
Awarded Amount to Date:	$80,593
PI:	Julie Sedivy, Julie_Sedivy@brown.edu
Institution Name:	Brown University
State Code:	RI
PE Codes:	7252, 1311
Award Title:	Variability in Pragmatic Inferencing
Start Date:	04/15/2008
Expires:	03/31/2010
Awarded Amount to Date:	$80,593
PI:	David Sobel, sobel@cog.brown.edu

Institution Name: Brown University
State Code: RI
PE Codes: 7252, 1311

NSF Contract Numbers:

Submitted on 02/12/2010 by Eric Potsdam
BCS: Approved 04/06/2010 by Mark L. Weiss
SBE: Approved 05/05/2010 by Lisa L. Jones

Emotional Factors that Influence Remembering a Face

Highlight ID: 20263, Version: AC/GPA

The ability to memorize a face is often studied without reference to emotion, but new NSF-supported research at Northwestern University shows that even the most basic visual memory is affected by emotion. This study used stimuli with neutral facial expressions to show persuasively that visual encoding is systematically influenced by emotional information, in ways that could have significant implications for eyewitness testimony.

Joan Chiao and Ken Paller co-supervised graduate student Donna Bridge in uncovering new insights about the emotional context of face recognition and attentional focus, and how these factors influence memory accuracy. In their study, the researchers presented positive or negative contexts for faces to be learned, in the form of happy or sad vignettes about a pictured person. All faces portrayed a neutral expression, and the same facial image was used during learning and testing, but vignettes were only included during learning. Memory was found to be affected by the type of context at learning. Facial memory was superior when encoding took place with a happy compared to a sad emotional context, but only when tested with upright faces. When tested with inverted faces, the opposite result was found; memory was better following encoding with the sad context compared to the happy context. When perceiving an inverted face, more demands may be placed on processing facial features, which may be encoded better in the sad context. The typical mechanisms of expert face processing might rely on a holistic or configural strategy that is facilitated by a happy context, as long as faces are viewed in their canonical orientation. Taking these findings into account can help us make better use of our memory abilities in a variety of real-world circumstances.

Primary Strategic Outcome Goal: Discovery

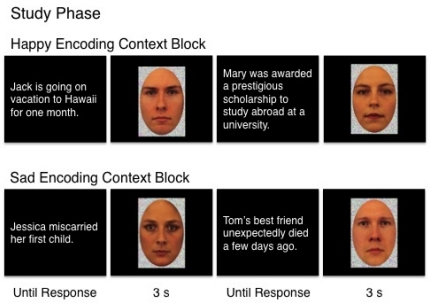
- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Graduate Education and Graduate Student Research

What is the intellectual merit of this activity?

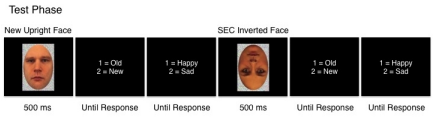
Although the ability to memorize faces is often studied without reference to emotion, this research shows that later memory can be



The top row of the figure shows happy vignettes that
accompanied faces to be learned.
The bottom row of the figure shows sad vignettes that accompanied faces to be learned.

Credit: Ken Paller

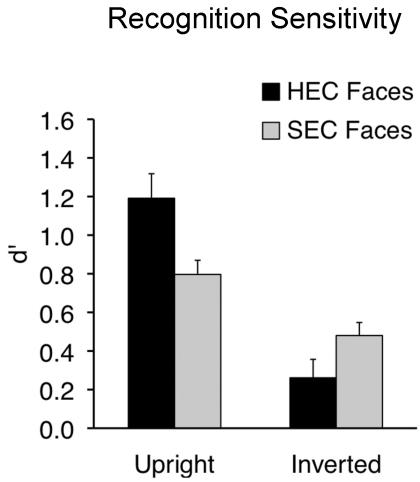
Image Provided by: Ken Paller [kap@northwestern.edu]



This figure shows the type of stimuli shown during the face memory test.

Credit: Ken Paller

Image Provided by: Ken Paller [kap@northwestern.edu]



This figure show that a happy encoding context (i.e., HEC) for faces is more effective than a sad encoding context (i.e., SEC), if the faces are upright. But if the faces are inverted, they are harder to recogize, and the sad encoding context is more effective.

biased by emotions at encoding. Visual encoding is affected by emotion in a way that depends both on the type of emotion and the type of visual encoding, expanding on our understanding of these basic perceptual processes.

Credit: Ken Paller

Image Provided by: Ken Paller [kap@northwestern.edu]

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *What may be the benefits of the proposed activity to society?*

Understanding how emotional context affects memory is very important to society in a broad range of activities, such as the law and education.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008* *and* *Important Notice 130: Transformative Research*

No

SBE/BCS 2010

Program Officer: Lynne Bernstein

NSF Award Numbers:

0518800

Award Title:	Fractionating Facial Memory Processes
Start Date:	08/01/2005
Expires:	07/31/2009
Awarded Amount to Date:	$495,000
PI:	Ken Paller, kap@northwestern.edu
Institution Name:	Northwestern University
State Code:	IL
PE Codes:	1699

NSF Contract Numbers:

Submitted on 02/03/2010 by Lynne E. Bernstein
BCS: Approved 04/06/2010 by Mark L. Weiss
SBE: Approved 04/29/2010 by Lisa L. Jones

Development of the High Level Visual Cortex Extends Through Adolescence

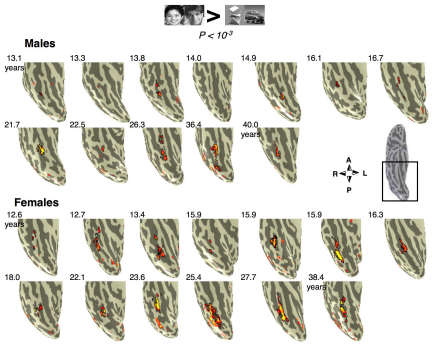
Highlight ID: 20383, Version: AC/GPA

Dr. Kalanit Grill-Spector and Dr. Golijeh Golarai from Stanford University used functional magnetic resonance (fMRI) at the Lucas Imaging Center and Neuroscience Institute to examine the development of face-, object- and place-selective regions in brains of adolescents (12- to 16-year olds) and adults (18- to 40-year olds). They discovered striking and prolonged development of face-selective cortical activations during adolescence that were specifically correlated with age-related improvements in face recognition memory abilities. In contrast, object- and place-selective activations showed adult-like characteristics by age 12.

In adults, the ventral temporal cortex includes several high-level visual regions that show selective responses to specific classes of stimuli such as faces, objects or places. These cortical regions are involved in visual recognition of these stimuli. However, it was not well understood how these regions develop and whether this development is related to improved visual recognition memory. The development of face-selective activations manifests as (1) an age-related increase in the cortical extent of face-selective activations, (2) an age-related increase in face-selectivity, (3) increased differentiation of distributed response patterns to faces versus nonfaces across ventral temporal cortex from adolescence to adulthood, and (4) a correlation between the spatial extent of face-selective activations and performance in face (but not object or place) recognition memory.

These findings are important because they indicate that brain function continues to develop well into the second decade of life even for regions involved in the basic tasks of perceiving and remembering faces. These results demonstrate that the visual brain does not develop at a constant rate, and suggest the intriguing possibility that experience plays an important role in cortical development, and that face-selective cortical regions are particularly amenable to experience.

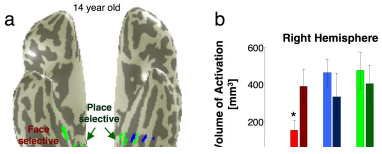
Primary Strategic Outcome Goal: Discovery



This figure shows an age-related increase in the cortical extent of face-selective activations across age. Examples from male participants are shown in the top half of the figure, and examples from females are shown in the bottom half.

Credit: Kalanit Grill-Spector

Image Provided by: kalanit grill-spector [kalanit@psych.stanford.edu]



- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals:

What is the intellectual merit of this activity?
Face perception is critical for social interaction and development, and it undergoes a prolonged maturation that last until the teens. This research project is determining the visual cortical processing changes that underly face perception and its development during adolescence.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *What may be the benefits of the proposed activity to society?*

All maps thresholded at *P*<0.001

This figure shows cortical areas specialized for faces, places, and objects in one 14-year-old (left side, a), and activation levels for adolescents versus adults (right side b).

Credit: Kalanit Grill-Spector

Image Provided by: kalanit grill-spector [kalanit@psych.stanford.edu]

These results suggest that visual experience with faces could play a key role in shaping cortical organization and proficiency in visual recognition of faces. Therefore, differences among individuals' face recognition abilities could be driven by differences in experience that affected their cortical development. These results suggest the possibility that intervention programs could be successful even during adolescence for individuals with deficiencies in face recognition such as those with congenital prosopagnosia or autism.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008 and Important Notice 130: Transformative Research*

Yes

The findings have important clinical implications for individuals with difficulties in face perception, such as in autism (0.4% prevalence) or congenital prosopagnosia (i.e., inability to recognize faces, in theabsence of a known brain lesion, thought to affect 2% of the adult population). Because the development of face recognition abilities and face-selective cortex continues into adolescence, training and interventions programs during childhood and adolescence could be beneficial to improve face recognition skills as well as social abilities related to face perception.

SBE/BCS 2010

Program Officer: Lynne Bernstein

NSF Award Numbers:

0617688

Award Title:	Neural correlates of maturation of face processing
Start Date:	08/15/2006
Expires:	07/31/2010
Awarded Amount to Date:	$625,415
PI:	Kalanit Grill-Spector, kalanit@psych.stanford.edu
Institution Name:	Stanford University
State Code:	CA
PE Codes:	1699

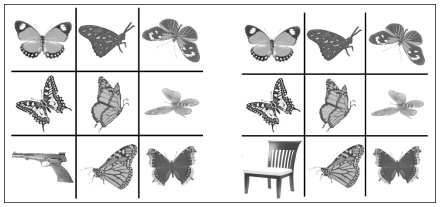
NSF Contract Numbers:

Submitted on 02/02/2010 by Lynne E. Bernstein
BCS: Approved 02/28/2010 by Mark L. Weiss
SBE: Approved 04/29/2010 by Lisa L. Jones

How Emotional Valence Affects Memory and Its Neural Substrates

Highlight ID: 20391, Version: AC/GPA

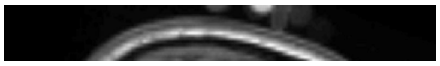
Much of the information that we encounter in everyday life has emotional relevance. A team of NSF-funded researchers at Boston College, led by Elizabeth Kensinger, are examining how young and older adults attend to and remember negative and positive items, such as a snake that slithers by on a hike or a $20 bill found on the side of the road. In one memory study, the researchers used a visual search paradigm to assess how quickly adults ages 18 to 35 and 65 and older detect negative, positive, or neutral items interspersed among distractor items. Participants were shown image arrays, and their task was to indicate whether all images were from the same category, or whether there was a different type of image present. The results revealed that young and older adults were faster to detect emotional images (like guns or $20 bills) than they were to detect neutral images (like chairs). Both age groups showed similar eye-gaze patterns, looking at the emotional targets earlier, and for a longer period of time, than the neutral targets. Thus, the behavior of young and older adults was quite similar. Interestingly, when neural activity was measured, age differences were detected. The ventromedial prefrontal cortex, a region of the brain located just behind the bridge of the nose, responded more strongly to negative targets in young adults but activated more strongly to positive targets in older adults. These results demonstrate that the underlying mechanisms used by different age groups to perform a cognitive



When presented with an array of visual objects, young and older adults are faster to notice emotional targets, such as a gun on the left, than they are to notice neutral targets, such as the chair on the right.

Credit: Elizabeth Kensinger

Image Provided by: Elizabeth Kensinger [elizabeth.kensinger.1@bc.edu]



task can be different. Although young and older adults achieve the same behavioral outcome when detecting emotional targets, they achieve it using different underlying brain processes.

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

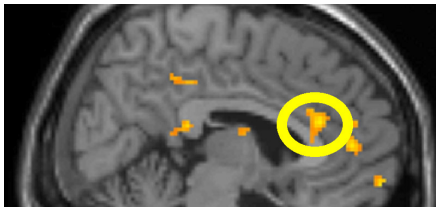
Secondary Strategic Outcome Goals:

What is the intellectual merit of this activity?
This research combines knowledge across the areas of memory and emotion, using behavioral and neuroimaging methods with young and older adults.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *What may be the benefits of the proposed activity to society?*

By refining our understanding of the mechanisms through which emotion influences attention and memory, the results from this project may increase understanding of the attentional biases and memory changes observed in affective disorders such as panic disorder, anxiety disorder, or Post Traumatic Stress Disorder.



During the detection of emotional objects, the ventromedial prefrontal cortex (circled in yellow) showed an age-related reversal in the types of emotional targets to which it was most responsive. In young adults, this region responded most strongly to negative items, whereas in older adults, it responded most strongly to positive items.

Credit: Elizabeth Kensinger

Image Provided by: Elizabeth Kensinger [elizabeth.kensinger.1@bc.edu]

Does this highlight represent potentially transformative research? *If so, please explain why. For more information, see Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008 and Important Notice 130: Transformative Research*

Yes

The memory for items encountered in everyday life has been considered independent of the emotional valence attached to those items. This research shows the importance of emotional valence for achieving an understanding of memory in young and older adults..

SBE/BCS 2010

Program Officer: Lynne E. Bernstein

NSF Award Numbers:

0542694

Award Title:	Emotion's Modulation of Attention and Memory: Effects of Aging
Start Date:	07/01/2006
Expires:	06/30/2009
Awarded Amount to Date:	$551,812
PI:	Elizabeth Kensinger, elizabeth.kensinger.1@bc.edu
Institution Name:	Boston College
State Code:	MA
PE Codes:	1699

NSF Contract Numbers:

Submitted on 02/02/2010 by Lynne E. Bernstein
BCS: Approved 02/22/2010 by Mark L. Weiss
SBE: Approved 03/10/2010 by Lisa L. Jones

Music and Speech Demonstrate Shared and Different Neural Bases

Highlight ID: 20445, Version: AC/GPA

Drs. Vinod Menon and Daniel Abrams of Stanford University, and Dr. Daniel Levitin of McGill University have shown that the temporal structure of speech and music are encoded differently by the brain.

Music and speech are human cultural universals that manipulate acoustically complex sounds in terms of hierarchical rules of temporal organization that becomes elaborated over time. Because of the ecological and behavioral significance of music and speech in human culture and evolution, the extent to which the neural resources deployed for processing music and speech are distinctive or shared is of great interest. One proposed hypothesis between music and speech relates to syntax - the rules governing how musical or linguistic elements can be combined and expressed over time. The hypothesis states that syntactic processing for language and music share a common set of neural resources instantiated in prefrontal cortex. The researchers used functional magnetic resonance imaging (fMRI) of brain activity to test this hypothesis with 20 right-handed non-musicians as they listened to natural and temporally-reordered musical and speech stimuli matched for familiarity, emotion, and valence. Heart-rate variability and mean respiration rates were simultaneously measured and were found not

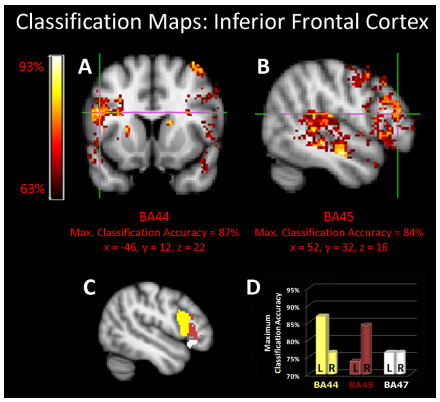


Figure 1 shows Multivariate Pattern Analysis of temporal structure in music and speech. (A-B)

to differ between musical and speech stimuli. Although the same manipulation of speech and music temporal structure elicited similar levels of brain activation, multivariate classification analysis revealed distinct spatial patterns of brain responses in the two domains. Distributed neuronal populations that included the inferior frontal cortex (Figure 1), the posterior and anterior superior and middle temporal gyri (Figure 2), and the auditory brainstem classified temporal structure manipulations in music and speech with significant levels of accuracy. While agreeing with previous findings that music and speech processing share neural substrates, this work shows that temporal structure in the two domains is encoded differently, that is, have different syntax, thus highlighting a fundamental dissimilarity in how the same neural resources are deployed.

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Graduate Education and Graduate Student Research
- Postdoctoral Education and Fellowships

What is the intellectual merit of this activity?
This research seeks to understand the principals by which the brain uses ordering of events in comprehending language and music. It uses sophisticated analysis methods to discover different patterns of activation of the cerebral cortex.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*

The project has provided training for Dr. Daniel Abrams a postdoctoral research fellow at Stanford. In addition, a number of research assistants have also been trained on experimental design, brain imaging data acquisition and analysis, and cognitive neuroscience.

Does this highlight represent potentially transformative research?
If so, please explain why. For more information, see Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008 and Important Notice 130: Transformative Research

Yes

This research provides a foundation for understanding how human communication through music and language are carried out by the cerebral cortex.

Classification maps for temporal structure in music and speech. (C) Color coded location of inferior frontal cortex regions of interest (ROIs). (D) Maximum classification accuracies in Brodmann Areas 44 (yellow), 45 (brown), and 47 (white).

Credit: Vinod Menon

Image Provided by: Vinod Menon [menon@stanford.edu]

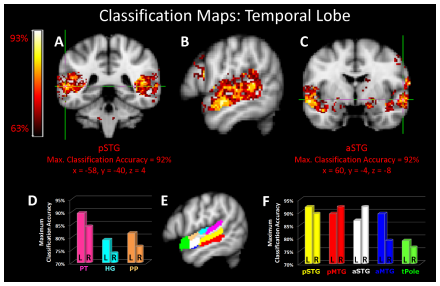


Figure 2 shows Multivariate Pattern Analysis of temporal structure in music and speech. (A-C) Classification maps for temporal structure in music and speech. (D) Maximum classification accuracies for PT (pink), HG (cyan) and PP (tan) in the superior temporal plane (E) Color coded location of temporal lobe ROIs. (F) Maximum classification accuracies for pSTG (yellow), pMTG (red), aSTG (white), aMTG (blue) and tPole (green) in middle and superior temporal gyri as well as the temporal pole. PT = Planum temporal, HG = Heschl's gyrus, PP = Planum Polare, STG = superior temporal gyrus; MTG = middle temporal gyrus, a = anterior, p = posterior, tPole = Temporal pole.

Credit: Vinod Menon

Image Provided by: Vinod Menon [menon@stanford.edu]

SBE/BCS 2010

Program Officer: Lynne E. Bernstein

NSF Award Numbers:

0449927

Award Title:	Neural Basis of Processing Temporal Structure in Music
Start Date:	08/01/2005
Expires:	07/31/2010
Awarded Amount to Date:	$450,000
PI:	Vinod Menon, Menon@stanford.edu
Institution Name:	Stanford University
State Code:	CA
PE Codes:	1699

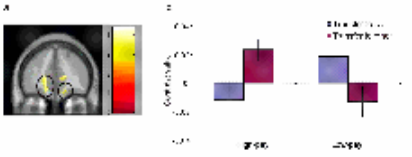
NSF Contract Numbers:

Submitted on 02/03/2010 by Lynne E. Bernstein
BCS: Approved 04/06/2010 by Mark L. Weiss
SBE: Approved 04/29/2010 by Lisa L. Jones

Common and Distinct Reward Systems in the Human Brain

Highlight ID: 20467, Version: AC/GPA

John O'Doherty at the California Institute of Technology used functional magnetic resonance imaging (fMRI) to measure activity in parts of the human brain, specifically the ventromedial prefrontal cortex and the ventral striatum, known to be involved in processing monetary and other rewards. His results showed that the brain's reward circuitry is sensitive to both advantageous and disadvantageous inequality, thereby providing insight into why equity concerns seem to be such a pervasive and fundamental feature of human social exchange.



Activity in ventromedial prefrontal cortex responding to potential monetary transfers being made to a volunteer in the fMRI scanner (self), or a volunteer outside (other). Activity in this region, as well as in ventral striatum, was modulated depending on whether the individual being scanned had received an initial large monetary endowment (high-pay), or had instead received nothing (low-pay). That is, results show increased responses following transfers to the other, if in the high-pay group, but instead show stronger responses following transfers to self, if in the low-pay group.

Credit: John O'Doherty

Image Provided by: John O'Doherty [johnpodoherty@gmail.com]

A well-known finding in social science is that individuals are very sensitive to inequality in income distributions. In corporations, wages are typically secret and vary less than productivity, as though workers have a strong aversion for earning less than others do. Workers also seem to reciprocate when they feel companies have treated them well but withdraw effort when they feel wronged. These social patterns have been replicated under controlled conditions in behavioral economics experiments. For instance participants regularly share wealth with strangers, punish non-cooperators at a cost to themselves, and reject unfair divisions of a pool of money. However, it is unclear why people are so sensitive to inequality in their behavioral preferences. One possibility is that perceptions of income inequality directly influence an individual's sense of the worth or value of a monetary reward. In this study, inequality was created by recruiting pairs of volunteers and giving one volunteer a large monetary endowment at the start of the experiment ($50), while the other volunteer received nothing. While both subjects evaluated further monetary transfers from the experimenter to themselves and to the other participant, neural responses in the ventral striatum and ventromedial prefrontal cortex were more responsive to transfers to others than to self in the "high-pay" subject; whereas the activity of the "low-pay" subject showed the opposite pattern.

These findings contribute to a more comprehensive picture of reward and punishment representations in the human brain. The research could also provide insights into the mechanisms underlying complex decision making behaviors that depend on integration of different types of reward information.

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals:

What is the intellectual merit of this activity?
This work will result in a more comprehensive picture of reward and punishment representations in the human brain. The research could also provide insights into the mechanisms underlying complex decision making behaviors that depend on integration of different types of reward information.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *What may be the benefits of the proposed activity to society?*
- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*

This research could lead to the development of novel techniques to help people make better decisions, or improve learning and skill acquisition through the use of reinforcement.
The funding from this application is being used to support a new research group that can provide research training opportunities for undergraduate, graduate, and post-doctoral trainees in cognitive neuroscience and brain imaging.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008* *and* *Important Notice 130: Transformative Research*

Yes

The findings generated by this research could help elucidate the fundamental learning mechanisms that underlie all motivated behaviors. Such findings could have a significant impact on fields outside cognitive neuroscience such as economics and decision theory.

SBE/BCS 2010

Program Officer: Lynne E. Bernstein

NSF Award Numbers:

0617174

Award Title:	Common and Distinct Reward and Punishment Systems in the Human Brain
Start Date:	09/01/2006
Expires:	08/31/2010
Awarded Amount to Date:	$298,130
PI:	John O'Doherty, jdoherty@hss.caltech.edu
Institution Name:	California Institute of Technology
State Code:	CA
PE Codes:	1699

NSF Contract Numbers:

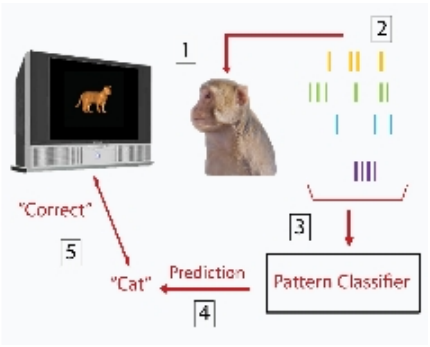
Submitted on 02/19/2010 by Lynne E. Bernstein
BCS: Approved 03/01/2010 by Amber L. Story
SBE: Approved 04/29/2010 by Lisa L. Jones

Neural Representation of Categories

Highlight ID: 20469, Version: AC/GPA

New research carried out at the Massachusetts Institute of Technology by Drs. Earl Miller, Tomaso Poggio, and David Freedman, and graduate student Ethan Meyers has shown that 'abstract category' information is contained in dynamic patterns of neural activity of the inferior temporal (IT) and the prefrontal cortex (PFC).

How information is coded in neural activity is a fundamental question in neuroscience. Humans have the ability to rapidly categorize visual objects, even when the particular example of the object in the category has never been seen before. For example, humans have no trouble identifying that an object is a cat, even if that particular cat had different fur color or head shape from all the other cats previously seen. The relative ease with which humans can categorize objects belies the complex computational steps that are necessary to solve this task, as is evidenced by the relatively poor performance of computer vision recognition systems. In order to understand the neural basis that allows humans and other primates to perform these recognition tasks, the researchers trained two monkeys to perform a cat vs. dog categorization task while recording from neurons in cortical areas of their brains. A 'population decoding' approach based on machine learning techniques was used to predict from the activity of approximately 200 neurons which category of image the monkeys were seeing. The results showed that the pattern of neural activity in the neuronal population can be used by a static classifier to infer the correct category. Importantly, the results also showed that the information in the neural population undergoes a consistent evolution in time as the monkey recognizes the object. The first result confirms that neural activity in higher cortical areas can be "read-out" by the population decoding method. This result can lead to a better understanding of cognitive functions, to help develop neuro-prosthetics, and to design smarter computer vision machines. The second result suggests ways to improve the performance of the decoding technique -- and to improve understanding of the neural code -- by modeling the time dynamics of neural activity.



An illustration of the steps involved in population decoding. 1. A monkey watches a monitor as images of cats and dogs are shown on a screen (the monkey is performing a behavioral task in which he must indicate whether the images is of a cat or a dog). 2. Neural activity is recorded from ~200 neurons as the monkey performs the task. 3. The neural activity is fed into a pattern classifier that tries to predict the category of the image shown to the monkey based on the neural activity. 5. The prediction of the classifier is evaluated to see if it is correct. Results from this work show that the pattern of neural activity that best predicts whether a cat or a dog was shown changes with time (i.e., there are different patterns of activity that predict the category at different latencies relative to when the image is shown).

Credit: Tomaso Poggio

Image Provided by: Tomaso Poggio [tp@csail.mit.edu]

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals:

What is the intellectual merit of this activity?
Drs. Tomaso Poggio and Earl Miller are working to interpret the neural computations underlying complex visual recognition tasks. Their studies will help to transfer knowledge gained from animal models of visual perception to the understanding of higher cognitive visual processes in humans.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *What may be the benefits of the proposed activity to society?*

This research will help to understand the normal function of the brain and afford means of helping when it does not function normally. It will contribute to making machines see better and to new approaches to robotics.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008* *and* *Important Notice 130: Transformative Research*

Yes

An understanding of how visual recognition is carried out by the brain would

SBE/BCS 2010

Program Officer: Lynne E. Bernstein

NSF Award Numbers:

0640097

Award Title:	Computational Models and Physiological Studies of Feedback in Visual Object Recognition Tasks
Start Date:	04/15/2007
Expires:	03/31/2011
Awarded Amount to Date:	$475,721
PI:	Tomaso Poggio, tp@ai.mit.edu

Institution Name: Massachusetts Institute of Technology

State Code: MA

PE Codes: 1699

NSF Contract Numbers:

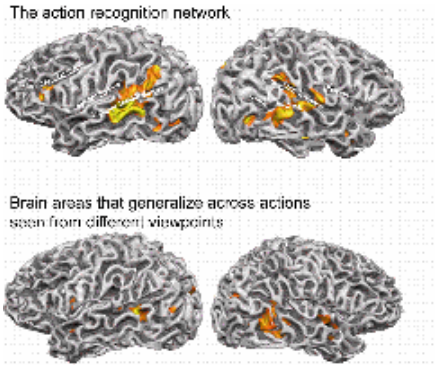
Submitted on 02/12/2010 by Lynne E. Bernstein
BCS: Approved 03/02/2010 by Amber L. Story
SBE: Approved 05/03/2010 by Lisa L. Jones

Neural Specificity for Action Recognition in the Human Brain

Highlight ID: 20474, Version: AC/GPA

Emily Grossman from the University of California Irvine has identified specialized populations of neurons in the human brain that have the functional properties needed for high-level action encoding across a range of viewing conditions. These action-tuned neural populations are thought to reflect the output of complex visual analyses and to form the basis of many higher-level social cognitive functions.

Recognizing and interpreting the body movements of others is a critical skill in daily life, needed for many aspects of social interactions, such as inferring intent and deceit. In previous studies, Grossman and others have identified the human superior temporal sulcus (STS), at the junction of the occipital, temporal and parietal lobes, as a brain area associated with and causally involved in action recognition. To reveal the underlying neural tuning within this brain area, Grossman and colleagues employed a statistical analysis, the "fMR (functional magnetic resonance)-adaptation" technique, which capitalizes on repeated exposures to the identical stimulus resulting in a weakened neural response. This phenomena is taken as an estimate of the specificity in the underlying neural tuning and selectivity. Using the fMR-adaptation technique, the researchers identified neural populations that were specific for individual actions, and that generalize across changes in viewpoint perspective commonly encountered in natural vision (e.g., changes in position and size). Viewing perspective changes pose significant computational challenges to the visual system due to the dramatic changes in retinal images. The researchers found that only a subset of brain areas have neural signals that generalize across such perspective changes. In particular, the STS has patterns of responses that are specific to individual actions, and that generalize across mirror-reversal depictions of the same action, shifts in position, and changes in size. Thus the human STS has the hallmark features of a brain area that encodes high-level properties of actions.



Functional magnetic resonance imaging (fMRI) measurements of the action recognition network. The top panel shows brain areas that are engaged during observations of point-light animations (i.e., an array of points that show the motion of an actor's joints). The activated areas are associated with visual form and motion analysis (i.e., premotor cortex and multisensory areas), with the most activation in the superior temporal sulcus. The bottom panel shows the areas that are invariant to changes in viewing perspective, that is, when the action is mirror reversed.

Credit: Emily Grossman

Image Provided by: Emily Grossman [grossman@uci.edu]

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Undergraduate Education and Undergraduate Student Research
- Graduate Education and Graduate Student Research

What is the intellectual merit of this activity?

Cognitive neuroscience studies of motion and form perception are largely independent bodies of literature, perhaps due to the physical segregation of brain areas subserving the two types of perception. Action recognition, on the other hand,integrates components of motion and form perception, recruits brain areas associated with both types of perception, and is linked to cortical activity in a third brain area, the human superior temporal sulcus. This project integrates the brain basis of motion and form integration.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *What may be the benefits of the proposed activity to society?*
- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*

This project has provided training opportunity for a number of students, including one graduate student and numerous undergraduates. In particular, the student that contributed the most significant amount of work on this project, was an undergraduate woman of Native American descent. Her training acquired by working on this project contributed to her acquiring a competitive research assistant position and will undoubtedly contribute to her future applications to graduate programs.

This research contributes to understanding the brain basis of human action recognition. Because humans are naturally social creatures, each day we are constantly engaged in interactions with others. Of all the events in our visual environment, perhaps none are as interesting to us as the movements of others. Yet our ability to recognize those actions relies on a complex visual analysis which is not yet entirely understood. To understand the brain basis of action recognition is to contribute to better understanding of human safety (e.g., visibility of pedestrians in poor viewing conditions), human social cognition (e.g., reading "body language"), and the associated failures (e.g.,, difficulties in interpreting social situations for individuals with autism).

This project has also contributed to the training of numerous additional undergraduates in the lab who have been involved in various stages of brain imaging data analysis and have been involved in discussions of experimental planning and results via regular lab meetings.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008 and Important Notice 130: Transformative Research*

Yes

Solving the problem of how the brain encodes visually-perceived actions would open the way to understanding many of the other perceptual tasks it accomplishes.Theories of biological motion draw from a number of scientific domains, including research in visual perception, social perception, action understanding and motor imitation (the "mirror neuron" system). Results from the present project will influence thinking in all of these domains.

SBE/BCS 2010

Program Officer: Lynne E. Bernstein

NSF Award Numbers:

0748314

Award Title:	CAREER: Perceptual and Neural Analysis of Biological Motion
Start Date:	09/15/2008
Expires:	08/31/2012
Awarded Amount to Date:	$400,000
PI:	Emily Grossman, grossman@uci.edu
Institution Name:	University of California-Irvine
State Code:	CA
PE Codes:	1699

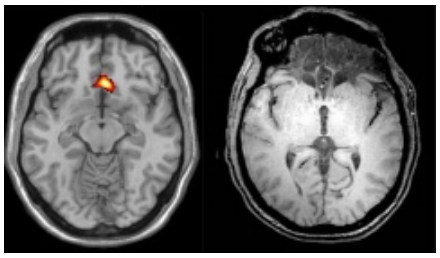
NSF Contract Numbers:

Submitted on 03/02/2010 by Lynne E. Bernstein
BCS: Approved 04/06/2010 by Mark L. Weiss
SBE: Approved 05/03/2010 by Lisa L. Jones

A Brain Region for Regulating the Influence of Emotion on Decision-making

Highlight ID: 20518, Version: AC/GPA

Dr. Jennifer Beer of the University of Texas at Austin and Dr. Robert Knight of the University of California, Berkeley have discovered a brain region that is critical for regulating the influence of emotion on decision-making.



Activation in the orbitofrontal cortex (left panel) predicts whether emotion will be used to guide decision-making. Damage to the orbitofrontal cortex (right panel) makes it difficult for people to distinguish between emotion that is useful versus irrelevant for decision-making.

Credit: Jennifer Beer

Image Provided by: Jennifer Beer [beer@mail.utexas.edu]

Many decisions are driven by emotion. In some cases, the emotion is helpful, but in other cases it is not. For example, following your gut may be helpful in novel situations or situations that are ambiguous. However, irrelevant emotions such as those elicited by a rough day at work or chronically disordered emotional tendencies may impair thinking. How does the brain handle emotions that can color thinking? Are there neural distinctions between emotional and rational thinking? Or does the brain filter information (including emotion) for its relevance to a decision? The researchers tested these two competing possibilities. Using functional magnetic resonance imaging (fMRI), their research has revealed that the orbitofrontal cerebral cortex is a critical region for figuring out when allowing emotions to guide thinking is appropriate, and when the influence of emotions should be suppressed. When emotions are helpful for making sense of an ambiguous situation (e.g., the situation has threat cues and safety cues), the reaction of the orbitofrontal cortex actually predicts whether the emotion will subsequently be used to guide thinking about the situation. However, when emotions are irrelevant to the task at hand, orbitofrontal cortex activity predicts when people will suppress its influence. In an ongoing study, the researchers are also finding that people who have damage to the orbitofrontal cortex have trouble determining when emotion should guide their thinking.

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals:

What is the intellectual merit of this activity?
Previously, researchers had thought that the neural systems associated with using emotion to guide thinking were distinct from the neural systems that are associated with preventing emotional influence. The current research is showing that a common neural system is important for monitoring whether emotion is helpful for guiding decision-making. In this way, the

same brain region might be involved when helpful emotion is used to guide decision-making, and when the influence of irrelevant emotion is suppressed.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *What may be the benefits of the proposed activity to society?*

Understanding the neural systems through which emotion influences thinking is critical for prevention and treatment of a number of mental health problems. Many people with mental health problems are in a particularly vulnerable situation, because they can experience emotions that are too strong, too weak or irrelevant. These emotions then direct their cognitive processing in maladaptive directions. In addition, these people can also have weaker capabilities to stop the influence of their emotions on their cognitive processing. In other words, they have more emotion to regulate than healthy folks, and they might have less capability to regulate those emotions. For example, these kinds of issues have been associated with depression, borderline personality disorder, attention deficit hyperactivity disorder and obsessive-compulsive disorder. This research can lead to a basic understanding of the influence of emotion and can lead to clinical applications.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008* *and* *Important Notice 130: Transformative Research*

Yes

This research suggests a new approach to how emotion and thinking are combined in the brain.

SBE/BCS 2010

Program Officer: Lynne E. Bernstein

NSF Award Numbers:

0746017

Award Title:	Collaborative Research: Orbitofrontal Cortex and Emotion-Cognition Interactions
Start Date:	06/01/2008
Expires:	05/31/2011
Awarded Amount to Date:	$474,054
PI:	Jennifer Beer, beer@psy.utexas.edu
Institution Name:	University of Texas at Austin
State Code:	TX
PE Codes:	1699

NSF Contract Numbers:

Submitted on 02/12/2010 by Lynne E. Bernstein
BCS: Approved 03/01/2010 by Amber L. Story
SBE: Approved 04/29/2010 by Lisa L. Jones

Documenting Athabaskan Language through Personal Histories

Highlight ID: 20547, Version: AC/GPA

With NSF support, Dr. Sharon Hargus of the University of Washington is interviewing native speakers of Babine-Witsuwit'en, an Athabaskan language spoken in the Bulkley/Morice River valleys of western central British Columbia, Canada. Dr. Hargus has collected a large amount of data on Witsuwit'en, an endangered Athabaskan language with only about 100 speakers remaining. These texts are being translated and transcribed and will be very useful for answering linguistic questions about sentence level grammar, such as question formation, negation, and intonation. For example, Hargus has found evidence for a type of intonation contour used in Witsuwit'en yes/no questions which may be cognate with a tonal contour used to mark uncertainty in Tsek'ene, another Athabaskan language of British Columbia.

Primary interviewer Lillian Morris with Roy Morris during November 2009 interview in Moricetown, B.C.

Credit: Photo by Sharon Hargus.

Image Provided by: sharon@u.washington.edu

Form 1515

In addition, these speakers are providing anecdotal support for claims about climate change in this part of North America. They uniformly report that the region used to be colder when they were growing up, corroborating local weather data from Environment Canada, available for 1922 to the present. According to Rick Thoman, Lead Forecaster, National Weather Service, Fairbanks, Alaska, the climate data indicate a strong shift to an earlier melt-out of the winter snowpack starting in 1976.

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals:

What is the intellectual merit of this activity?
This research brings diverse evidence, both weather data and personal narratives, to bear on claims of climate change in western

Canada.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*

The project involves interviews with native Americans living in western central British Columbia. Their personal narratives contribute to our understanding of local climate changes.

Does this highlight represent potentially transformative research?
If so, please explain why. For more information, see Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008 and Important Notice 130: Transformative Research

No

SBE/BCS 2010

Program Officer: Eric Potsdam

NSF Award Numbers:

0651853

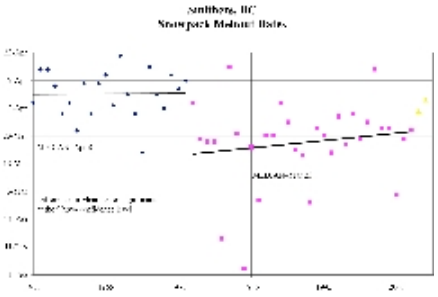
Award Title:	Athabaskan Personal Histories of Climate Change in Alaska and Canada
Start Date:	07/01/2007
Expires:	06/30/2010
Awarded Amount to Date:	$250,000
PI:	Sharon Hargus, sharon@u.washington.edu
Institution Name:	University of Washington
State Code:	WA
PE Codes:	5221, 5205, 1311

Witsuwit'en native speaker George Williams working with Sharon Hargus in Vancouver B.C., January 2010, translating Lillian Morris's 2009 interview of Roy Morris.

Credit: Photo by Dave Paul Nelson.

Image Provided by: sharon@u.washington.edu

Form 1515



1955-2007 spring snowpack meltout dates, prepared by Rick Thoman (NWS) from Environment Canada data, Smithers A weather station.

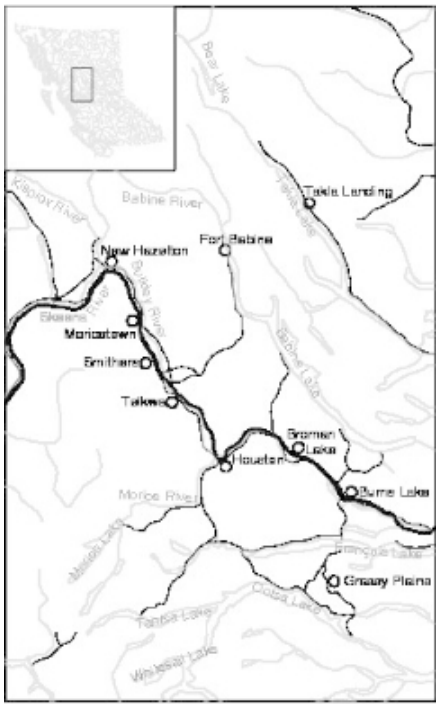
Credit: Image supplied by Sharon Hargus.

Image Provided by: sharon@u.washington.edu

Form 1515

NSF Contract Numbers:

Submitted on 02/17/2010 by Eric Potsdam
BCS: Approved 03/04/2010 by Amber L. Story
SBE: Approved 05/03/2010 by Lisa L. Jones



Traditional Witsuwit'en territory in the Bulkley and Morice River valleys of British Columbia, Canada.

Credit: This map is reprinted with permission of the Publisher from Witsuwit'en Grammar: Phonetics, Phonology, Morphology by Sharon Hargus copyright University of British Columbia Press 2007. All rights reserved by the Publisher.

Image Provided by: sharon@u.washington.edu

Form 1515

Charting Milestones in African-American Speech Development

Highlight ID: 20548, Version: AC/GPA

Dr. Shelley Velleman of the University of Massachusetts Amherst, along with colleagues and student researchers, have established milestones specific to speech sound development in African-American English speaking (AAE) children. An important consequence is that different developmental expectations should be used for children whose first dialect is AAE. Expectations should not be lowered, but rather adjusted for dialect. Providing the proper information to speech-language pathologists should decrease the disproportion of inappropriate diagnoses for children speaking AAE.

When speech-language pathologists assess a child's speech development, they often use a developmental milestones chart, which tells them what sounds and speech structures (e.g., multisyllabic words, consonant blends, etc.) are expected at what ages. The existing milestones charts, however, are based largely upon children who speak General American English (GAE) - the so-called "standard" dialect of the United States. The typical developmental path in children who learn AAE as their first dialect is clearly different and, until now, has been largely unknown. Consequently, children who speak AAE tend to be identified as having speech-language disorders much more frequently than children whose first dialect is GAE.

The new milestones highlight the fact that AAE-first learners master several of the most difficult sounds (such as "s" and "r") earlier than learners of GAE. Key differences between the two dialects suggest that GAE learners will emphasize complex word structures (final consonants and blends) at the expense of the more complex sounds. AAE-first learners will do the opposite, their learning tends to emphasize sound over structure.

Findings from this NSF-funded project extend the results of previous ground-breaking research on AAE at UMass Amherst for which Velleman was a consultant. The prior research, directed by Harry Seymour and funded by NIH, developed while a speech and language test that is not biased against speakers of AAE, [*Diagnostic Evaluation of Language Variation (DELV)]* (Seymour, Roeper & de Villiers, 2003, 2005). Seymour's project targeted children ages 4 to 9 years; the current project brings the study of language variation to its origins in children's very first speech development.

Seymour, H. S., Roeper, T., & deVilliers, J. (2003). *Diagnostic Evaluation of Language Variation Screening Test (DELV-ST)*. San Antonio, TX: Psychological Corporation.

Seymour, H. S., Roeper, T., & deVilliers, J. (2005). *Diagnostic Evaluation of Language Variation - Norm-Referenced (DELV-NR).* San Antonio, TX: Psychological Corporation.

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Undergraduate Education and Undergraduate Student Research
- Graduate Education and Graduate Student Research
- Broadening Participation to Improve Workforce Development

What is the intellectual merit of this activity?
The research has developed milestones for AAE speech development and determined ways in which it is different from the development of GAE in children.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*
- *What may be the benefits of the proposed activity to society?*
- *Will the results be disseminated broadly to enhance scientific and technological understanding?*

This project has supported several very talented minority students who would otherwise have had little opportunity to participate in research. Two of these students were recruited from historically black colleges and universities' undergraduate programs. Several of the undergraduate research assistants are now working towards master's degrees in Communication Disorders. Some are specializing in the development of AAE.

The research provides practical guidelines for speech pathologists working with AAE-speaking children. Such clinicians no longer have to rely on guildelines meant for GAE-speakers. An important consequence is that different developmental expectations should be used for children whose first dialect is AAE. Expectations should not be lowered, but rather adjusted for dialect. Providing the proper information to speech-language pathologists should decrease the disproportion of inappropriate diagnoses for children speaking AAE.

These results have been presented widely at speech-language pathology and dialect conferences. There are currently papers at all stages in the publication pipeline. Velleman is writing a textbook for graduate courses in speech sound disorders that includes these findings.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008* *and* *Important Notice 130: Transformative Research*

Yes

In providing more accurate milestones for AAE children's speech development, the research is transforming the way speech pathologists understand and diagnose AAE-speaking children. The research will hopefully lead to fewer mis-diagnoses in this population.

SBE/BCS 2010

Program Officer: Eric Potsdam

NSF Award Numbers:

0318135

Award Title:	AAE Phonological Development
Start Date:	08/01/2003
Expires:	07/31/2009
Awarded Amount to Date:	$442,726
PI:	Shelley Velleman, velleman@comdis.umass.edu
Institution Name:	University of Massachusetts Amherst
State Code:	MA
PE Codes:	7266, 1698, 1311

NSF Contract Numbers:

Submitted on 02/12/2010 by Eric Potsdam
BCS: Approved 02/22/2010 by Mark L. Weiss
SBE: Approved 03/10/2010 by Lisa L. Jones

Transcranial Magnetic Stimulation Guided by Functional Magnetic Resonance Imaging Selectively Disrupts Memory for Motion

Highlight ID: 20550, Version: AC/GPA

Scott Slotnick, Ph.D., of Boston College has made new discoveries about how visual memories are constructed by our brains from the visual components (such as shape, color, location, or motion) of objects. Every time we look at an object, our brains first break it into its visual components, as indicated by activation in cortical regions associated with processing individual features, and then this feature information is used to construct our percept of an intact object. Like perception, memory has been described as constructive in nature, that is, features that are processed in different cortical regions are combined. Dr. Slotnick used transcranial magnetic stimulation (TMS) to disrupt the visual motion processing cortical region (MT) and, following the constructive view of memory, hypothesized that this would selectively impair memory for motion.

Participants were shown shapes that were either moving or stationary to the left or right of the point of visual fixation. At test, participants were shown the shapes again and were asked to classify them as ones that had been either moving or stationary. Dr. Slotnick used functional magnetic resonance imaging (fMRI) to localize the MT region in each study participant. Then the fMRI results were used to direct the application of TMS between the study and test phases. Disruption of MT did not impair memory for previously stationary items but did significantly impair memory for previously moving items. The present results provide the first evidence to date that feature processing cortical activity is necessary for accurate remembering. These results also provide compelling support for the view that memory, like perception, is a constructive process, for which information is combined from different feature processing regions of the brain.

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

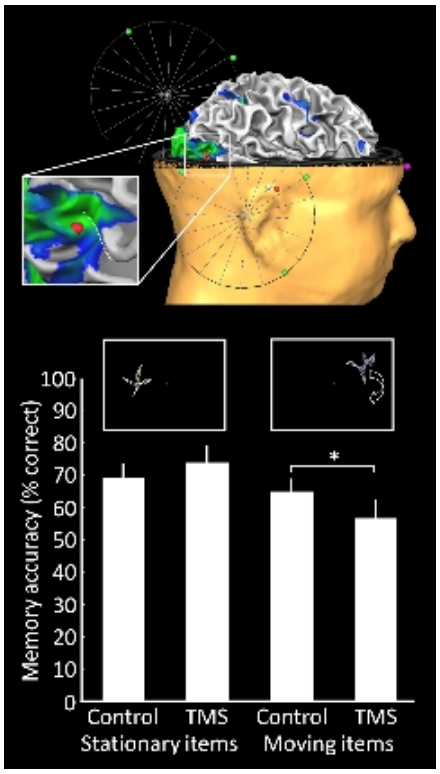
Secondary Strategic Outcome Goals: Learning

- Undergraduate Education and Undergraduate Student Research
- Graduate Education and Graduate Student Research

What is the intellectual merit of this activity?
This research project is discovering fundamental processes of the brain that support memory of visual objects.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*
- *To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships?*



Top picture, a representative participant's head surface and right hemisphere cortical surface (gray) with motion related activity (more significant activity is shown in green). The transcranial magnetic stimulation (TMS) coil is delineated by two wireframe wheels. TMS was applied to motion processing region MT, marked by the red sphere. An enlarged view of the MT region is shown with a white dotted line tracing the fundus of the inferior temporal sulcus. Bottom chart, memory performance corresponding to previously stationary items (left) and previously moving items (right). The control conditions consisted of the same tasks without TMS.

Credit: Scott Slotnick

Image Provided by: Scott Slotnick [sd.slotnick@bc.edu]

Funding of this project fostering the growth of the neuroscience program at Boston College through direct participation of graduate and undergraduate students in the research and by providing the basis for new courses that will focus on methods in cognitive neuroscience. More broadly, this project could explain certain types of memory loss in patients and could also have implications for law (relating to the level of detail in eyewitness testimony).

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008 and Important Notice 130: Transformative Research*

Yes

This project will provide the most compelling evidence to date bearing on the constructive memory hypothesis. While the combination of fMRI source localization and TMS has been used to study visual perception and attention, these combined methodologies have not been used to study memory or other cognitive functions. As such, the techniques developed to conduct this research will serve as a methodological framework for future cognitive neuroscience studies.

SBE/BCS 2010

Program Officer: Lynne E. Bernstein

NSF Award Numbers:

0745880

Award Title:	The Neural Mechanisms of Memory for Object Shape and Motion: Integrating Evidence from fMRI, ERPs, and TMS
Start Date:	05/01/2008
Expires:	04/30/2011
Awarded Amount to Date:	$321,430

PI: Scott Slotnick, sd.slotnick@bc.edu
Institution Name: Boston College
State Code: MA
PE Codes: 1699

NSF Contract Numbers:

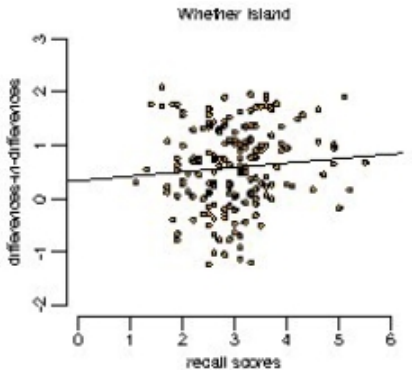
Submitted on 02/11/2010 by Lynne E. Bernstein
BCS: Approved 04/06/2010 by Mark L. Weiss
SBE: Approved 05/03/2010 by Lisa L. Jones

Memory Study Suggests Unconscious Use of Complex Linguistic Knowledge

Highlight ID: 20551, Version: AC/GPA

With support from NSF, Professors Jon Sprouse and Lisa Pearl at the University of California at Irvine have discovered that having a good memory doesn't mean you can understand certain difficult sentences any better than someone without those memory skills. This is remarkable because it suggests that general cognitive skills are not sufficient to understand language. In addition, we unconsciously use complex knowledge about the structure of our language.

Other researchers have argued that sentences containing what theoretical linguists have called "syntactic island violations" sound less acceptable to us than other sentences because they require us to execute more complex linguistic processes, and sometimes our memory capacity is not up to the task. However, Sprouse and Pearl found that there was no relation between working memory capacity and the perceived unacceptability of sentences containing syntactic island violations. This means that the differences in how acceptable these sentences are cannot be due to memory troubles. An alternative explanation is that we prefer sentences that follow certain structural rules and sentences with syntactic island violations do not follow some of these structural rules. We unconsciously realize this as we process the sentences. Such an interpretation of the data requires positing language-specific knowledge that speakers use to understand language. Interestingly, it may be that knowledge of these rules cannot be learned without some innate ability for language that linguists call Universal Grammar, a premise at the heart of a central debate in theoretical linguistics and developmental psychology. Now that Sprouse and Pearl have identified syntactic island violations as a language phenomenon that could use these rules, they will investigate how we could come to learn them given the language we hear as we grow up - and, importantly, whether we need Universal Grammar to do it.



This scatterplot shows the (lack of) relationship between memory (as measured by number of words that can be recalled in a specific order) and how unacceptable a sentence containing syntactic islands is perceived to be. Larger values on the y-axis indicate stronger ratings of unacceptability. If the unacceptability of syntactic island violations were due to inadequate working memory, there should be an inverse relationship: as memory scores increase, the strength of the island effect should decrease. This figure shows that there is no significant relationship between memory scores and the strength of syntactic island violations.

Credit: Lisa S. Pearl & Jon Sprouse, Department of Cognitive Sciences, University of California, Irvine

Image Provided by: lpearl@uci.edu

Form 1515

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Undergraduate Education and Undergraduate Student Research
- Graduate Education and Graduate Student Research

What is the intellectual merit of this activity?

This study has demonstrated that the perceived unacceptability of sentences containing syntactic island violations cannot be due to working memory limitations, thereby strengthening the claim that unconscious knowledge of syntactic islands is driving the observed perceptions. This activity is part of the foundation for a larger project that concretely investigates the existence and content of the innate ability for language that linguists call Universal Grammar. In particular, this activity identifies syntactic islands as complex linguistic knowledge that adults have learned from listening to the language around them. A complementary set of computational studies then assesses the data children could use to learn this complex linguistic knowledge, and whether this learning requires Universal Grammar.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*

Professor Lisa Pearl and several undergraduate students at UC Irvine consider different ways of representing the structures that are important for identifying syntactic islands.

Credit: Lisa S. Pearl & Jon Sprouse, Department of Cognitive Sciences, University of California, Irvine

Image Provided by: lpearl@uci.edu

Form 1515

- *To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships?*
- *Will the results be disseminated broadly to enhance scientific and technological understanding?*

To foster continuing research in this area, Pearl and Sprouse are making available the experimental software tools they developed to collect acceptability judgments in order to help researchers who want to identify other language phenomenon that involve complex structural rules. In addition, they have been integrating teaching, training, and learning with their research by giving UC Irvine students hands-on experience in experimental studies focusing on the scientific study of language. This allows these students to hone their reasoning skills and familiarize themselves with critical aspects of running an experimental linguistic study.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008* *and* *Important Notice 130: Transformative Research*

Yes

This study represents a merging of theoretical linguistics research with experimental psycholinguistic techniques, which is a growing movement within the field that promises to be informative for both theoretical linguistics and psycholinguistics. This study is part of a larger project that provides a methodology for addressing one of the central debates in language and learning, and which demonstrates how to apply this methodology to complex phenomena central to linguistic theory, such as syntactic island constraints.

SBE/BCS 2010

Program Officer: Eric Potsdam

NSF Award Numbers:

0843896

Award Title:	Testing the Universal Grammar Hypothesis
Start Date:	03/01/2009
Expires:	02/29/2012
Awarded Amount to Date:	$176,713
PI:	Lisa Pearl, lpearl@uci.edu
Institution Name:	University of California-Irvine
State Code:	CA
PE Codes:	1311

NSF Contract Numbers:

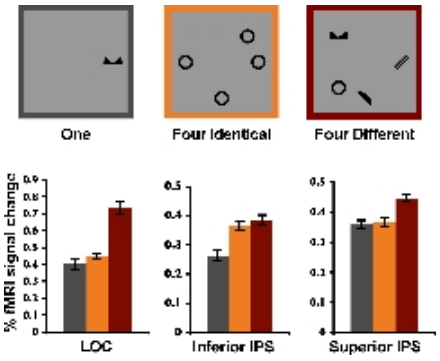
Submitted on 03/03/2010 by Eric Potsdam
BCS: Approved 03/03/2010 by Amber L. Story
SBE: Approved 05/03/2010 by Lisa L. Jones

Distinct Neural Mechanisms Support Visual Individual Object Identification

Highlight ID: 20553, Version: AC/GPA

Dr. Yaoda Xu from Harvard University and her colleague Dr. Marvin Chun from Yale University have recently identified two distinct brain mechanisms supporting object individuation and identification. Using functional magnetic resonance imaging (fMRI), the researchers have shown that while the inferior intra-parietal sulcus (IPS) of the brain selects a fixed number of about four objects via their spatial locations, the superior IPS and the lateral occipital complex (LOC) encode the features of a subset of the selected objects in great detail (object shapes in this case).

Many everyday activities, such as driving on a busy street, require encoding of distinctive visual objects from crowded scenes. To extract the most relevant visual information to guide behavior and thought, a visual system is faced with two challenges. One challenge is object individuation, or selecting discrete units of visual information from competing inputs from the environment (e.g., detecting an approaching vehicle on the road). A second challenge is object identification, integrating visual information initially processed in separate visual areas (such as color, shape, and motion) to achieve a single coherent visual percept (e.g., a red moving car on the left). Dr. Xu and Dr. Chun hypothesized that the inferior IPS individuates visual objects from the crowded display, and the superior IPS participates in subsequent object identification. A critical prediction of their theory was tested, naely, that while object individuation is not sensitive to the repetition of identical objects, object identification is. Ten observers were asked to encode either a single black shape, four identical black shapes, or four different black shapes, and then judge whether a subsequently presented shape matched one of the encoded shapes. While observers were performing this task, neural responses were measured with fMRI. In the inferior IPS, activation was lower for the one shape than for either of the four same or four different shapes. In the superior IPS and LOC, activation did not differ between the one and the four identical shape conditions. Thus, even



Top panel: Examples of the visual stimuli used in the study. Bottom panel: fMRI responses from the LOC, the inferior IPS and the superior IPS. These results show that, during object individuation and identification, both of the four-object shape conditions were treated similarly in the inferior IPS, but the one object and the four identical objects were treated similarly in the LOC and the superior IPS.

Credit: Yaoda Xu

Image Provided by: Yaoda Xu [yaodaxu@wjh.harvard.edu]

when an object's shape is task-relevant, object individuation in the inferior IPS treats four identical objects similarly to four different objects, whereas object shape identification in the superior IPS treats four identical objects as a single unique object. These results provide evidence confirming the role of the inferior IPS in object individuation and the roles of the superior IPS and higher visual areas in object identification.

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Undergraduate Education and Undergraduate Student Research
- Graduate Education and Graduate Student Research

What is the intellectual merit of this activity?
This work will provide with a broad understanding of the role of the parietal cortex in visual perception.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *What may be the benefits of the proposed activity to society?*

Because parietal cortex is often damaged by stroke, causing deficits in visual information selection and integration, the outcome of this research may provide clues to aid patient rehabilitation after parietal lesions. The research may also provide significant insights to computer vision and the design of sophisticated artificial visual systems. Finally, the project will provide research experience for both graduate and undergraduate students.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008 and Important Notice 130: Transformative Research*

Yes

In everyday life, perceivers are confronted with continuous and overwhelming influxes of visual information from the environment. To extract the most relevant visual information to guide behavior and thought, a visual system is faced with two challenges. One challenge is to select discrete units of visual information from competing inputs from the environment (e.g., detecting an approaching vehicle on the road). A second challenge is to integrate visual information initially processed in separate visual areas (such as color, shape and motion) to achieve a single coherent visual percept (e.g., a red moving car on the left). Although vision research has primarily focused on feature processing in visual cortex, brain lesion and brain imaging studies indicate that the parietal cortex plays an essential, but at present largely mysterious role in visual information selection and integration. This research would help establish the role of the parietal cortex for visual processing.

SBE/BCS 2010

Program Officer: Lynne E. Bernstein

NSF Award Numbers:

0855112

Award Title:	Understanding the Role of the Parietal Cortex in Visual Object Grouping and Feature Binding
Start Date:	09/01/2008
Expires:	08/31/2010
Awarded Amount to Date:	$491,959
PI:	Yaoda Xu, yaodaxu@wjh.harvard.edu
Institution Name:	Harvard University
State Code:	MA
PE Codes:	1699

NSF Contract Numbers:

Submitted on 02/12/2010 by Lynne E. Bernstein
BCS: Approved 04/06/2010 by Mark L. Weiss
SBE: Approved 05/03/2010 by Lisa L. Jones

Cross-Linguistic Similarities in the Interpretation of Referring Expressions

Highlight ID: 20561, Version: AC/GPA

With support from NSF, Professor Jeanette Gundel and her research assistants from the University of Minnesota Linguistics Program found that the form and use of referring expressions (such as *this project, it,* or *the senator*) are remarkably similar across languages.

The investigation tests and expands the empirical base of a theory developed by Gundel and colleagues (Nancy Hedberg and Ron Zacharski) which hypothesizes that all natural languages have words that encode the cognitive status of a referring expression in the mind of the addressee. The different statuses that an expression can have are arranged in a hierarchy. The form of the expression indicates how the hearer is to cognitively access the referent. For example, in English, the form *it* encodes the highest possible status, instructing the addressee to associate an entity that is in

Principal Investigator Jeanette Gundel (in front)

his/her focus of attention. The article *a*, in contrast, encodes the lowest possible status, "type identifiable", and is simply an instruction to associate/construct an appropriate type representation.

In order to test predictions of the theory, Gundel's research team investigated referring forms in conversational and written corpora from five diverse languages, three of which are endangered. They found that all five languages have forms that explicitly encode the three highest statuses in the hierarchy. However, not all languages explicitly encoded distinctions between lower statuses on the hierarchy. That is, some languages do not have the equivalent of English *a*. The researchers argue that the missing lower statuses in some languages is a consequence of the fact that the lower statuses are less informative because they are less specified for cognitive status. Languages prefer to lexicalize more informative concepts. This research informs our understanding of how linguistic knowledge interacts with other cognitive systems and, more specifically, how reference works.

with three linguistics graduate students (middle row), Amel Khalfaoui, Linda Humnick, and Mamadou Bassene, and one undergraduate (in back), Dustin Chacon.

Credit: Image supplied by Jeanette Gundel.

Image Provided by: gunde003@umn.edu

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Undergraduate Education and Undergraduate Student Research
- Graduate Education and Graduate Student Research

What is the intellectual merit of this activity?
The project informs our understanding of how linguistic knowledge interacts with other cognitive systems and, more specifically, how reference works. It challenges traditional accounts that classify referring forms into mutually exclusive categories such as "definite" vs. "indefinite" or "proximal" vs. "distal", which are characterized in non-cognitive terms. The theory posits that cognitive status is a more relevant factor in classification. By providing information about five under-described languages, three of which are endangered, it also contributes to our understanding of the extent to which human languages can differ from one another and the extent to which they are alike.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*
- *What may be the benefits of the proposed activity to society?*
- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*

Results of this project have practical application in translation, automated language generation and understanding, and information retrieval. They also have potential clinical applications in pathologies such as Alzheimer's Disease and Autism, which involve impairments in aspects of language use that require correct assessment of the memory and attention states of others. The project has trained 4 graduate and 2 undergraduate students, including 3 from underrepresented groups.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008 and Important Notice 130: Transformative Research*

Yes

The theory challenges the traditional understanding of referring expressions, which classifies them into mutually exclusive semantic categories such as "definite" vs. "indefinite" or "proximal" vs. "distal". The theory posits that cognitive status is a more relevant factor in classification.

SBE/BCS 2010

Program Officer: Eric Potsdam

NSF Award Numbers:

0519890

Award Title:	A Crosslinguistic Study of Reference and Cognitive Status
Start Date:	09/01/2005
Expires:	02/28/2010
Awarded Amount to Date:	$125,365
PI:	Jeanette Gundel, gunde003@umn.edu
Institution Name:	University of Minnesota-Twin Cities
State Code:	MN
PE Codes:	1311

NSF Contract Numbers:

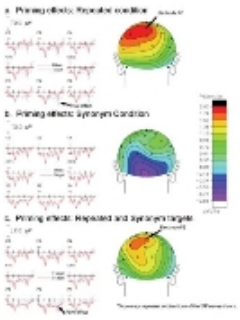
Submitted on 03/03/2010 by Eric Potsdam
BCS: Approved 04/06/2010 by Mark L. Weiss
SBE: Approved 05/03/2010 by Lisa L. Jones

Experments Clarify How Linguistic Knowledge is Represented in the Mind

Highlight ID: 20563, Version: AC/GPA

Professors Matt Traxler and Tamara Swaab, and colleagues at the University of California, Davis, have discovered that the process of understanding one sentence can speed the process of understanding a subsequent sentence that has the same syntactic structure. The results of this NSF-funded research indicate that information about syntactic structure is pre-compiled and stored in long-term memory rather than being created from scratch each time a sentence is encountered. These results further indicate that those syntactic structure representations are associated with specific words. Findings clarify how linguistic knowledge is represented in the mind and how comprehenders use that information in real time to interpret sentences.

To understand a sentence, comprehenders identify the meanings of the words in the sentence, and they also determine how the words in the sentence relate to one another. Comprehenders then build syntactic structure to represent this information. Competing theories provide different explanations of how comprehenders build syntactic structure representations and the theories make different claims about how comprehenders mentally represent syntactic structures. According to Chomskian approaches, comprehenders generate a syntactic structure representation by applying general-purpose rules each time a new sentence is encountered. Lexicalist approaches to syntax contend that some aspects of syntactic structure information are pre-built, stored in long-term memory, and associated with specific words.



ERP Results from a Syntactic Priming Study (Tooley, Traxler, & Swaab, 2009). The top panel shows that the brain responds to a target sentence differently when it is preceded by a syntactically related sentence with the same critical verb. The middle panel shows that this priming effect is eliminated when a different critical verb appears in the prime and the target. The bottom panel shows that the priming effect is larger when the critical verb is repeated across the prime and target sentences than when it is not.

Credit: Matthew Traxler, UC Davis

Image Provided by: mjtraxler@ucdavis.edu

Form 1515

The research used eye-tracking and electrophysiological (ERP) methods to assess how comprehenders respond to sentences and to test the two approaches. In syntactic priming experiments, comprehenders read a prime sentence immediately before they read a target sentence. The research manipulated the relationship between the prime and the target sentence and assessed comprehenders' response to the target. The results show that processing a prime sentence speeds processing of a target sentence if the two have similar syntactic structures and if a critical word is repeated across the prime and the target. Less priming is observed if two sentences have the same syntactic structure but no overlapping content words.

The findings challenge entrenched ideas about the nature of syntactic representations, the mental processes used to assign a syntactic structure representation to a sentence, and the primacy of syntactic structure computations over other mental processes that are necessary for sentence interpretation. The fact that syntactic priming effects are consistently larger when content words, in addition to syntactic structure, are repeated across prime and target sentences indicates that syntactic structure information is associated in long-term memory with individual word representations and is not generated anew every time a new sentence is encountered.

Such advances in basic understanding of sentence interpretation processes can provide insights that lead to better teaching methods and better interventions in the treatment of language disorders such as Aphasia. In addition, the research program has provided training opportunities for a number of young female and minority scientists. The outcomes of this research program have been widely disseminated in peer-reviewed journals and scientific conferences in the United States, Europe, and Asia.

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals:

What is the intellectual merit of this activity?

A comprehensive theory of human language ability will describe the mental representations and processes that comprehenders use to interpret sentences. Syntactic priming experiments provide a window into these mental representations and processes. By manipulating characteristics of prime and target sentences, we can test theories of how lexical (word-related) and syntactic (sentence structure) knowledge contribute to sentence understanding.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*
- *What may be the benefits of the proposed activity to society?*
- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*
- *Will the results be disseminated broadly to enhance scientific and technological understanding?*

Advances in basic understanding of sentence interpretation processes can provide insights that lead to better teaching methods and better interventions in the treatment of language disorders such as Aphasia. In addition, the research program has provided training opportunities for a number of young female and minority scientists. The outcomes of this research program have been widely disseminated in peer-reviewed journals and scientific conferences in the United States, Europe, and Asia.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008 and Important Notice 130: Transformative Research*

Yes

One potentially transformative aspect of this research is that some of the findings challenge entrenched ideas about the nature of syntactic representations, the mental processes used to assign a syntactic structure representation to a sentence, and the primacy of syntactic structure computations over other mental processes that are necessary for sentence interpretation. Some linguistic theories propose that comprehenders use general-purpose rules to build a syntactic structure for a given sentence. Emerging theories propose instead that information about syntactic structure is pre-existing and is tied to specific words in long-term memory. Syntactic priming effects in both comprehension and production are consistently larger when content words, in addition to syntactic structure, are repeated across prime and target sentences. This indicates that syntactic structure information is associated in long-term memory with individual word representations and is not generated anew every time a new sentence is encountered.

SBE/BCS 2010

Program Officer: Eric Potsdam

NSF Award Numbers:

0446618

Award Title:	Syntactic Priming in Comprehension
Start Date:	09/01/2005
Expires:	02/28/2010
Awarded Amount to Date:	$98,529
PI:	Matthew Traxler, mjtraxler@ucdavis.edu
Institution Name:	University of California-Davis
State Code:	CA
PE Codes:	1311

NSF Contract Numbers:

Submitted on 02/12/2010 by Eric Potsdam
BCS: Approved 02/22/2010 by Mark L. Weiss
SBE: Approved 03/08/2010 by Lisa L. Jones

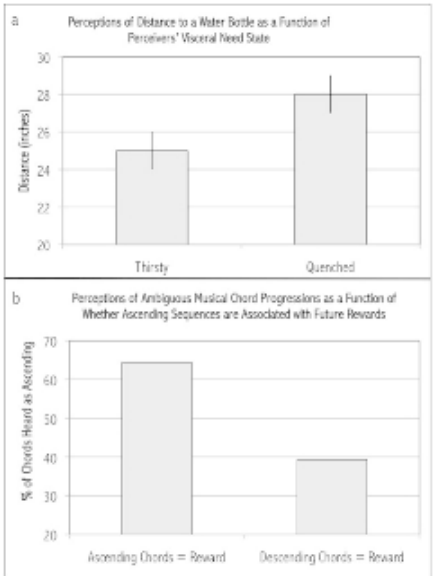
Does Desire Play a Role in Visual and Auditory Perception?

Highlight ID: 20564, Version: AC/GPA

Research conducted by David Dunning (Cornell University) and Emily Balcetis (New York University) has explored how motivated reasoning - or "wishful thinking" - shapes how we perceive the physical world around us, even without us being aware of it. They have found evidence suggesting that people inhibit threatening ideas from reaching conscious awareness, and that people's perceptual systems are biased towards seeing or hearing those stimuli that the perceiver desires. For example, their work shows that people actually see desirable objects as physically closer to them than undesirable ones. When thirsty, they estimate that a water bottle lies closer to them than when they are not thirsty (see figure below). The researchers suggest that these biases arise in order to encourage perceivers to engage in behaviors leading to the acquisition of a desirable object that can serve visceral and psychological goals.

In a separate series of studies, researchers linked ascending or descending auditory tones to rewards and prizes. They then played a different series of tones that were ambiguous as to whether they were ascending or descending. Participants did not recognize that ambiguity, however. They reported that they heard the notes in the way that previously had been linked to desirable outcomes (see figure below). Dunning, Balcetis, and their research team speculate that desirability causes people to see their environment in a way that helps them pursue their goals and maintain positive impressions about themselves and their future prospects.

This line of research demonstrates that, contrary to what most people think, our conscious representations of the outside world are influenced by internal psychological states like desires and goals. Wishful thinking has its impact on human thought without conscious awareness by exerting an influence very early on before any thought reaches consciousness-that is, as people are literally taking in



Perception dependent upon internal goal states and motivation

Credit: Test

Image Provided by: t@t.com

information through their senses about their world around them.

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Undergraduate Education and Undergraduate Student Research
- Graduate Education and Graduate Student Research

What is the intellectual merit of this activity?

People's thought and behavior are shaped by their motives and goals, particularly the motivation towards wishful thinking-wanting to believe that one is a fortunate person, in a benevolent world that will provide a prosperous future. The current research addresses a paradox that arises from this: how does wishful thinking bias people's thoughts without any awareness of the influence? The central contention of the work is that wishful thinking has its impact on human thought without conscious awareness by exerting an influence very early on before any thought reaches consciousness-that is, as people are literally taking in information through their senses about their world around them.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*
- *Will the results be disseminated broadly to enhance scientific and technological understanding?*

It is the practice of both the Dunning and Balcetis labs to include undergraduates, many from underrepresented groups from underserved communities, in the conduct of this research while teaching them basic scientific research methods. In addition, reports about this research have already been disseminated in the popular press, and both Dunning and Balcetis seek to enhance their lab websites to present the work to the public as well as the underlying scientific principles used to conduct the research.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008 and Important Notice 130: Transformative Research*

Yes

This research consists of a transformative blending of research and theory in social/personality psychology with insights gained from work on perception psychology. Using techniques long established in perception research, the investigators can construct fine-grained measures of how human thought and behavior is influenced by a person's goals and motivations. Importantly, goals-even those goals they do not know they hold-influences perception without people's awareness. It is hoped that this work will lead to a better understanding of the psychological dynamics that underlie human behavior.

SBE/BCS 2010

Program Officer: Kellina Craig-Henderson

NSF Award Numbers:

0745806

Award Title:	Motivated Reasoning Without Awareness
Start Date:	09/01/2008
Expires:	08/31/2011
Awarded Amount to Date:	$282,729
PI:	David Dunning, dad6@cornell.edu
Institution Name:	Cornell University
State Code:	NY
PE Codes:	1332

NSF Contract Numbers:

Submitted on 02/12/2010 by Kellina Craig-Henderson
BCS: Approved 04/06/2010 by Mark L. Weiss
SBE: Approved 05/03/2010 by Lisa L. Jones

Women's Romantic Preferences and Goal Pursuits Contribute to Math/Science Gender Gap

Highlight ID: 20566, Version: AC/GPA

Lora Park (SUNY Buffalo) and colleagues have been examining factors that affect women's performance and persistence in Science, Technology, Engineering, and Math (STEM) fields. Their research suggests that women's underperformance and disproportionate dropout rate from STEM may be due, in part, to their romantic partner preferences and conflicting goal pursuits related to attractiveness (i.e., wanting to appear romantically desirable) versus intelligence (i.e., wanting to appear academically competent).

Whereas men may not experience much conflict when pursuing

goals related to appearing attractive and intelligent, women - particularly those who prefer romantic partners who are smarter than they are - may experience significant conflict, such that the activation of thoughts or goals related to attractiveness may interfere with thoughts or goals related to intelligence, especially in traditionally masculine domains such as STEM.

Woman at work on a math problem.

Credit: Supplied by the PI.

Image Provided by: lorapark@buffalo.edu

In one study, women who were primed with an attractiveness goal performed worse on a math test and expressed less identification with and interest in math the more they preferred a smarter romantic partner. These women also reported greater self-handicapping and showed slower reaction times to intelligence-related words when subliminally primed with attractiveness-related words. Thus, for women who prefer that their romantic partners are smarter than they are, thoughts of attractiveness automatically interfere with thoughts of intelligence. Furthermore, women who preferred smarter partners believe that women who are less intelligent than men in STEM fields are more romantically desirable, and personally prefer to date partners who are smarter than themselves in STEM fields.

This research contributes to a basic understanding of how goal pursuit related to attractiveness and intelligence can influence outcomes that have both personal and societal impact. By investigating the links between gender, romantic preferences, goal pursuit, and specific achievement-related outcomes, this research illuminates one way in which women are at heightened risk for underperformance and attrition from STEM fields.

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Undergraduate Education and Undergraduate Student Research
- Graduate Education and Graduate Student Research

What is the intellectual merit of this activity?

This research advances understanding of specific personal and situational factors that heighten women's risk for underperformance and attrition from STEM fields. In particular, this research has the potential to provide insights into how, when, and why pursuit of one goal (e.g., attractiveness) may help versus hinder pursuit of another goal (e.g., intelligence), with consequences for women's achievement and motivation in STEM fields.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*
- *What may be the benefits of the proposed activity to society?*
- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*
- *Will the results be disseminated broadly to enhance scientific and technological understanding?*

The PI has integrated research, teaching, and education by training and mentoring graduate and undergraduate students and by disseminating the findings of this research widely to the academic community and to the general public. Furthermore, findings from this research could guide the development of interventions designed to recruit and retain women in STEM fields, by understanding the role of romantic partner preferences and goal pursuits in shaping women's achievement and motivation in STEM.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008 and Important Notice 130: Transformative Research*

Yes

In examining factors that contribute to women's underperformance in STEM fields, social psychologists have often focused on situational, external factors (e.g., negative cultural stereotypes about women's math ability, being outnumbered, sexist attitudes toward women). The present research goes beyond previous findings by integrating both personal and situational factors in predicting women's performance and interest in STEM fields. Specifically, women's romantic partner preferences, combined with their goal pursuits to appear romantically attractive versus intelligent, may contribute to the math/science gender gap.

Although romantic preferences and goal pursuits may not seem intuitively tied to women's STEM achievement, these studies suggest that women who prefer smarter romantic partners perform worse on math tests when thinking about themselves as attractive and show cognitive interference between notions of attractiveness and intelligence. Thus, interventions to recruit women into traditionally masculine fields such as STEM should consider the potential impact of women's own interpersonal motivations and preferences, which may hinder them from achieving their full potential in STEM fields.

SBE/BCS 2010

Program Officer: Kellina Craig-Henderson

NSF Award Numbers:

0814225

Award Title:	Effects of Goal Pursuit on Women's Performance and Persistence in Science, Technology, Engineering, and Math (STEM)
Start Date:	09/01/2008
Expires:	08/31/2011
Awarded Amount to Date:	$400,000
PI:	Lora Park, lorapark@buffalo.edu
Institution Name:	SUNY at Buffalo
State Code:	NY
PE Codes:	7625, 1332

NSF Contract Numbers:

Submitted on 02/24/2010 by Kellina Craig-Henderson
BCS: Approved 03/01/2010 by Mark L. Weiss
SBE: Approved 04/29/2010 by Lisa L. Jones

Memory Change and Updating Over Time

Highlight ID: 20573, Version: AC/GPA

Drs. Lynn Nadel, Rebecca Gomez, and Almut Hupbach at the University of Arizona are investigating fundamental aspects of how memories are changed and updated over time. Memory is essential to how we understand ourselves, how we prepare to act effectively in the future, and how we communicate with each other. Although it is often assumed that memories are accurate, in fact memory frequently misleads us, and its properties change as we age, or when we are stressed or suffer some form of brain damage.

When an apparently stable, or consolidated, memory for something one learned some time ago is reactivated, it can become labile and open to change. Retrieval can reinforce the reactivated memory, or update it through the incorporation of new information, a process called "reconsolidation." While memory reconsolidation has been widely studied in animals, the researchers developed a new method to study memory reconsolidation in humans. Participants first learn a set of common objects. Two days later, their memory of this learning episode is reactivated, and then a second set of unrelated objects is presented. Two more days later, when asked to recall the first set of objects, participants include many objects from the second set, showing that they had "updated" the reactivated memory of the first set. This "updating" or "reconsolidation" effect requires reactivation. Subjects who had not reactivated their memory for the first set before being exposed to the second set did not show this effect. The researchers also found that the context in which learning takes place can be a potent reactivating cue, that updated memories appear to be stable over time, and that memory updating also occurs in very young children, suggesting that this phenomenon is a fundamental building block in human development. This research contributes to the centuries-old debate over the stability, accuracy, and flexibiity of memory.

Objects to be remembered.

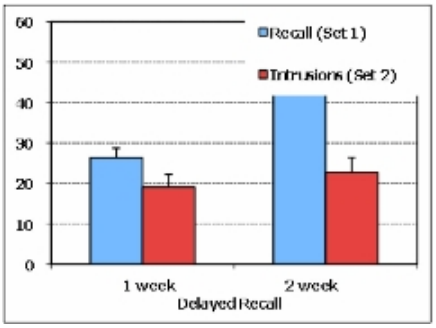
Credit: Lynn Nadel

Image Provided by: Lynn Nadel [nadel@u.arizona.edu]

New objects presented at the time of memory reactivation.

Credit: Lynn Nadel

Image Provided by: Lynn Nadel [nadel@u.arizona.edu]



Items that were studied earlier are recalled one week later, along with intrusions from newly encountered items. Intrusions occur again after two weeks.

Credit: Lynn Nadel

Image Provided by: Lynn Nadel [nadel@u.arizona.edu]

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Undergraduate Education and Undergraduate Student Research

What is the intellectual merit of this activity?
Drs. Lynn Nadel, Rebecca Gomez, and Almut Hupbach at the University of Arizona have developed a research paradigm for investigating reconsolidation in episodic memory, a form of memory that allows for the conscious recollection of events. This research raises important questions having to do with whether updated memories are transient or long lasting and whether the effects occur only for new memories or for old memories as well. There is also the question of what factors trigger memory reactivation, whether these factors are affected by the strength of the original memory, whether the strength of these reminders diminishes over time, and whether implicit reminders differ from explicit ones in the extent to which they affect updating of an existing memory.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *What may be the benefits of the proposed activity to society?*
- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*

Knowledge about how memory is changed over time, and by experience, has profound implications for everyday life, influencing assumptions made within legal and clinical settings about what counts as normal memory. Understanding memory dynamics is also important for identifying the conditions affecting the updating of prior knowledge in learning and cognitive development, both in early childhood and across the lifespan. Understanding such conditions could have a profound effect on theories of cognitive change, on understanding when normal change goes awry and could also have implications for learning in educational

practice.
This project is also providing educational experience to undergraduate students.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008 and Important Notice 130: Transformative Research*

Yes

The extent to which memory preserves an accurate record of the past has been debated for over a century. The veridical memory view assumes that once memory consolidation is complete, memory is stable and no longer subject to change. Furthermore, the neurobiological processes responsible for consolidation involve strengthening, but not modification of a memory. Others have argued that memories are not fixed, but instead are transformed over time as a function of experience. Mounting evidence suggests that when memories are reactivated they become labile and open to change. Retrieval can reinforce the reactivated memory, or update it through the incorporation of new information. Such transformed memories then undergo a time-dependent re-consolidation process. Although the consolidation account, emphasizing strengthening and stabilization, was the de facto paradigm of research on memory dynamics in both psychology and neuroscience for many years, there is now increasing evidence that stable memory is the exception, not the rule. Until recently we have lacked experimental approaches to systematically address memory malleability, hence the mechanisms controlling memory updating remain obscure. Reconsolidation, and the underlying instability it reveals, demonstrates the essential transformative nature of memory systems and could help us understand a variety of memory malleability phenomena studied broadly in human cognition, as well as the updating of prior knowledge more generally.

SBE/BCS 2010

Program Officer: Lynne E. Bernstein

NSF Award Numbers:

0743988

Award Title:	Reconsolidation in Human Episodic Memory
Start Date:	06/15/2008
Expires:	05/31/2011
Awarded Amount to Date:	$590,052
PI:	Lynn Nadel, nadel@u.arizona.edu
Institution Name:	University of Arizona
State Code:	AZ
PE Codes:	1699

NSF Contract Numbers:

Submitted on 02/12/2010 by Lynne E. Bernstein
BCS: Approved 03/02/2010 by Amber L. Story
SBE: Approved 05/05/2010 by Lisa L. Jones

Gender Differences in the Development of Infant Handedness

Highlight ID: 20585, Version: AC/GPA

Dr. George F. Michel, University of North Carolina at Greensboro, is conducting research to determine how hand-use preferences develop during infancy. His research has discovered that while most infants have a strong hand preference early in infancy, the onset of walking changes the strength of hand preference differently depending on gender -- boys' handedness becomes less strong whereas girls' handedness becomes stronger. Since handedness reflects differences in functioning between the left and right halves of the brain, this may be an early indication of how differences in the brains of boys and girls develop.

Infant demonstrating a hand-use preference for acquiring an object.

Credit: George F. Michel, Psychology Department, University of North Carolina Greensboro

Image Provided by: gfmichel@uncg.edu

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Handedness plays an important role in those manual skills involved in tool use and construction of human artifacts (tools, shelter, art) and the lack of handedness is a frequent characteristic of abnormal psychological development (autism, dyslexia, schizophrenia). Previously, Dr. Michel found that infant hand use preferences derive from the direction that newborns prefer to orient their heads. Since the majority of newborns prefer to orient their heads to the right, the majority of infants will exhibit a right bias in their hand-use preference for acquiring objects. However, nearly 40% will not have established a consistent hand-use preference by 15 months of age. Dr Michel's current study charts the course of handedness development from 6 to 15 months of age, assessing infants monthly, to identify the relation of handedness for acquiring objects to handedness for manipulating objects to handedness for role differentiated bimanual manipulation (RDBM or how the two hands cooperate during bimanual manipulation). RDBM is essential for efficient tool use and represents a sophisticated pattern of communication between the left and right halves of the brain. The current study found that handedness in RDBM appears at about the same age as walking, and Dr. Michel is currently investigating the precise ways in which walking, RDMB, and handedness relate to one another, and how RDMB may account for some of the differences between the development of boys and girls.

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Undergraduate Education and Undergraduate Student Research
- Graduate Education and Graduate Student Research
- Broadening Participation to Improve Workforce Development

What is the intellectual merit of this activity?

This research provides crucial detailed descriptions of the early development of handedness and its relation to other forms of neuromotor and skill development.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*
- *What may be the benefits of the proposed activity to society?*

Dr. Michel's research project has been providing research experience to undergraduates as well as graduate students from a wide range of ethnic and cultural backgrounds (Hispanic, East Indian, South Korean, Eastern European). Moreover, the subject population is highly diverse having migrated from many different regions (e.g., Southeast Asia, India, China, Mexico, and Puerto Rico). This research supports several graduate and undergraduate students and serves as conduit for undergraduates to pursue graduate training. It may also have implications for understanding disorders that are associated with atypical handedness.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008* *and* *Important Notice 130: Transformative Research*

No

SBE/BCS 2010

Program Officer: Amy Sussman

NSF Award Numbers:

0718045

Award Title:	Development of Infant Handedness
Start Date:	09/01/2007
Expires:	08/31/2010
Awarded Amount to Date:	$419,276
PI:	George Michel, gfmichel@uncg.edu
Institution Name:	University of North Carolina Greensboro
State Code:	NC
PE Codes:	7252, 1698

NSF Contract Numbers:

Submitted on 02/12/2010 by Kristin E. Kuyuk
BCS: Approved 03/03/2010 by Amber L. Story
SBE: Approved 05/03/2010 by Lisa L. Jones

Early Agriculture and Human Well-being

Highlight ID: 20595, Version: AC/GPA

Archaeologist Dawnie Steadman and biological anthropologist Charles Cobb (both of Binghamton University) examined the impact of warfare on the spatial dispersal of communities during the Mississippian period (ca AD 1000-1450) in central Tennessee, a period that coincides with the emergence of early towns and agriculture. This research provides insights into the unintended consequences of shifting from a hunter/gatherer lifestyle to subsistence farming, particularly the detrimental effects on health of increasing dependence on agriculture.

The so-called "first epidemiological transition" is associated with the domestication of plants and animals ("Neolithic Revolution") and refers to how agriculture and sedentism may have adversely affected human health. Samples of 1600 human skeletons from sixteen archaeological sites have been analyzed by Steadman with regard to sex, age, trauma, and paleopathology. These data are being cross-referenced to a landscape study by Cobb of 300 Mississippian settlements in the same region. Results indicate a surge in settlement density through time, along with a movement toward more ecologically marginal zones. There is corresponding evidence in the skeletal record for crowding, nutritional stress, and interpersonal violence expressed in the form of such signatures as

Shell gorget associated wtih the Mississippian-period Castalian Springs Site

tuberculosis, porotic hyperostosis, and blunt force trauma.

While it seems counter-intuitive that the replacement of hunting and gathering with a more controlled food supply led to a decrease rather than increase in human health, such appears to be the case. Although the advent of agriculture led to a rise in food productivity it was also fraught with physical difficulties, manifested in such infirmities as protein deprivation and stressors related to the burdens of field labor. Until this project, the role of conflict had not been systematically incorporated into this model. The terrain of human settlement is a compromise between strategies to effectively exploit local resources for subsistence, and the need to provide personal and community safety under conditions of chronic conflict. The acceleration of population nucleation and investment in architectural infrastructure that may increase concerns with warfare may also promote thresholds of crowding associated with certain infectious diseases and other stressors.

Mississippian-period Castalian Springs Site, Tennessee.

Credit: Charles Cobb, University of South Carolina

Image Provided by: cobbcr@mailbox.sc.edu

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Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Graduate Education and Graduate Student Research

What is the intellectual merit of this activity?

The research combines, in innovative fashion, archaeological and biological data which provides insight into the relationship between human subsistence patterns, settlement pattern, aggression and health. It incorporates a long term perspective on human behavior and adaptation which anthropology is uniquely qualified to provide.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*
- *What may be the benefits of the proposed activity to society?*

This project provides information relative to public health issues in the developing world. It illuminates the relationship between health and other aspects of social behavior. It also provided financial support and academic training for graduate students who were supported by the grant.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008* *and* *Important Notice 130: Transformative Research*

No

SBE/BCS 2010

Program Officer: John Yellen

NSF Award Numbers:

0613173

Award Title:	Topographies of Mississippian Conflict and Health in the Middle Cumberland Region
Start Date:	07/01/2006
Expires:	06/30/2009
Awarded Amount to Date:	$207,402
PI:	Dawnie Steadman, osteo@binghamton.edu
Institution Name:	SUNY at Binghamton
State Code:	NY
PE Codes:	1392, 1391

NSF Contract Numbers:

Submitted on 03/04/2010 by Kristin E. Kuyuk
BCS: Approved 03/04/2010 by Mark L. Weiss
SBE: Approved 05/03/2010 by Lisa L. Jones

Prehistoric Native American Turquoise Database

Highlight ID: 20596, Version: AC/GPA

Drs. Mostafa Fayek and Joan Mathien (University of New Mexico) and doctoral student Sharon Hull have developed a stable isotope technique that can link turquoise artifacts recovered from archaeological sites to their prehistoric mine. Using this technique, the team of geologists and archaeologists has built a reference database consisting of hundreds of analyses of samples from nearly every known turquoise deposit in the American Southwest (Figure 1). This significant accomplishment, which combines extensive fieldwork with laboratory analysis, now provides an important database which will allow linkages to be made that will improve our understanding of the socio-economic relationships between pre-Columbian populations in the American Southwest and Mexico.

Figure 1. Stable isotope reference database for turquoise mines from the American Southwest (see map for location of mines).

Archaeologists largely rely on excavated material such as pottery, ornaments, and stone tools to gain insight into past cultures. Researchers wish to know whether prehistoric civilizations, such as the Maya and Aztec of Middle America, and the Anasazi of the semi-arid U.S. Southwest, and the complex cultural manifestations associated with these civilizations, developed independent of one another. They also seek to understand how these groups successfully survived for hundreds of years in an unpredictable and demanding Southwest environment. One approach to understanding the relationships between prehistoric cultures is to reconstruct the trade networks for the materials recovered from archaeological sites. A remarkable number (>1,000,000 pieces) of turquoise artifacts have been recovered from Anasazi, Mayan, and Aztec archaeological sites. Archaeologists have sought to chemically "fingerprint" turquoise, thus allowing them to link specific artifacts to their sources and reconstruct turquoise trade networks. Because the technique is non-destructive, archaeologists can analyze turquoise artifacts and then employ the database to identify their source. In the near future, a website will be developed to make the database available to the archaeological community. Dr. Fayek's team will continue to expand the database as more material from turquoise deposits is collected and analyzed.

Primary Strategic Outcome Goal: Discovery

- Geosciences
- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Graduate Education and Graduate Student Research

Credit: Mostafa Fayek and Sharon Hull, University of New Mexico and the University of Manitoba

Image Provided by: mfayek@unm.edu

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Figure 2. Turquoise bracelet from the Chaco Canyon collection. On loan from the American Museum of Natural History, New York, NY.

Credit: Mostafa Fayek and Sharon Hull, University of New Mexico and the University of Manitoba

Image Provided by: mfayek@unm.edu

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What is the intellectual merit of this activity?

Scientists wish to gain insight into the processes which led to the rise and maintenance of complex societies. They also attempt to understand the mechanisms by which such societies at relatively simple levels of technology, adapted to highly variable and unpredictable environments. The research conducted by Dr. Fayek and colleagues provides a valuable tool to reconstruct these processes.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*
- *To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships?*

Ms. Hull's dissertation includes analysis of artefacts from three relevant archaeological sites. The database which results from the overall project will become publically available and widely used.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008 and Important Notice 130: Transformative Research*

Yes

This research is potentially transformative because it provides a new window through which to understand the development of cultural complexity in the prehistoric American Southwest.

SBE/BCS 2010

Program Officer: John Yellen

NSF Award Numbers:

0609638

Award Title:	Sourcing Turquoise Using H and Cu Isotopes
Start Date:	07/01/2006
Expires:	06/30/2010
Awarded Amount to Date:	$125,928
PI:	Mostafa Fayek, mfayek@unm.edu
Institution Name:	University of New Mexico
State Code:	NM
PE Codes:	1393

NSF Contract Numbers:

Submitted on 02/26/2010 by Kristin E. Kuyuk
BCS: Approved 02/28/2010 by Mark L. Weiss
SBE: Approved 04/29/2010 by Lisa L. Jones

Social Evaluation in Young Babies

Highlight ID: 20604, Version: AC/GPA

The capacity to understand and judge the social interactions of other people is a fundamental aspect of human life, influencing whom we wish to interact with and whom we prefer to avoid, as well as how we think others should be treated. Investigating the development of this capacity, Drs. Karen Wynn and Paul Bloom of Yale University, along with graduate student Kiley Hamlin, have found that even young infants distinguish prosocial from antisocial actions and prefer individuals who act positively over those who act harmfully towards others.

In one set of studies, infants saw a character - a wooden block with large eyes - attempting to climb a steep hill but having trouble. Another character, the "Helper", entered the scene, and helped the Climber get to the top of the hill by giving nudges from behind. In the next scene, the Climber was again attempting to climb the hill, but this time a "Hinderer" pushed it down to the bottom of the hill. When infants were subsequently presented with the Helper and Hinderer characters and encouraged to reach for one of them, the large majority chose the Helper and avoided the Hinderer. Even 3-month-old infants, too young to reach for objects, oriented their attention to the Helper rather than the Hinderer.

Infants not only *like* prosocial individuals more, but also have ideas as to how they should be treated. In further studies, the investigators found that even 8-month-old infants want 'nice guys' to be treated well and 'bad guys' to be treated badly: they prefer characters who help Helpers and punish Hinderers, and shun characters who do the reverse.

These findings suggest that a rudimentary capacity for social evaluation is present in the first year of life. This discovery has both theoretical implications for debates about the evolution of morality, as well as practical ones, including understanding the time course of normal social-cognitive development and the possible early diagnosis of social disorders such as autism and psychopathy.

When given choice, babies choose Helper over Hinder.

Credit: Karen Wynn, Yale University

Image Provided by: karen.wynn@yale.edu

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Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

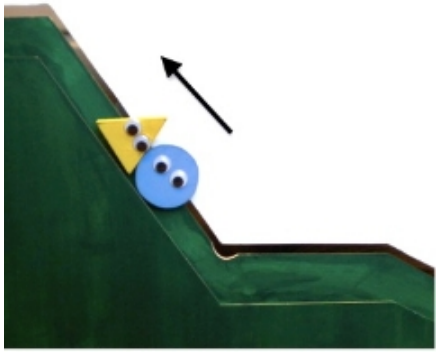
- Graduate Education and Graduate Student Research

What is the intellectual merit of this activity?

Infant studies such as this one inform the ongoing debate within multiple fields (psychology, anthropology, evolutionary theory, and cognitive neuroscience) about which aspects of social evaluation have emerged through biological evolution and which are the product of culture and society. This research also helps us understand the normal developmental trajectory of this capacity.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *What may be the benefits of the proposed activity to society?*
- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*
- *Will the results be disseminated broadly to enhance scientific and technological understanding?*



Blue circle (Helper) helps Climber up the hill.

Credit: Karen Wynn, Yale University

Image Provided by: karen.wynn@yale.edu

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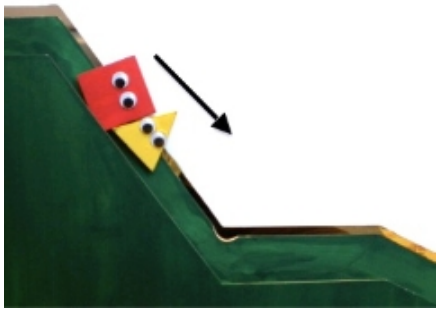
Benefits to society: Learning about the normal course of the development of social evaluative capacities may help us understand, and possibly diagnose, disorders of social understanding (such as autism or psychopathy).

Advance discovery while promoting teaching, training, and learning: Graduate and undergraduate students are involved in the research activities.

Results disseminated broadly: Results have been disseminated to both the scientific community as well as through popular media outlets (such as PBS television).



Red square (Hinderer) pushes Climber down the hill.

Credit: Karen Wynn, Yale University

Image Provided by: karen.wynn@yale.edu

Does this highlight represent potentially transformative research?
If so, please explain why. For more information, see Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008 and Important Notice 130: Transformative

Research

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No

SBE/BCS 2010

Program Officer: Amy Sussman

NSF Award Numbers:

0715557

Award Title:	Social Evaluation in Infants and Toddlers
Start Date:	08/01/2007
Expires:	07/31/2009
Awarded Amount to Date:	$174,999
PI:	M. Karen Wynn, karen.wynn@yale.edu
Institution Name:	Yale University
State Code:	CT
PE Codes:	1698

NSF Contract Numbers:

Submitted on 02/16/2010 by Kristin E. Kuyuk
BCS: Approved 03/23/2010 by Mark L. Weiss
SBE: Approved 04/29/2010 by Lisa L. Jones

New Computer Models to Explore Crowd Behavior in Dense Urban Settings

Highlight ID: 20646, Version: AC/GPA

NSF-supported researcher Paul Torrens and a team of graduate students at Arizona State University are developing computer models to explore how people move through urban environments. By refining their models through analysis of actual movements by people and employing highly advanced visualization approaches, these researchers are developing immersive, realistic synthetic crowd scenes for use in educational and policy-analytic settings. The models help to answer questions such as: How do people make use of spatial thinking in determining their actions and interactions? How does the geography of their behavior influence every-day activities? What role does spatial cognition plays in the formation of social gatherings, and how do people's spatial behavior develop in emergency scenarios?

The researchers have developed agent-based computer models that examine independent and collective behavior of individual people as computer avatars that look and behave with detailed realism. The model serves as a synthetic laboratory for exploring ideas, plans, and policies that are not conveniently experimented with on the ground; for example, the potential pedestrian flow along streetscapes that have yet to be built, crowd behavior in riot conditions, and mass-exit dynamics amid hazardous events.

Figure 1: An agent-based model of pedestrian behavior in a downtown setting. The independent behavior of each synthetic character is modeled in incredible detail.

Credit: Paul M. Torrens

Image Provided by: torrens@geosimulation.com

Form 1515

Torrens and his colleagues recently explored the use of movement samples generated as digital shadows from location-aware devices to improve the models. These data may come from a variety of sources, such as handheld gaming devices equipped with geographic positioning systems, cellular telephones triangulated across telecommunications towers, and radio-frequency identity tags affixed to the products that people carry around stores. The researchers have developed a scheme for machine-learning people's behavioral geography from these data by mining databases of trajectory samples as snapshots of people's movement through space and time. Geographic information systems and spatial analysis are used to identify, reference, measure, and extract behavioral signatures from the data, often at very local scales on the order of a few meters. These mined behaviors then are introduced into the existing agent-based models as a library of knowledge that the agents can call upon when making decisions. This new approach is of significant use in improving the fidelity of agent-based models by providing schemes for calibrating algorithms related to real-world situations. It also has potential further applications in developing location-based services to assist in way finding, shopping, and mobile gaming, and it will advance the development of automated survey of human behavior in dense urban settings.

Primary Strategic Outcome Goal: Discovery

- CAREER Program
- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Undergraduate Education and Undergraduate Student Research
- Graduate Education and Graduate Student Research

What is the intellectual merit of this activity?
The research advances the state-of-the-art in crowd modeling by representing individuals, crowds, and the ambient city with rich detail.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*
- *Will the results be disseminated broadly to enhance scientific and technological understanding?*

The investigator developed and taught a seminar on agent-based modeling of human movement at Arizona State University. Portions of the research have been used as instructional material in upper-level undergraduate and graduate-level classes. Two Ph.D. students are funded directly through the project as research assistants. These students are developing their doctoral dissertations on sub-sets of the research for this project.

Research results are disseminated via publications and presentations.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008* *and* *Important Notice 130: Transformative Research*

No

SBE/BCS 2010

Program Officer: Thomas Baerwald

NSF Award Numbers:

0643322

Award Title:	CAREER: Exploring the Dynamics of Individual Pedestrian and Crowd Behavior in Dense Urban Settings: A Computational Approach
Start Date:	06/01/2007
Expires:	05/31/2011
Awarded Amount to Date:	$331,055
PI:	Paul Torrens, torrens@geosimulation.com
Institution Name:	Arizona State University
State Code:	AZ
PE Codes:	1352, 1333

NSF Contract Numbers:

Submitted on 02/16/2010 by Thomas J. Baerwald
BCS: Approved 04/06/2010 by Mark L. Weiss
SBE: Approved 05/03/2010 by Lisa L. Jones

Unique Adaptation to High-Altitude Hypoxia by Ethiopians

Highlight ID: 20647, Version: AC/GPA

Human populations live at high altitudes in many regions of the world. Cynthia Beall and colleagues have found that a high-altitude population in Southeast Ethiopia adapted to hypoxia, lowered oxygen pressure encountered at elevation, in a rather different fashion than another population in NW Ethiopia. Beall and her interdisciplinary, international team compared two ethnic groups, the Amharic ethno-linguistic group in Northwest Ethiopia and the Oromo ethno-linguistic group is Southeast Ethiopia. The Amhara have a history of living at high altitudes for at least 5,000 years and perhaps much longer. The Oromo moved to high altitude about 500 years ago. Thus, the Amhara have had many more generations of exposure to the stress of high-altitude hypoxia and presumably would have evolved significant differences from their lowland relatives. Surprisingly, the highland Amhara differed less from their lowland counterparts than the highland Oromo differed from theirs. For example, hemoglobin concentration was about 1.1 gm/dl higher and the percent of hemoglobin saturated with oxygen was about 6% lower among Amhara tested at 3700m compared with those tested at 1200m. In contrast, hemoglobin concentration was about 2.2 gm/dl higher and the percent of hemoglobin carrying oxygen was about 11% lower among Oromo tested at 4000m as compared with 1500m. The low altitude samples of each population did not differ from one another. This suggests that the Amhara have evolved physiological responses that result in less deviation from normal sea-level homeostatic values.

This study contributes to a body of investigation into the origins of human biological variation. It was previously known that high-altitude populations of the Andean and Tibetan plateaus adapted differently to hypoxia. Little was known about the third major inhabited high plateau, in East Africa. This research illustrates that human biology can achieve healthy oxygen homeostasis in a number of ways and offers insight into why some individuals cope with exposure to hypoxia better than others.

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

An Oromo man from the highland study group.

Credit: Cynthia Beall

Image Provided by: cmb2@case.edu

Form 1515

Secondary Strategic Outcome Goals:

What is the intellectual merit of this activity?
This research provides further understanding of human biological variation and the different ways that populations of people adapt to body stress - in this case, lack of oxygen.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*
- *What may be the benefits of the proposed activity to society?*
- *To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships?*

This project includes African scientists and has increased collaboration between U.S. and Ethiopian scholars. In addition, the findings from this study may be useful in understanding why some humans can successfully adapt to body stress and others do not, which can impact public health.

Oxygen is measured in the hemoglobin of highland dwelling Oromo.

Credit: Cynthia Beall

Image Provided by: cmb2@case.edu

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Does this highlight represent potentially transformative research?
If so, please explain why. For more information, see Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008 and Important Notice 130: Transformative Research

No

SBE/BCS 2010

Program Officer: Kaye Reed

NSF Award Numbers:

0452326

Award Title:	Ethiopian Adaptation to High-altitude Hypoxia
Start Date:	01/15/2005
Expires:	12/31/2010
Awarded Amount to Date:	$277,534
PI:	Cynthia Beall, cynthia.beall@case.edu
Institution Name:	Case Western Reserve University
State Code:	OH
PE Codes:	1392

NSF Contract Numbers:

Submitted on 02/23/2010 by Kaye Reed
BCS: Approved 03/01/2010 by Mark L. Weiss
SBE: Approved 05/03/2010 by Lisa L. Jones

Owl Monkey Fathers Provide Care for Offspring

Highlight ID: 20652, Version: AC/GPA

Dr. Eduardo Fernandez-Duque's Owl Monkey Project provides crucial information on the behavior, demography, and reproductive ecology of small neotropical monkeys, one of the few socially monogamous primates in the world. With NSF support, Dr. Fernandez-Duque recently evaluated hypotheses for explaining this maintenance of monogamy. Results support the hypothesis that the mother's energetic costs are lessened by the male's contribution to infant care: putative fathers tended to lose more weight than the mothers during the time they provided care. It was also found that the presence of adults who range solitarily in search of reproductive opportunities constitutes a concrete source of intrasexual aggression that may be favoring the maintenance of close proximity between pair mates. Alternatively, differences in the infant production of each group or in the age at natal dispersal by young individuals were not associated with differences in the abundance and distribution of food resources among territories.

Dr. Fernandez-Duque spent 70 months in the field, developing this international and multidisciplinary research program. Under the guidance of the PI, the year-round field activities have been coordinated, conducted, and expanded by a team of young Argentinean biologists. Field work takes place primarily in Estancia Guaycolec, a 25,000 hectare cattle ranch in the Province of Formosa in the Argentinean Chaco, but has recently expanded to Pilcomayo National Park (58,000 hectare), where owl monkeys are protected.

Owl monkeys are captured, and among much other data, weight is recorded for both males and females during offspring rearing. This enables the researchers to measure the energy expended by each sex during this time.

Credit: Eduardo Fernandez-Duque

Image Provided by: eduardof@sas.upenn.edu

Form 1515

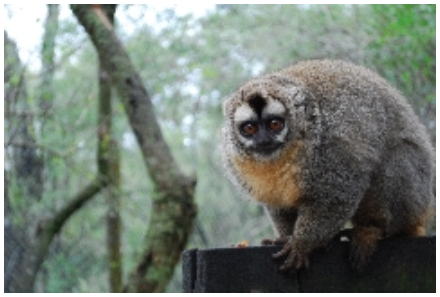
The Centro de Ecología Aplicada del Litoral (CONICET, Argentinean National Council of Research), the National Parks Administration and the Department of Anthropology of the University of Pennsylvania all provide institutional support.

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Undergraduate Education and Undergraduate Student Research
- Graduate Education and Graduate Student Research
- International Research Experiences for Undergraduate & Graduate Students



An owl monkey poses for a portrait.

Credit: Eduardo Fernandez-Duque

Image Provided by: eduuardof@sas.upenn.edu

Form 1515

What is the intellectual merit of this activity?
The Owl Monkey Project is designed to help understand how ecological and social factors regulate social monogamy and infant care in primates, including humans. It also allows examination of some of the environmental factors that may have been key in triggering evolutionary switches between diurnal and nocturnal habits in primates.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*
- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*
- *To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships?*
- *Will the results be disseminated broadly to enhance scientific and technological understanding?*

The broader impacts have been numerous. Being the only long-term program on any mammal species in the Argentinean Gran Chaco, it has had multiplying effects on the conservation of this ecosystem and its fauna. It has also contributed substantially to local education programs. In 1999, Fernandez-Duque co-founded Fundación ECO of Formosa (http://www.fundacioneco.org.ar/) and since then he has collaborated with them in developing primate conservation field courses, establishing the Mirikiná (local name for owl monkeys) Reserve (1,500 ha) in Guaycolec Ranch and launching a National Program for the Conservation of Owl Monkeys. Several REU-NSF sponsored students have benefited from educational opportunities:

The project has also largely benefited from the participation of more than 200 students (52% females and 48% males) from the U.S. (100 students), Argentina (120 students) and 14 other countries (30 students). Finally, some of the data and samples collected led to studies and publications in collaboration with colleagues from institutions worldwide.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008 and Important Notice 130: Transformative Research*

No

SBE/BCS 2010

Program Officer: Kaye Reed

NSF Award Numbers:

0621020

Award Title:	Social Monogamy in Free-ranging Owl Monkeys (Aotus azarai azarai) of Argentina
Start Date:	09/01/2006
Expires:	08/31/2010
Awarded Amount to Date:	$207,505
PI:	Eduardo Fernandez-Duque, eduardof@sas.upenn.edu
Institution Name:	University of Pennsylvania
State Code:	PA
PE Codes:	1392

NSF Contract Numbers:

Submitted on 02/23/2010 by Kaye Reed
BCS: Approved 02/23/2010 by Mark L. Weiss
SBE: Approved 05/06/2010 by Lisa L. Jones

New Hominid Fossils from Woranso-Mille, Ethiopia

Highlight ID: 20663, Version: AC/GPA

New fossil evidence from the Woranso-Mille study area in the central Afar of Ethiopia allowed for the effective testing of the hypothesis that *Australopithecus anamensis* (3.9 - 4.2 Million Years (Myr)) was the immediate ancestor of *A. afarensis* (Lucy's species; 3.6 - 2.9 Myr). Previously, the weakest point of the hypothesis was a lack of hominid fossil remains from the time period between 3.6 and 3.9 My ago. The *A. anamensis* fossils recovered from the Woranso-Mille consist of isolated teeth, mandibles, and maxillae. They show closer affinity to fossils from Allia Bay and Kanapoi, Kenya and Asa Issie, Ethiopia than with those from the nearly adjacent site of Hadar where only *A. afarensis* has been recovered. Dr. Yohannes Haile-Selassie and Dr. Bruce Latimer suggest that because these fossils cannot be unequivocally assigned to either species, the use of two different species names to refer to a single evolving lineage may not be warranted. In addition to these findings, the paleoanthropological team recovered a partial skeleton of *A. afarensis* that is currently under study. This specimen includes elements such as the pelvis, femur, humerus, ulna, ribs, and vertebra, in addition to the most complete scapula and clavicle thus far known for the species. This fossil promises to answer numerous questions related to the function of the early hominid shoulder girdle and shape of the early hominid rib cage. The fossils collected from the Woranso-Mille area (4,300 specimens thus far) not only elucidate the tempo and mode of early human evolution, but also shed light on the composition of mammalian faunal assemblages during the transition from the Early to Middle Pliocene.

This project is co-led by Drs. Haile-Selassie (Cleveland Museum of Natural History) and Latimer (Case Western Reserve University) and includes numerous scientists and graduate/undergraduate students from Addis Ababa University (Ethiopia), Berkeley Geochronology Center, Case Western Reserve University, and Stanford University. The project investigated fossiliferous deposits chronometrically dated to between 3.6 and 3.8 million years ago. This time frame was previously poorly sampled in the fossil record of human evolution.

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Graduate Education and Graduate Student Research
- International Research Experiences for Undergraduate & Graduate Students
- Public Understanding of Science and Lifelong Learning

Researchers crawl shoulder to shoulder on the ground searching for fossils in the arid landscape of the central Afar in Ethiopia. Yellow flags mark locations of fossils.

Credit: Yohannes Haile-Selassie

Image Provided by: yhailese@cmnh.org

Form 1515

A hominid fossil is found on the surface during a survey of the Woranso-Mille region in the Afar of Ethiopia.

Credit: Yohannes Haile-Selassie

Image Provided by: yhailese@cmnh.org

Form 1515

What is the intellectual merit of this activity?
The project has provided many fossils, both hominid and other mammals, from a critical time period in human evolutionary history. The work has enabled the exploration of the tempo and mode of evolution. In addition, recoveries of other hominids will enable further critical research on human ancestors to be accomplished.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*
- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*
- *Will the results be disseminated broadly to enhance scientific and technological understanding?*

The Woranso-Mille project is involved in training graduate and undergraduate students from Ethiopia and the United States. Undergraduate students from Case Western Reserve University have been participating in the field and laboratory research since 2007 and were trained in faunal identification, curation, preparation, and analysis of fossil specimens. Graduate students from the Addis Ababa University, Case Western Reserve University, and Stanford University have developed their thesis projects based on fossil material from the study area. The project has established a strong collaboration network with local Ethiopian institutions such as Addis Ababa University and the National Museum of Ethiopia and between the Cleveland Museum of Natural History and Case Western Reserve University in the United States. Results of the project have been communicated with the rest of the scientific community and the public at large through publications, lectures, and website positing of field activities (for example, http://www.cmnh.org/site/ResearchandCollections/InTheField.aspx).

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008* *and* *Important Notice 130: Transformative Research*

No

SBE/BCS 2010

Program Officer: Kaye Reed

NSF Award Numbers:

0542037

Award Title:	Geology and Paleontology of the Woranso-Mille, Afar, Ethiopia
Start Date:	05/15/2006
Expires:	04/30/2009
Awarded Amount to Date:	$199,457
PI:	Yohannes Haile-Selassie, yhailese@cmnh.org
Institution Name:	Cleveland Museum of Natural History
State Code:	OH
PE Codes:	1392

NSF Contract Numbers:

Submitted on 02/23/2010 by Kaye Reed
BCS: Approved 02/23/2010 by Mark L. Weiss
SBE: Approved 05/13/2010 by Lisa L. Jones

Nocturnal Primates Provide Clues to the Evolution of Color Vision

Highlight ID: 20671, Version: AC/GPA

Unlike most mammals, primates have highly varied color vision abilities. Even species active primarily at night vary dramatically in how they perceive colors. With NSF support, Ph.D. student Carrie Veilleux with her advisor Dr. E. Christopher Kirk at the University of Texas, are exploring how ecological factors have influenced the evolution of color vision in nocturnal primates by looking for evidence of natural selection acting on the S-opsin gene. This gene codes for the photopigment found in blue-sensitive retinal cone cells, and is critical for color vision. Veilleux's preliminary findings suggest that differences in nocturnal light environments have influenced the evolution of color vision abilities in nocturnal lemurs. Among the sportive lemurs (genus *Lepilemur*), populations from dry forests, which are abundant in ambient blue light, appear to be under natural selection to maintain blue-sensitive color vision. In contrast, the *Lepilemur* from rainforests, which are lacking ambient blue light, have lost selective pressure to maintain blue-sensitive color vision. Surprisingly, however, fork-marked lemurs (genus *Phaner*) from both dry and rainforests share a mutation in the gene which deactivates blue-sensitive cones. This result suggests that, unlike for fruit or leaf-eating primates, color cues may be unimportant for foraging for the gum-eating *Phaner.*

Carrie Veilleux (right) works in the genetics lab at the University of Texas, Austin to understand the distribution of the S-opsin gene in a variety of nocturnal primates. She is training and working with undergraduate, Elissa Ludeman.

Credit: E. Christopher Kirk

Image Provided by: eckirk@mail.utexas.edu

Form 1515

Genetic samples collected by Dr. Edward Louis (Henry Doorly Zoo, Omaha, NE) and Veilleux measured nocturnal ambient light in two lemur habitats in Madagascar, Kirindy Mitea National Park and Ranomafana National Park, to directly link ecological factors with genetic evidence of selection. By examining the influence of ambient light and diet on nocturnal lemur color vision, Veilleux hopes not only to understand the evolution of primate colorblindness, but also to provide a broader framework for identifying the factors responsible for the evolution of different color vision abilities across primates. As such, the results of this project permit better evaluation of competing ecological scenarios of primate origins.

Researchers measured ambient light in forests and more open habitats in which the fork-marked lemur (*Phaner*) lives in Madagascar.

Credit: E. Christopher Kirk

Image Provided by: eckirk@mail.utexas.edu

Form 1515

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Undergraduate Education and Undergraduate Student Research
- Graduate Education and Graduate Student Research
- International Research Experiences for Undergraduate & Graduate Students

What is the intellectual merit of this activity?
It is currently a mystery why many different groups of primates and other mammals have entirely lost their ability to perceive color. Some researchers, assuming nocturnal color vision is irrelevant, have interpreted the retention of color vision in some nocturnal primates as implying the earliest primates were day-active. Veilleux's research instead suggests that the retention of color vision in some nocturnal primates may be related to selective benefits of nocturnal color vision. Furthermore, this research provides a model for exploring effects of habitat and dietary transition on the evolution of unique features of human color vision.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity,*

disability, geographic, etc?)

- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*

Undergraduate student involvement is a priority in this project, providing training in genetic methods to several volunteer research assistants.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008 and Important Notice 130: Transformative Research*

Yes

Yes. Traditionally, color cues were thought to be irrelevant for nocturnal primate and mammal ecology. This research, however, suggests that nocturnal color vision is selectively important for some nocturnal primates. This result requires researchers reevaluate the importance of color vision in nocturnal primate ecology, behavior, and evolution.

SBE/BCS 2010

Program Officer: Kaye Reed

NSF Award Numbers:

0752692

Award Title:	Doctoral Dissertation Improvement: Ecological Correlates of Differential Selection on S Opsin Genes in Nocturnal Primates
Start Date:	05/01/2008
Expires:	04/30/2010
Awarded Amount to Date:	$13,133
PI:	Edward Kirk, eckirk@mail.utexas.edu
Institution Name:	University of Texas at Austin
State Code:	TX
PE Codes:	1392

NSF Contract Numbers:

Submitted on 02/23/2010 by Kaye Reed
BCS: Approved 02/23/2010 by Mark L. Weiss
SBE: Approved 05/06/2010 by Lisa L. Jones

Cognitive Skills in Families with Autism Reveal Clues to Genetic Influences on Language Development

Highlight ID: 20689, Version: AC/GPA

Dr. Molly Losh at the University of North Carolina, Chapel Hill is investigating genetic influence on language development through the lens of autism. Findings to date indicate that a subtle developmental profile of language and mathematical skills in the parents of children with autism may be qualitatively similar to the profile of individuals with autism, providing support for genetic influences on language development and clues to the genetics of autism itself.

Autism is a disability that seriously disrupts the growth of language, cognition, and social functioning. Genetic liability to autism has been shown to manifest as subtle language features among parents and other relatives. However, critical questions remain unanswered concerning which specific developmental language features and trajectories are under genetic influence. To answer these questions, Dr. Losh has capitalized on the unprecedented availability of archived childhood cognitive assessment records from a large cohort of families with a child with autism. Preliminary analyses indicated that, as children, a large portion of these parents showed a significant split between language and math skills. For instance, in third grade, about 70% of parents had overall math scores 20 points or more higher than their overall language scores, a cognitive profile that is qualitatively similar to, though more subtle than, profiles often observed in individuals with autism. Closer examination revealed that in the early years, grammatical ability was a particular weakness. By fifth grade, however, sufficient gains in grammatical skills were made that there was no longer a split between overall language and math scores.

The split between language and math skills among a significant proportion of parents of children with autism, qualitatively similar to that often observed in autism (though much milder in expression), suggests that these characteristics may be genetically meaningful. The project, which involves DNA collection from individuals with autism and their family members, will enhance our understanding of genes and language growth more generally, as well as inform the genetics of autism specifically.

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Diagnostic assessment in which experimenters attempt to elicit reciprocal social behaviors, including eye contact, emotional expression, and conversational interaction, in order to evaluate these key developmental skills that are seriously impaired in autism.

Credit: Molly Losh, University of North Carolina, Chapel Hill

Image Provided by: molly.losh@unc.edu

Researchers collect DNA samples from family members of autistic children.

Credit: Molly Losh, University of North Carolina, Chapel Hill

Image Provided by: molly.losh@unc.edu

Secondary Strategic Outcome Goals: Learning

- Undergraduate Education and Undergraduate Student Research
- Graduate Education and Graduate Student Research

What is the intellectual merit of this activity?

The research is helping us understand the complex process of language development, and will add to our knowledge about genetic influences on language development as well as genetic susceptibility to autism.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*
- *What may be the benefits of the proposed activity to society?*
- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*
- *To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships?*

Broadening participation of under-represented groups: This investigation focuses on families with a child with a developmental disability, namely autism.

Benefits to society: This research will add to our understanding of language development, including language dysfunctions that may run in families. Findings from this study will help to identify genetic and neurobiological underpinnings of autism, and could ultimately inform diagnostic and intervention practices in this serious developmental disablity.

Advancing discovery while promoting teaching, training, and learning: This project will train graduate and undergraduate students in multiple overlapping fields of research (e.g., psychology, linguistics, and genetics).

Enhancing research infrastructure: The project crosses multiple fields of research and involves consultation and data sharing across institutions.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008* *and* *Important Notice 130: Transformative Research*

Yes

The project takes an innovative approach, using a retrospective longitudinal research design that examines parents' elementary school standardized testing records to determine trajectories of language development in domains associated with autism. This unique strategy to link early parental data with the data of children with autism may have a significant impact on the fields of developmental psychology and behavior genetics, as well as on the more specific study of the heritability of language delay within autism spectrum disorders.

SBE/BCS 2010

Program Officer: Amy Sussman

NSF Award Numbers:

0820394

Award Title:	A Multigenerational Longitudinal Study of Language Development: Insight from Autism
Start Date:	09/15/2008
Expires:	08/31/2011
Awarded Amount to Date:	$276,000
PI:	Molly Losh, molly_losh@med.unc.edu
Institution Name:	University of North Carolina at Chapel Hill
State Code:	NC
PE Codes:	1698

NSF Contract Numbers:

Submitted on 02/17/2010 by Kristin E. Kuyuk
BCS: Approved 03/23/2010 by Mark L. Weiss
SBE: Approved 04/27/2010 by Lisa L. Jones

An Interesting Case of Parallel Evolution in Baboons and Humans

Highlight ID: 20697, Version: AC/GPA

Dr. Susan Alberts and former graduate student Dr. Jenny Tung, have identified an intriguing case of parallel evolution between humans and baboons involving resistance to malarial parasites. This work was motivated by the close evolutionary relationship shared between baboons and humans, which are similar not only on the genetic level, but also share key ecological and life history traits.

Do these translate into similarities at the level of how our genes influence differences among individuals? The answer seems to be "yes", at least in the case of resistance to malarial parasites. In

humans, variation in the regulatory region of the *FY* (also called *DARC*) gene affects the likelihood of being infected by *P. vivax* , one of the four human *Plasmodium* parasites. One human variant completely eliminates expression of this gene on red blood cells, and consequently protects its human carriers from this kind of malaria. Although baboons do not suffer from *P. vivax* infection in the wild, they commonly acquire a parasite called *Hepatocystis* , a close relative of *Plasmodium.* Like humans, baboons show variation on the regulatory region of the *FY* gene. Further, Alberts and Tung have shown that the variants in this region influence the amount of *FY* expression on baboon red blood cells, and are also associated with differential susceptibility to *Hepatocystis* . Although the protective effect of the *FY* variant in baboons is not as pronounced as the effect observed in humans (and occurs in a different region of the gene), this result suggests that, over the course of their respective evolutionary histories, baboons and humans have come up with similar ways of dealing with pathogen pressure from these kinds of parasites, adding to the list of resemblances between these two large-bodied, generalist primates.

The baboons from Amboseli, Kenya, whose genes were studied in this research, forage across the plains in search of food. Some of these baboons have a natural immunity to malaria from a mutation in one of their genes, similar to one that some humans also possess.

Credit: Jenny Tung

Image Provided by: jt5@duke.edu

Form 1515

Baboons have both adapted to diverse habitats and, in major aspects of their life histories, have largely escaped from the seasonal constraints of these diverse habitats even in arid regions with high seasonal and interannual variability. This is a combination of traits that they share with humans but with few other primates, making them an interesting model for how environmental and genetic effects combine to influence trait variation in a primate that is, in many fundamental respects, very similar to ourselves. However, we still know relatively little about genetic variation in baboon populations, and even less about how genetic variation affects important traits, such as disease susceptibility and behavioral characteristics. This research addresses that gap by taking advantage of a long-term study of wild baboons in the Amboseli basin of Southern Kenya. Alberts and Tung have been studying the relationship between genetic variation, gene expression, and trait variation in members of this well-studied population.

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Graduate Education and Graduate Student Research
- International Research Experiences for Undergraduate & Graduate Students

What is the intellectual merit of this activity?
Among primates, baboons second only to humans in geographical and environmental range. Furthermore, baboons (like humans and unlike most other primates) are non-seasonal reproducers; females conceive and give birth in any month of the year. In other words, baboons have both adapted to diverse habitats and, in major aspects of their life histories, have largely escaped from the seasonal constraints of these diverse habitats even in arid regions with high seasonal and interannual variability. Thus, as a model for understanding how humans have adapted in similar situtations to disease susceptibility is an intriguing contrast. This research will also support the production of samples and datasets of interest to the larger scientific community. Additionally, it will foster integrative research in the field through using molecular genetic techniques to address anthropological and evolutionary questions.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*
- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*

The research contributes to the ongoing training of three Kenyan field assistants, thus improving understanding of conservation. The work also contributed to the training of the co-PI and undergraduates interested in anthropological research.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008* *and* *Important Notice 130: Transformative Research*

No

SBE/BCS 2010

Program Officer: Kaye Reed

NSF Award Numbers:

0725502

Award Title:	Doctoral Dissertation Improvement: Genetic Variation and Gene Expression in Wild Baboons
Start Date:	07/01/2007
Expires:	06/30/2009
Awarded Amount to Date:	$14,996
PI:	Susan Alberts, alberts@duke.edu
Institution Name:	Duke University
State Code:	NC
PE Codes:	1392

NSF Contract Numbers:

Submitted on 02/23/2010 by Kaye Reed
BCS: Approved 02/23/2010 by Mark L. Weiss
SBE: Approved 05/06/2010 by Lisa L. Jones

African Languages Inform Linguistic Theory

Highlight ID: 20714, Version: AC/GPA

With NSF support, the African Anaphor (Afranaph) Project, led by Ken Safir at Rutgers University, is exploring specific patterns in the grammars of African languages and networking with African and Africanist linguists interested in understanding the nature of the human language capacity. The fruits of this research, including grammar sketches, essays, and raw data, are publically available in a large database at http://www.africananaphora.rutgers.edu/ .

The project is elicits highly detailed, subtle data targeted to bear on how linguistic theory should treat specific domains of grammar and forms of linguistic variation. It is particularly attuned to how less studied languages can inform empirical and theoretical questions. Some of the patterns discovered are new and yet to be integrated into linguistic theory.

The database was designed to specifically suit the special needs of language documentation but also allow for data searches and comparisons. Other databases adopt a different strategy, providing more general facts about a wide variety of languages, but offering less detailed information for researchers to investigate more deeply. This project enhances the scientific infrastructure needed to explore language patterns and variations.

Front page of the African Anaphor Project website.

Credit: Web page capture, February 16, 2010.

Image Provided by: epotsdam@nsf.gov

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Research Infrastructure

- Research Resources (minor facilities, infrastructure and instrumentation, field stations, museum collections, etc.)

What is the intellectual merit of this activity?
One of the ways that the project is distinctive is that the data being elicited is highly detailed, subtle, and targeted to bear on how linguistic theory should treat specific domains of grammar and forms of linguistic variation. Other databases adopt a different strategy, providing more general facts about a wide variety of languages, but with much less information that the researcher interested in specifics can follow up on. Since some of the patterns uncovered are new to scholarship and contribute to an understanding of the boundary conditions on what the right theory of human grammar will be, the richness of the data is particularly important for supporting our discoveries. The database has been designed to suit the special needs of language documentation on the one hand but also allows a great deal of flexibility so that new forms of search and comparison can be introduced as an understanding of what is significant increases.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*
- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*

Many of the native speaker consultants being used on the project are African and do not have access to a US-class education system. These speakers are being trained as linguists as they contribute to the project. They are typically early in their careers - quite a few are graduate students - so the Afranaph project provides them contact with the world of international scholarship in their formative years.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008* *and* *Important Notice 130: Transformative Research*

No

SBE/BCS 2010

Program Officer: Eric Potsdam

NSF Award Numbers:

0523102

Award Title:	African Anaphora Project
Start Date:	08/01/2005
Expires:	07/31/2010
Awarded Amount to Date:	$260,155

PI:	Kenneth Safir, safir@ruccs.rutgers.edu
Institution Name:	Rutgers University New Brunswick
State Code:	NJ
PE Codes:	1311

0919086

Award Title:	Uncovering Theoretically Significant Empirical Patterns in the African Languages
Start Date:	10/01/2009
Expires:	09/30/2012
Awarded Amount to Date:	$399,895
PI:	Kenneth Safir, safir@ruccs.rutgers.edu
Institution Name:	Rutgers University New Brunswick
State Code:	NJ
PE Codes:	1311

NSF Contract Numbers:

Submitted on 02/16/2010 by Eric Potsdam
BCS: Approved 03/04/2010 by Amber L. Story
SBE: Approved 05/03/2010 by Lisa L. Jones

Social Explorer Wins

Highlight ID: 20715, Version: AC/GPA

Social Explorer, an NSF-supported online tool for the visual display of demographic information in the United States from 1790 to the present, was named an "Outstanding Reference Source" by the Reference and User Services Association (RUSA), a division of the American Library Association. The award was announced in mid-January 2010. Social Explorer was the only online reference source to receive this prestigious award.

Social Explorer was funded by NSF as part of the National Historic Geographic Information System (NHGIS) project. Awards supporting development of the NHGIS have gone to the University of Minnesota-Twin Cities and to the City University of New York-Queen's College. NHGIS provides free of charge aggregate census data and GIS-compatible boundary files for the United States between 1790 and 2000. Highlights of the NHGIS include: State and county statistical data from 1790-2000; Census tract statistical data from 1910-2000; Historic state and county boundary files (1790-2000) and census tract boundary files (1910-2000); All summary data (at all summary levels, including census blocks), 1970-2000; and County Business Patterns, 1970-2000.

Social Explorer was developed at CUNY-Queens under the leadership of Andrew Beveridge. It provides the capability for users to access contemporary and historic census data and to view it on maps at a variety of geographic levels, including neighborhoods, counties, and states. The site contains a collection of interactive demographic maps that can be viewed, queried, and manipulated on the site. The site was designed to be user-friendly and to allow for easy exploration of census data, to get answers to specific questions, and to provide a way to get a sense of demographic variation over both space and time.

Within days of Social Explorer being designated as a RUSA awardee, the systems utility was demonstrated through its use by the New York Times to provide background material for an article on the diaspora of Haitians who have settled in the U.S. The Haitian community mobilized rapidly to assist Haiti when that nation was struck by a catastrophic earthquake. Whereas the New York Times article included a single map showing the distribution of residents of Haitian ancestry in the New York area, Social Explorer provides users with the capability to create to create customized maps at scales and resolutions of their own choosing which allowed, as demonstrated by Figures 1 and 2.

Primary Strategic Outcome Goal: Research Infrastructure

- Networking and Computational Resources Infrastructure and Services
- Research Resources (minor facilities, infrastructure and instrumentation, field stations, museum collections, etc.)

Secondary Strategic Outcome Goals: Discovery

Figure 1. A map created on Social Explorer showing the distribution of residents of Haitian ancestry in 2000 in the New York City area.

Credit: Social Explorer

Image Provided by:
andrew.beveridge@qc.cuny.edu

Figure 2. A larger-scale map created on Social Explorer showing the distribution of residents of Haitian ancestry in 2000 in eastern Queens of New York City and western Nassau County.

Credit: Social Explorer

Image Provided by:
andrew.beveridge@qc.cuny.edu

- Social, Behavioral, and Economic Research

What is the intellectual merit of this activity?
The NHGIS project in general and Social Explorer specifically provides researchers and other users with ready access to U.S. census data from the first census in 1790 to the present, with accurate information regarding the geography of the units reported in each of the censuses. It therefore facilitates a broad range of basic and applied research within, across, and beyond the social and behavioral sciences.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *What may be the benefits of the proposed activity to society?*
- *To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships?*

The NHGIS and Social Explorer provide a valuable research resource, providing rapid access to current and historic census data that have an enormous range of scholarly and practical uses.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008* *and* *Important Notice 130: Transformative Research*

No

SBE/BCS 2010

Program Officer: Thomas Baerwald

NSF Award Numbers:

0647902

Award Title:	Collaborative Research: The National Historical Geographic Information System
Start Date:	04/15/2007
Expires:	03/31/2011
Awarded Amount to Date:	$99,981
PI:	Andrew Beveridge, andy@socialexplorer.com
Institution Name:	CUNY Queens College
State Code:	NY
PE Codes:	1352, 1333, 1331, 1320

0648045

Award Title:	Collaborative Research: The National Historical Geographic Information System
Start Date:	04/15/2007
Expires:	03/31/2011
Awarded Amount to Date:	$1,034,493
PI:	John Adams, adams004@umn.edu
Institution Name:	University of Minnesota-Twin Cities
State Code:	MN
PE Codes:	5209, 1352, 1333, 1331, 1320

NSF Contract Numbers:

Submitted on 02/18/2010 by Thomas J. Baerwald
BCS: Approved 03/01/2010 by Amber L. Story
SBE: Approved 04/29/2010 by Lisa L. Jones

Stress, Physiological Reactivity, and Memory Across Development

Highlight ID: 20723, Version: AC/GPA

Stress affects memory in a myriad of ways, few of which are fully understood. Drs. Jodi Quas and Ilona Yim (University of California, Irvine) take a novel approach to address important questions about the effects of stress on children's memory. They have found that biological and behavioral stress responses differ across age, and stress at the time of the event improves memory whereas stress at the time of remembering hinders memory.

In the research, children (ages 7-15) and adults complete tasks in a laboratory. For some participants, the tasks are challenging "tests" administered by serious interviewers. For others, the tasks are administered by casual interviewers. During the tasks, participants' biological (e.g., hormones) and behavioral (e.g., fidgeting) stress responses are measured. Two weeks later, participants' memory for the tasks is tested. For some, the interview is a "test," and the interviewer behaves seriously. For others, the interviewer behaves casually. Participants' biological and behavioral responses are again measured. These procedures allow the researchers to vary

Supportive, casual interviewer shows a boy how to use the saliva sampling kit to obtain biological

and measure stress at both memory encoding and retrieval.

Preliminary results reveal that stress responses vary with age: younger children often display more nervous behavior but have smaller biological stress responses. Also, stress during the tasks is related to improved memory performance, especially in children; however, stress while trying to remember the tasks is related to poorer performance. These results tentatively suggest first that stress during an event does not automatically lead to poor memory in children; in fact, it may actually help memory. Second, stress while trying to remember an event may lead to poor performance, even if children actually remember the information they are trying to report. More generally, results have important implications for theories linking emotion and cognition across development and for applied questions in legal cases (e.g., witnesses), education (e.g., test taking), and clinical settings (e.g., clients describing traumas).

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals:

What is the intellectual merit of this activity?

The results of this study will add to our understanding of how emotion, specifically stress, interacts with memory processes, and how these interactions change developmentally.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *What may be the benefits of the proposed activity to society?*
- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*

indicators of stress response.

Credit: Jodi Quas & Ilona Yim, University of California, Irvine

Image Provided by: jquas@uci.edu

A girl answers questions posed by serious interviewers.

Credit: Jodi Quas & Ilona Yim, University of California, Irvine

Image Provided by: jquas@uci.edu

Benefits to society: The results of this study have implications for settings in which memory is frequently affected by stress, including legal settings (eyewitness testimony), education (test taking), and clinical settings (therapeutic interventions that ask clients to describe traumas).

Advance discovery while promoting teaching, training, and learning: This project has been training graduate students in research, including data analysis and conference presentations, as well as providing a diverse group of undergraduates with opportunities to learn how to collect data with child and adult participants and code and interpret data.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008* *and* *Important Notice 130: Transformative Research*

No

SBE/BCS 2010

Program Officer: Amy Sussman

NSF Award Numbers:

0721377

Award Title:	Stress, Physiological Reactivity, and Memory Across Development
Start Date:	08/01/2007
Expires:	07/31/2011
Awarded Amount to Date:	$344,543
PI:	Jodi Quas, jquas@uci.edu
Institution Name:	University of California-Irvine
State Code:	CA
PE Codes:	1698

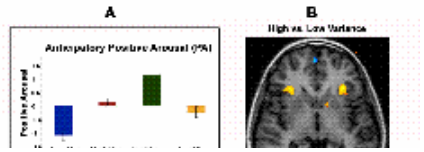
NSF Contract Numbers:

Submitted on 02/17/2010 by Kristin E. Kuyuk
BCS: Approved 02/22/2010 by Mark L. Weiss
SBE: Approved 03/08/2010 by Lisa L. Jones

Anticipatory Affect and Financial Risk Taking

Highlight ID: 20734, Version: AC/GPA

Even though not many have won the lottery or died prematurely, the broad success of casinos and insurance agencies attests to the compelling nature of skewed gambles. Behavioral and neuroimaging studies, however, have not focused on the influence of skewness on financial behavior. Supported by the National Science Foundation, Dr Brian Knutson and graduate student Charlene Wu at Stanford University, in collaboration with finance



expert Dr. Peter Bossaerts of the California Institute of Technology, have carried out an initial characterization of affective and neural reactions to financially skewed gambles (i.e., involving low probability but large magnitude outcomes).

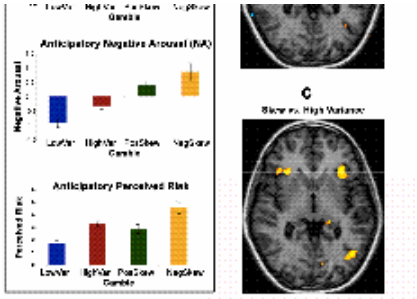
In this research project, participants played gambles that varied in terms of expected reward, risk, and skewness, while undergoing functional magnetic resonance imaging. Controlling for reward and risk, skewed gambles elicited increasingly aroused affect and associated neural activity (i.e., in the insula and striatum), which could account for preferences for positively skewed gambles. A theory of anticipatory affect posits that the magnitude of potential outcomes can induce affect, which promotes approach towards or avoidance of financial risk. In the present study, skewed gambles elicited more anticipatory arousal than high risk gambles, as well as more anterior insular and striatal activation. Positively skewed gambles also elicited more striatal activation than negatively skewed gambles, particularly in subjects who preferred positively skewed to negatively skewed gambles.

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals:

What is the intellectual merit of this activity?
Emotional appeals pervade advertising, marketing, and politics. While some of these appeals convey relevant information about associated products or messages, others feature apparently unrelated items (e.g., a fashion model near a sports car). From the viewpoint of a strictly rational actor, if these unrelated emotional stimuli provide no useful additional information, they should not influence decisions related to the product or message under consideration. Yet, particularly in situations involving minimal reflective processing, incidental emotional stimuli can influence attitudes and even behavior. However, the physiological underpinnings, the timecourse, the specificity, and the limits of this potential influence are not well understood. This project is investigating how emotions that occur during anticipation of outcomes (i.e., "anticipatory affect") influence financial risk taking.



(A) Anticipatory affect and perceived risk by gamble type. Positively skewed gambles elicit greater positive arousal than high risk gambles; while negatively skewed gambles elicit greater negative arousal than high risk gambles. Perceived risk parallels negative arousal to each gamble.

(B and C) Neural activity during anticipation of different gamble types. High versus low risk gambles elicit greater anterior insula and striatal activity, but skewed gambles elicit even greater anterior insula and striatal activity than high risk gambles (n=15, p<.001, uncorrected).

Credit: Brian Knutson

Image Provided by: Brian Knutson [knutson@psych.stanford.edu]

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *What may be the benefits of the proposed activity to society?*

Although traditional theories (e.g., the Efficient Market Hypothesis) posit that financial markets approximate equilibrium, other theories have proposed that collective reactions to skewed events might drive markets to depart from equilibrium. An understanding of the mechanisms by which skewed events influence affect, neural activity, and behavior might help individuals to optimize their financial decisions, and further might inform fiscal policy.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008* *and* *Important Notice 130: Transformative Research*

Yes

Using behavioral testing and brain imagining techniques (functional magnetic resonance imaging), the investigators are testing a model of anticipatory affect that predicts that: (1) positive arousal (e.g., "excitement") promotes risk seeking; (2) negative arousal (e.g., "anxiety") promotes risk aversion; and (3) anticipatory affect has a stronger influence on financial risk taking when cognitive reflection is minimal. If this model is correct, then it will influence a range of fields, including economics, psychology, and cognitive neuroscience.

SBE/BCS 2010

Program Officer: Lynne E. Bernstein

NSF Award Numbers:

0748915

Award Title:	Anticipatory Affect and Financial Risk Taking
Start Date:	07/15/2008
Expires:	06/30/2011
Awarded Amount to Date:	$335,603
PI:	Brian Knutson, knutson@stanford.edu
Institution Name:	Stanford University
State Code:	CA
PE Codes:	1699, 1321

NSF Contract Numbers:

Submitted on 02/19/2010 by Lynne E. Bernstein
BCS: Approved 02/22/2010 by Mark L. Weiss
SBE: Approved 03/08/2010 by Lisa L. Jones

Archaeometric Science in an Undergraduate Context

Highlight ID: 20750, Version: AC/GPA

At the Institute for Integrated Research in Materials, Environments, and Society (IIRMES), California State University Long Beach (CSULB), solutions to archaeometry's facilities and training challenges are being developed. Grants from NSF have played a major role in IIRMES growth. NSF Major Research Instrumentation awards funded purchase of an environmental scanning electron microscope (SEM), two inductively coupled plasma mass spectrometry (ICP-MS) instruments, a light-isotope ratio mass spectrometer, and, most recently, development of instrumentation for a novel archaeometric dating technique based on rehydroxylation of fired ceramics. The NSF Archaeology and Archaeometry Program has also provided laboratory support for interdisciplinary research and training in artifact provenance, dating, and geochemical and isotopic investigations of past environments and human subsistence.

Priscilla Macias (undergraduate geology major, CSULB) and Doug Drake (graduate anthropology major, Washington State University) use the portable XRF spectrometer at IIRMES to analyze obsidian artifacts.

Credit: Hector Neff

Image Provided by: hneff@csulb.edu

Form 1515

For over a half century, progress in archaeology has been driven in significant part by successful adoption and exploitation of measurement techniques developed in the physical and biological sciences. Challenges arising from this strategy include the need to fund acquisition and maintenance of high-tech, costly instruments and the need to train archaeologists, who often have a primarily social science/liberal arts background, to apply the analytical techniques. These challenges are especially acute in undergraduate institutions where faculty members carry heavy teaching loads that limit their laboratory research time and their opportunity to explore new analytical approaches.

Founded in 2005, IIRMES grew out of informal collaborations between geologists, biologists, and archaeologists on the CSULB campus. IIRMES faculty scientists collaborated in securing initial funding for instrument acquisition and maintenance and in interdisciplinary research efforts. Multiple colleges on campus have supported laboratory renovation and a director's salary. The additional support from NSF has allowed students to receive hands-on formal training in instrumental analysis techniques. In addition, students from CSULB, CSU-Fullerton, CSU-Dominguez Hills, and UC-Santa Barbara work as lab assistants alongside IIRMES researchers and visiting scholars from other U.S. and foreign institutions.

Primary Strategic Outcome Goal: Discovery

- Mathematical and Physical Sciences
- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Undergraduate Education and Undergraduate Student Research
- Graduate Education and Graduate Student Research

What is the intellectual merit of this activity?

At the present time the collective impact of these awards rests primarily on their broader impacts.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*
- *To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships?*

These NSF awards have facilitated the development of an innovative teaching and research laboratory at an undergraduate state university. It has provided important student training opportunities and allowed faculty access to instrumentation which would not, normally, be otherwise available.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008* *and* *Important Notice 130: Transformative Research*

No

SBE/BCS 2010

Program Officer: John Yellen

NSF Award Numbers:

0604712

Award Title:	Solid-Sample Inorganic Analysis Facilities for Archaeological Research at IIRMES, CSULB
Start Date:	07/01/2006
Expires:	06/30/2009
Awarded Amount to Date:	$154,256
PI:	Hector Neff, hneff@csulb.edu
Institution Name:	California State University-Long Beach Foundation
State Code:	CA

PE Codes: 1393

NSF Contract Numbers:

Submitted on 03/02/2010 by Kristin E. Kuyuk
BCS: Approved 03/02/2010 by Mark L. Weiss
SBE: Approved 05/03/2010 by Lisa L. Jones

Oldest Dated Rock Art Discovered in Europe

Highlight ID: 20758, Version: AC/GPA

Dr. Randall White (New York University) and an archaeological research team working at the Abri Castanet site in the Dordogne region of Southwest France have discovered and dated the oldest known wall art on earth (32,600 years old). Through a fortuitous circumstance, researchers discovered the art on the undersurface of a one-ton fragment of rock that collapsed from the ceiling of the rock shelter. The Abri Castanet site is associated with the Aurignacian peoples, the first behaviorally modern group to inhabit Europe, representing a geographic end point in the modern human expansion out of Africa. This sample of 'parietal art' (pictures painted or engraved on the walls of European rock shelters and caves) offers an important glimpse into the lives of these prehistoric peoples.

Wall art is often extremely difficult or impossible to date. Unless pigments contain preserved organic binders, radiocarbon dating is not possible and other relevant absolute dating techniques do not exist. This forces archaeologists to rely on superimposition of images or stylistic analyses which can yield relative rather than absolute ages. Although it is possible to determine whether one image is older than another, one cannot anchor the entire sequence in time. At Castanet, however, the geological deposit into which it was incorporated provided the basis for the absolute date.

For modern archaeological science, it is a great advantage that the Aurignacians at Castanet inhabited a previously unoccupied bedrock platform, permitting the research team to document the ways in which its complicated morphology was adapted to the organization of technological, subsistence, and symbolic activities. Archaeologists wish to understand what cultural and social strategies accounted for the Aurignacians' success in rapidly replacing widespread Neanderthal people. The site has yielded a rich assemblage of stone, bone and antler tools, and accompanying fabrication debris as well as dozens of painted and engraved limestone slabs and hundreds of personal ornaments. Recovery of thousands of cultural objects (as small as 1.2 mm in size) and the precise mapping of each object across the site may be as close as one will ever get to a snapshot of an Aurignacian camp site... a kind of paleoethnography. Well-preserved pit hearths at the base of the principal archaeological level seem to have been the focal point of human action and contain rich and diverse cultural débris. The site has more fundamental secrets to yield.

Panoramic view of Abri Castanet (right) and Abri Blanchard (left). The 1995-2009 excavations are situated under the shed-like shelter at right of photo.

Credit: Randall White, Castanet Project

Image Provided by: randall.white@nyu.edu

Form 1515

Details of the undersurface of the engraved, sculpted and red-stained surface of the roof-collapse block excavated in 2007. Bone fragments adhering to this surface have been dated by C14 to 32,600 years ago.

Credit: Randall White, Castanet Project

Image Provided by: randall.white@nyu.edu

Form 1515

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Undergraduate Education and Undergraduate Student Research
- Graduate Education and Graduate Student Research
- International Research Experiences for Undergraduate & Graduate Students

What is the intellectual merit of this activity?

This research is contributing to a rigorous understanding of one of the most important 'moments' in human innovation and change.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*
- *To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships?*

This research project includes students from multiple nations. It provides excellent training and inter-cultural learning situations. The work also furthers US-French scientific cooperation.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008 and Important Notice 130: Transformative Research*

No

SBE/BCS 2010

Program Officer: John Yellen

NSF Award Numbers:

0714049

Award Title:	Site Structure at the Abri Castanet
Start Date:	07/15/2007
Expires:	06/30/2010
Awarded Amount to Date:	$135,431
PI:	Randall White, randall.white@nyu.edu
Institution Name:	New York University
State Code:	NY
PE Codes:	1391

NSF Contract Numbers:

Submitted on 02/23/2010 by Kristin E. Kuyuk
BCS: Approved 02/23/2010 by Mark L. Weiss
SBE: Approved 05/06/2010 by Lisa L. Jones

Prelude to Agriculture in the Near East

Highlight ID: 20762, Version: AC/GPA

Archaeological excavations at Dhra' near the Dead Sea in Jordan have demonstrated that systematic, large-scale food storage actually occurred several thousand years before the domestication of plants (around 11,300-11,175 cal BP). Researcher Ian Kuijt (University of Notre Dame) and his collaborator Bill Finlayson (Council for British Research in the Levant) have uncovered the remains of three distinct types of structures at Dhra. Two structures were used as food processing locations, and the third served as a simple granary. Discovery of these structures challenges previous assumptions that the first food storage occurred in the Near East coincident with plant domestication ca. 9,500 years ago.

The term 'Neolithic Revolution' is used by archaeologists to describe the shift from a hunting and gathering mode of subsistence to the reliance on domesticated plants and animals. This, in fact, did constitute a 'revolution' which fundamentally changed society's relationship to the environment and set the stage for the rise of complex society. Archaeologists have known for decades that the revolution constituted a package which included population increase, larger and more permanent settlements and food storage. However, it has been difficult to sort out the complex linkages between cause and effect to determine which changes occurred first.

People living at Dhra, during the time period around 11,300-11,175 cal BP, termed 'Pre-Pottery Neolithic A' (PPNA), were the first to develop systematic large-scale food storage, which included sophisticated granaries. Designed with suspended floors for air circulation and protection from rodents, storage buildings were located between other residential buildings where people slept and processed foods. The data support recent arguments for the deliberate cultivation of wild cereals at this time. Evidence for PPNA storage complements studies that document pre-domestication cultivation of plants in the Jordan Valley.

Silo excavation at Dhra.

Credit: Ian Kuijt, University of Notre Dame

Image Provided by: ian.kuijt.1@nd.edu

Dhra silo: an artist's reconstruction.

Credit: Ian Kuijt, University of Notre Dame

Image Provided by: ian.kuijt@nd.edu

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Graduate Education and Graduate Student Research
- International Research Experiences for Undergraduate & Graduate Students

What is the intellectual merit of this activity?

This research has provided a more detailed understanding of the development of food production in the Near East by identification of the world's first food storage of grain at 11,500 years ago.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*
- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*
- *Will the results be disseminated broadly to enhance scientific and technological understanding?*

Over five years this project has provided training, mentoring and development for undergraduate and graduate students from multiple countries. As part of this project, the researchers have made it a priority to share the results of excavations

with a wide range of audiences, including local Jordanians, members of the broader research community, and the general public. The research has resulted in several publications.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008 and Important Notice 130: Transformative Research*

Yes

This research uncovered the world's first food storage of grain at 11,500 years ago, 2000 years earlier than previously assumed.

SBE/BCS 2010

Program Officer: John Yellen

NSF Award Numbers:

0207662

Award Title:	Social and Economic Context of Early Neolithic Villages
Start Date:	09/01/2002
Expires:	08/31/2008
Awarded Amount to Date:	$189,231
PI:	Ian Kuijt, Ian.Kuijt.1@nd.edu
Institution Name:	University of Notre Dame
State Code:	IN
PE Codes:	1391

NSF Contract Numbers:

Submitted on 02/26/2010 by Kristin E. Kuyuk
BCS: Approved 02/28/2010 by Mark L. Weiss
SBE: Approved 04/29/2010 by Lisa L. Jones

The Basin of Mexico Prehistory Database

Highlight ID: 20763, Version: AC/GPA

Dr. Kenneth Hirth (Pennsylvania State University) and his students created a database of important archaeological sites in Central Mexico based on data collected in the 1960s and 1970s. The Basin of Mexico, home to the ancient Aztec and Teotihuacan cultures, has long been recognized as a major area of ancient cultural development in the New World. It is one of the few areas where a comprehensive picture of Pre-hispanic civilization is available from the earliest agricultural villages to the rise of the imperial state. Unfortunately, the rapid growth of Mexico City's metropolitan area from 3,000,000 persons in 1950 to 22,000,000 persons today has devastated archaeological sites within the region.

Much that is known about the development of complex society in Central Mexico is derived from field surveys conducted from 1960-1975, before Mexico City grew to its current limits. Mexico City's urban sprawl now covers over 40% of the basin and the cultural preservation office of the National Institute of Anthropology (INAH) in Mexico City estimates that somewhere between 40-50% of all archaeological sites in the Basin have been destroyed. The remainder were severely damaged by modern development.

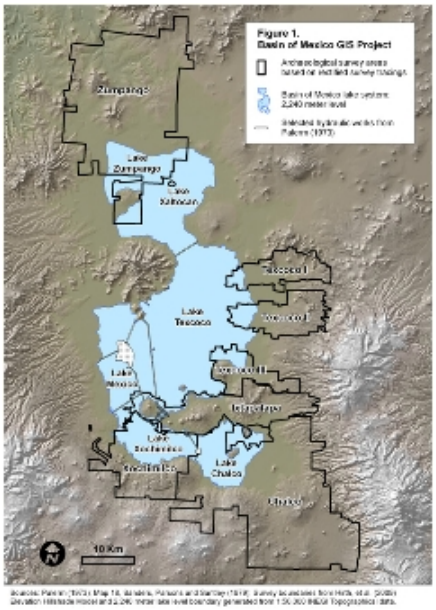
While invaluable, and in line with technological limitations of that time, the data collected in the 1960s and 1970s, were recorded in paper format and are not amenable to powerful analytic techniques. Dr. Hirth and his students retrieved this unique and irreplaceable data and compiled it in a modern Geographical Information System (GIS) which will be accessible to future archaeologists interested in analysis and preservation of prehistoric remains. A total of 2,072 archaeological sites were identified in five survey regions and repositioned on the contemporary landscape. Basic site and archaeological information are now available in summary electronic format at http://www.pop.psu.edu/gia-core/Central_Mexico_GIS. The preparation of GIS materials for the Basin of Mexico will allow the Mexican government to register and protect these archaeological resources more efficiently and effectively.

Primary Strategic Outcome Goal: Discovery

- International
- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Graduate Education and Graduate Student Research

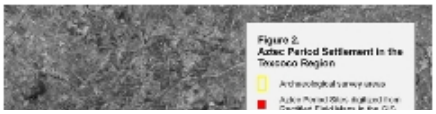


Basin of Mexico study area and the location of the five survey regions that were used to build the GIS database.

Credit: Penn State University, University of Michigan, Penn State University

Image Provided by: kgh2@psu.edu

Form 1515



- International Research Experiences for Undergraduate & Graduate Students

What is the intellectual merit of this activity?

The reformatted information provides an important set of data which can be used by archaeologists to address a wide range of questions. The database has the potential to provide insight into processes which led to the development to state level societies.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships?*

This project is making a significant contribution to international cooperation and preservation of prehistoric cultural resources of Mexico for both scientific and public use.

Does this highlight represent potentially transformative research? *If so, please explain why. For more information, see* *Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008* *and* *Important Notice 130: Transformative Research*

No

SBE/BCS 2010

Program Officer: John Yellen

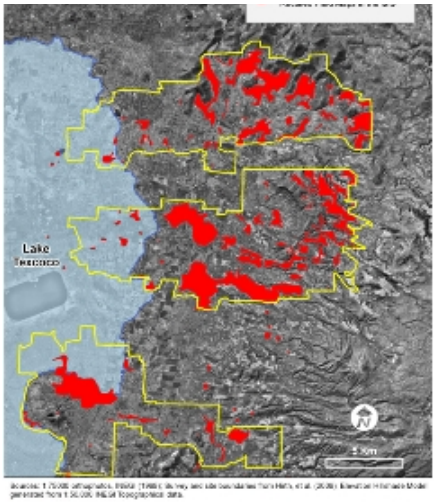
NSF Award Numbers:

0609926

Award Title:	GIS Data Base and Spatial Analysis of the Basin of Mexico
Start Date:	08/01/2006
Expires:	07/31/2009
Awarded Amount to Date:	$156,807
PI:	Kenneth Hirth, Kgh2@psu.edu
Institution Name:	Pennsylvania State Univ University Park
State Code:	PA
PE Codes:	1391

NSF Contract Numbers:

Submitted on 03/02/2010 by Kristin E. Kuyuk
BCS: Approved 03/02/2010 by Mark L. Weiss
SBE: Approved 05/03/2010 by Lisa L. Jones

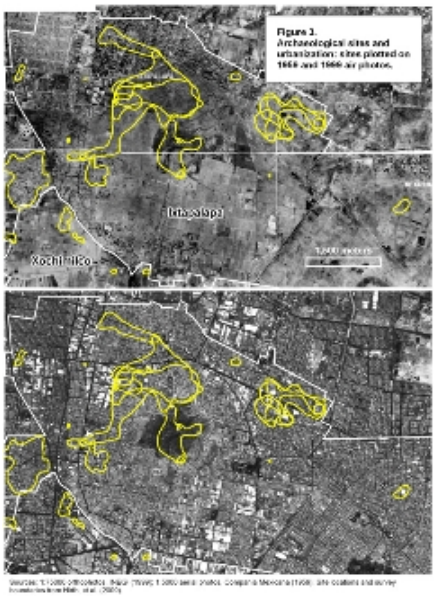


Aztec period settlement pattern in the Texcoco region superimposed on the modern landscape.

Credit: Penn State University, University of Michigan, Penn State University

Image Provided by: kgh2@psu.edu

Form 1515



A section of the Ixtapapalapa and Xochimilco surveys as they were originally recorded and as they exist today. The upper portion of the figure records the locations of archaeological sites on the 1959 aerial photographs used in the original survey. The lower portion of the figure illustrates what the urban landscape looks like today after the sites were repositioned using GIS technology.

Credit: tbdPenn State University, University of Michigan, Penn State University

Image Provided by: kgh2@psu.edu

Form 1515

Mental States Influence Visual Perception

Highlight ID: 20788, Version: AC/GPA

Perceptual experience involves the integration of several senses. When you take a walk, you may feel and see the warm sunshine, or see and hear (and perhaps smell) a barking dog. Research by Satoru Suzuki and Marcia Grabowecky at Northwestern University, together with postdoctoral scholar Emmanuel Guzman-Martinez and graduate students Luci Iordanescu, Eric Smith, and Yee Joon Kim, suggests that this "multisensory" experience profoundly influences what you see.

When looking at yourself in the mirror while shaving or grooming, you are likely to be attending to bodily sensations. In contrast, when showing a photograph of yourself to others, you are likely to be thinking about how others think of you. Through these experiences, visual processing of a mirrored version of your face might be associated with attending to bodily sensations, whereas visual processing of an un-mirrored version of your face, as in a photograph, might be associated with aspects of your social qualities. In fact, when asked to focus on their bodily sensations, people recognized mirrored versions of their face better than un-mirrored versions. When asked to think about their personal strengths and weaknesses, people recognized their un-mirrored face better than a mirrored version. Thus, high level mental states (focusing on your bodily sensations or your social qualities) can influence visual perception in a surprisingly precise manner. What you "see" is a function of an integrated set of information that is much richer than what is available directly to vision itself.

The sounds that items make also influence visual perception. For example, when looking for your lost keys, you may find them faster if you shake another key chain because the jingling sound cross-modally enhances visual processing for detecting key-chain patterns. Similarly, playing gunshot sounds facilitates the visual detection of a gun. This suggests that vigilance performance, such as that needed by airport baggage screeners, may be improved simply by playing characteristic sounds of to-be-detected objects. The integration of information from the various senses enhances detection of objects that are in your field of vision but are unnoticed when only visual information is available.

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals:

What is the intellectual merit of this activity?

This research contributes to the attention literature and provides an integrative understanding of voluntary visual attention abilities as well as insights into the mechanisms of gender differences and ADHD. It underscores the importance of multisensory integration in normal perception.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*
- *What may be the benefits of the proposed activity to society?*
- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*

When looking at yourself in a mirror, you are likely to be alone and attending to your bodily sensations, whereas when looking at yourself in a photograph, you are likely to be with others and thinking about yourself in a social context. These associations influence your visual perception.

Credit: Satoru Suzuki, Department of Psychology and Interdepartmental Neuroscience Program, Northwestern University

Image Provided by: satoru@northwestern.edu

Form 1515

You can find a gun faster when you hear a gun-shot sound. Presenting sounds may aid airport baggage screening.

Credit: Satoru Suzuki, Department of Psychology and Interdepartmental Neuroscience Program, Northwestern University

Image Provided by: satoru@northwestern.edu

Form 1515

This project, and the data stemming from it, contributes to the ability to evaluate results from specific interventions (sleep deprivation, meditation and attention training, video-game playing) or from specific populations (learning disabilities, mild cognitive impairment and normal aging) against our norms. It also suggests that vigilance performance, such as that needed by airport baggage screeners, may be improved simply by providing information from non-visual sources relevant to the objects being sought.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008 and Important Notice 130: Transformative Research*

Yes

This research suggests that the traditional focus on perception via one sensory modality at a time vastly undermines our ability to discover the basis of how we perceive our world. Multisensory integration is the norm, not the exception.

SBE/BCS 2010

Program Officer: Betty Tuller

NSF Award Numbers:

0643191

Award Title: An Integrative Investigation of Visual Attention

Start Date: 05/01/2007

Expires:	04/30/2011
Awarded Amount to Date:	$349,757
PI:	Satoru Suzuki, satoru@northwestern.edu
Institution Name:	Northwestern University
State Code:	IL
PE Codes:	7252

NSF Contract Numbers:

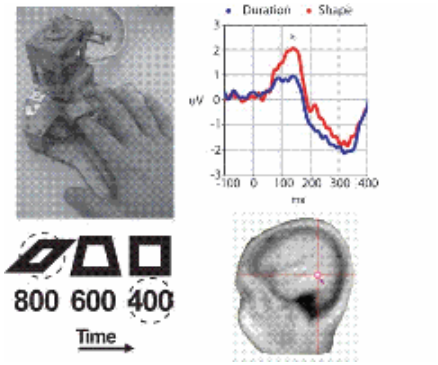
Submitted on 02/18/2010 by Kristin E. Kuyuk
BCS: Approved 02/21/2010 by Mark L. Weiss
SBE: Approved 03/08/2010 by Lisa L. Jones

Vision and Touch can Recruit the Same Cortical Region during Object Recognition

Highlight ID: 20900, Version: AC/GPA

Neuroimaging studies have shown that the area of the cerebral visual cortex long known to be involved in visual object recognition is also activated when objects are recognized by touch. This was surprising, because this area was thought to be involved with vision only. Joshua Lucan, a graduate student at the City University of New York, working with mentors Drs. Sophie Molholm and John Foxe, recently reported that they have pinpointed the timing, with millisecond resolution, of the visual cortical activity arising from touch.

Prior to their study an alternate explanation for activation of visual cortex during touch was that people tend to visualize the objects they feel, after they have recognized them through their somatic faculties. And the visualization-not the touch-was what caused the visual cortex response. Using high-density electroencephalography (EEG) to measure the electrical brain response to the precisely timed presentation of tactile shapes to the fingertip, they found compelling evidence that this so-called visual part of the brain is rapidly activated when objects are recognized by touch. The timing and location of the EEG activity was roughly equivalent to when objects are recognized visually, indicating that this cortical area is important to the perception of objects across both vision and touch. This research highlights the strong interconnectedness of the brain across sensory systems.



A participant rests his hand in a mechanical device developed to lift different tactile shapes to the surface of the index finger for fixed amounts of time. Three shapes were presented for for three different durations (numbers are in milliseconds) in random order. In alternating blocks participants made a button response to either a target shape (the parallelogram) or a target duration (400 ms). That is, participants were directed to either attend to the shape of the object or the length of time it contacted their finger. Data show the electrical brain response to the square presented for 600 ms. The red trace was produced when participants were attending to the target shape, and the blue trace was produced when the participants were attending to the target duration. Differences were significant. The added signal in the red trace was well explained by activity generated from the lateral occipital complex (pictured), a visual cortical region involved with the recognition of objects.

Credit: John Foxe

Image Provided by: Foxe, John [Foxe@NKI.RFMH.ORG]

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Graduate Education and Graduate Student Research

What is the intellectual merit of this activity?

This research is helping to demonstrate that the classical view of the brain's sensory-perceptual pathways is not adequate. Brain areas that were thought to be specialized for only a single type of sensory input can in fact process inputs from other sensory systems.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *What may be the benefits of the proposed activity to society?*
- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*

Students have gained research expertise working on this project.

The unmasking of multisensory capacities in the brain implies that the brain has resources to recover from injury and developmental disorders.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008 and Important Notice 130: Transformative Research*

Yes

This research demonstrates the strong interconnectedness of the brain across different sensory systems and has major implications for brain plasticity in overcoming injury and developmental disorders.

SBE/BCS 2010

Program Officer: Lynne E. Bernstein

NSF Award Numbers:

0519411

Award Title:	Multisensory Form Processing in Extrastriate Visual Guide
Start Date:	09/15/2005
Expires:	08/31/2009
Awarded Amount to Date:	$187,847
PI:	John Foxe, Foxe@nki.rfmh.org
Institution Name:	CUNY City College
State Code:	NY
PE Codes:	1699

NSF Contract Numbers:

Submitted on 03/08/2010 by Lynne E. Bernstein
BCS: Approved 04/15/2010 by Mark L. Weiss
SBE: Approved 05/10/2010 by Lisa L. Jones

For Human Cooperation, Hierarchy Worse than Diversity

Highlight ID: 20904, Version: AC/GPA

New research funded by the NSF Cultural Anthropology Program sheds light on how ethnic diversity impacts attempts to design sustainable and cooperative societies. In the past, social scientists have argued that ethnic diversity can impede cooperation, whether through misunderstanding or competition. Nations with more ethnic groups tend to be more corrupt and less harmonious than those with fewer. However, ethnography and experiments conducted in South India by University of California (Davis) doctoral student Timothy Waring found that hierarchy, rather diversity itself, is the largest problem.

Waring traveled to the Palani Hills of South India to conduct a series of experiments simulating resource management in rural villages where different caste groups share common resources. In these experiments, participants could choose to behave more and less cooperatively, as they strategized to receive cash payments equivalent to approximately a day's wage. Waring's results revealed that caste hierarchy damages cooperation more than caste diversity alone. Some caste groups in these villages have hereditary privileges, while some are considered "untouchables." Other castes are of equal rank to one another. By conducting treatments in which hierarchically ranked groups were present and experiments in which they were absent, Waring was able to separate the effects of hierarchy and diversity. He found that treatments in which both high and low ranking groups were present had the lowest levels of cooperation.

These results suggest that research findings based simply on correlations between ethnic "diversity," and corruption at a national level may be inflated by a failure to distinguish ethnic hierarchy (intergroup relations characterized by differential power) from simple ethnic diversity. Caste is a special ethnic context, so future work in other regions will be needed to validate the generality of these results.

Waring's findings are particularly significant when placed in the context of other research on cooperation University of California (Davis) lab. In a recent article in the Proceedings of the National Academy of Science, doctoral student Adrian Bell and two faculty members, Dr. Peter J. Richerson and Dr. Richard McElreath, reported on their analysis of genetic and cultural data from many human societies. They found that the social transmission of culture, both within and between groups, was more likely to be associated with large scale cooperation than was simple shared genetics. This finding calls into question claims that Darwinian competition always rules and that people generally seek to promote their own genetic group at the expense of others when it comes to choosing with whom to cooperate. In a third project, McElreath joined other researchers in a project (led by Dr. Jean Ensminger at the California Institute of Technology), that employed ethnography and experiments in diverse human societies to explain how culturally evolved institutions contribute to cross-society variation in cooperation.

Through all of this work, NSF supported research is helping to highlight and clarify the role of socially transmitted beliefs and institutions in encouraging and discouraging sustainable solutions to common resource problems.

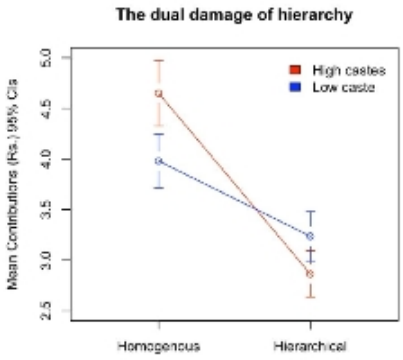
Citations

Bell, A. V., Richerson, P. J., & McElreath, R. (2009). Culture rather than genes provides greater scope for the evolution of large-scale

Land systems in the Palani Hills of Southern India are complex, involving significant investments in irrigation and other shared capital improvements.

Credit: Timothy Waring

Image Provided by: rmcelreath@gmail.com



This graph shows the results obtained in cooperation experiments conducted in rural villages in the Palani Hills of Southern India. The graph indicates that cooperation, measured experimentally by monetary contributions to a shared pot (vertical axis) , are greater when people are working with others of equivalent caste status (horizontal axis: "Homogeneous") than when they are working with others who caste status is higher or lower than their own (horizontal axis: "Hierarchy").

Credit: Timothy Waring

Image Provided by: rmcelreath@gmail.com

human prosociality. Proceedings of the National Academy of Sciences, 106, 17671-17674.

Primary Strategic Outcome Goal: Discovery

- International
- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Graduate Education and Graduate Student Research

What is the intellectual merit of this activity?

Cooperation is a key to successful human sociality. However, the evolutionary basis of cooperation is unclear, because behavior that benefits others can be costly to oneself and one's nearest kin. How could it be selected for evolutionarily? The research being done by these researchers helps us to understand what fosters cooperative behavior and what its costs and benefits are at different levels of social groupings.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *What may be the benefits of the proposed activity to society?*
- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*
- *Will the results be disseminated broadly to enhance scientific and technological understanding?*

Cooperation may or may not be natural to human beings, but it certainly is necessary if we are going to be able to work together to solve the enormous problems that our species faces in the world today. This research will help us understand what works and what does not work in promoting cooperative behavior, particularly in the context of competition over natural resources. Funding this research also supported the education of two graduate students.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008* *and* *Important Notice 130: Transformative Research*

Yes

This research will help to change how we understand the evolutionary basis for human cooperation.

SBE/BCS 2010

Program Officer: Deborah Winslow

NSF Award Numbers:

0823416

Award Title:	Doctoral Dissertation Research: Caste, Cooperation, and Irrigation Management in the Western Ghats, Tamil Nadu
Start Date:	09/01/2008
Expires:	02/28/2010
Awarded Amount to Date:	$12,222
PI:	Richard Mcelreath, mcelreath@ucdavis.edu
Institution Name:	University of California-Davis
State Code:	CA
PE Codes:	1390

0823448

Award Title:	Doctoral Dissertation Research: Cultural Variation and Evolution
Start Date:	09/01/2008
Expires:	07/31/2010
Awarded Amount to Date:	$14,990
PI:	Peter Richerson, pjricherson@ucdavis.edu
Institution Name:	University of California-Davis
State Code:	CA
PE Codes:	1390

0136761

Award Title:	The Roots of Human Sociality: An Ethno-Experimental Exploration of the Foundations of Economic Norms in 16 Small-Scale Societies
Start Date:	04/01/2002
Expires:	03/31/2007
Awarded Amount to Date:	$476,050
PI:	Jean Ensminger, jensming@hss.caltech.edu
Institution Name:	California Institute of Technology
State Code:	CA
PE Codes:	1390, 1321, 1320

NSF Contract Numbers:

Submitted on 03/02/2010 by Deborah Winslow
BCS: Approved 03/03/2010 by Mark L. Weiss
SBE: Approved 05/05/2010 by Lisa L. Jones

Using Blur to Affect Perceived Distance and Size

Highlight ID: 20913, Version: AC/GPA

Left panel: A cityscape rendered with no blur appears full-size and far away. Right panel: When the scene is rendered with a small depth of field and large amount of blur, it appears to be a miniature model close to the camera.

Credit: Original city images and GoogleEarth data are copyright Terrametrics, SanBorn, and Google.

Image Provided by: martybanks@berkeley.edu

It is critical for everyday activities - even survival - to be able to estimate the distances to objects. Traditionally, the primary cues used for distance estimation have been considered to be binocularity disparity (the difference between the images that project to each eye), familiar size, and various cues associated with perspective projection. A team at the University of California, Berkeley, consisting of graduate students Robert Held and Emily Cooper and Professors James O'Brien and Martin Banks, have demonstrated that blur in the retinal image also provides powerful information about distance.

In photography, a special lens or filter can be used to add blur to an image, simulating a short depth of field and making a large-scale scene appear close-up and miniaturized. Thus, downtown San Francisco can be made to look like a table-top model (Figure 1). Special-effects photographers have used the opposite approach to make small scenes look large. But photographers have several ways to affect blur that are not available to the human eye. For humans, there is no way to estimate distance from blur alone because a given amount of blur can be produced by many combinations of focal distance and object distance. The Berkeley team reasoned that blur in an image will only affect perceived distance when the pattern of blur is compatible with perspective cues. They presented participants with images in which the blur was completely consistent, mostly consistent, or inconsistent with the relative distance specified by the perspective information. Viewers indicated how distant the center object in the image appeared to be. As predicted, the consistent and mostly consistent blur produced the strongest effects on perceived distance; the inconsistent blur had virtually no effect. Naturally, when the perceived distance was short, the perceived size was small. Thus, blur is a reliable cue for distance and size, but only when combined with other depth information.

These findings help us understand 3D vision; and clearly show that blur is a richer source of information about distance and size than previously realized. The findings are directly relevant to improving computer graphics, photography, and cinematography.

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Undergraduate Education and Undergraduate Student Research
- Graduate Education and Graduate Student Research
- Postdoctoral Education and Fellowships

What is the intellectual merit of this activity?

This research is determining how viewers are able to compensate for incorrect viewing positions when viewing 2D pictures conveying 3D scene information and the conditions in which compensation works or fails. The identification of blur as an important element of perception is extremely novel.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *What may be the benefits of the proposed activity to society?*
- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*
- *Will the results be disseminated broadly to enhance scientific and technological understanding?*

Undergraduate, graduate, and post-graduate students have been involved in this work, numerous publications and presentations have been given by the students and PIs. Outreach efforts have included discussion with several companies within various industries to discuss the importance of blur to the design, presentation, and evaluation of visual information presented on displays to single or multiple viewers. The work is relevant to a large number of academic and applied disciplines including perceptual psychology, vision science, photography, computer graphics, cinematography, and art.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008* *and* *Important Notice 130: Transformative Research*

Yes

Traditionally, the primary cues used for distance estimation have been considered to be binocularity disparity, familiar size, and various cues associated with perspective projection. The fact that blur is part of the set of variables that determine perceived size and distance has far reaching implications for understanding human visual perception.

SBE/BCS 2010

Program Officer: Betty Tuller

NSF Award Numbers:

0617701

Award Title:	Psychophysics of Picture Perception
Start Date:	09/15/2006
Expires:	08/31/2010
Awarded Amount to Date:	$343,791
PI:	Martin Banks, martybanks@berkeley.edu
Institution Name:	University of California-Berkeley
State Code:	CA
PE Codes:	7252

NSF Contract Numbers:

Submitted on 02/23/2010 by Kristin E. Kuyuk
BCS: Approved 03/01/2010 by Amber L. Story
SBE: Approved 04/29/2010 by Lisa L. Jones

Understanding the Puzzle of Low Fertility in Italy

Highlight ID: 20923, Version: AC/GPA

NSF-funded researchers have been conducting research on why Italy today has one of the world's lowest fertility rates. The international and interdisciplinary team, led by David Kertzer (Brown University) discovered that the usual explanations, which focus primarily on economic factors, cannot fully account for why the average Italian woman can expect to have only 1.3 children, compared to 2.1 for American women and over 7 for women in some African nations. Instead, cultural factors and regional variation within Italy must also be brought into the analysis.

It is generally accepted that fertility is inversely related to female employment: the more women work outside the home, the fewer children they have. But Italy has both lower female labor force participation, and lower fertility rates than many other European countries. Furthermore, while Italians clearly are managing childbirth, they continue to use socially approved but less effective traditional contraceptive methods. The project's qualitative data come from the team's four intensive ethnographic investigations into the culture of family and reproductive decision-making, carried out in four very different Italian cities, two in the north (Bologna and Padua) and two in the south (Naples and Cagliari). The ethnographic data indicate that fertility goals and outcomes are intertwined with regional differences in gender norms, class ethics, and family ties, unrelated to economic variation, but rooted in social networks, availability of public services, kin support, and, especially, sociocultural norms regarding family building. Conventional factors, such as labor force participation, are important, but only in context with cultural and ideological considerations.

Primary Strategic Outcome Goal: Discovery

- International
- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

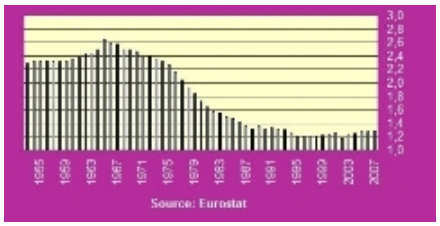
- Graduate Education and Graduate Student Research

What is the intellectual merit of this activity?
The research is methodologically innovative in its mixed methods approach to socio-demographic analysis. It also reveals how national trends can mask significant local variability that may hold the key to truly understanding the significance of those trends.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *What may be the benefits of the proposed activity to society?*
- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*
- *Will the results be disseminated broadly to enhance scientific and technological understanding?*

Understanding the determinants of population growth and decline is a key component of planning for a more sustainable world. The researchers have published widely in key scientific journals, in the



Sharply Declining Fertility Rates in Italy, 1955-2007

Credit: Eurostat

Image Provided by: David_Kertzer@brown.edu

Father and Child in Padova, Italy

Credit: Maya Judd

Image Provided by: David_Kertzer@brown.edu

Padova, Italy, is one of four sites where NSF-funded researchers investigated the causes

United States and in Italy. Funding this research also promoted teaching, training, and learning by supporting the education of a graduate student and further training for several junior scholars.

NSF-funded researchers investigated the causes of Italy's unusually low fertility rates.

Credit: Maya Judd

Image Provided by: David_Kertzer@brown.edu

Does this highlight represent potentially transformative research? *If so, please explain why. For more information, see Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008 and Important Notice 130: Transformative Research*

Yes

By bringing together both large quantitative data sets and intensive local studies, the researchers are creating tools that integrate cultural and economic perspectives.

SBE/BCS 2010

Program Officer: Deborah Winslow

NSF Award Numbers:

0418443

Award Title:	Explaining Very Low Fertility
Start Date:	10/01/2004
Expires:	03/31/2008
Awarded Amount to Date:	$258,490
PI:	David Kertzer, David_Kertzer@brown.edu
Institution Name:	Brown University
State Code:	RI
PE Codes:	1390, 1331

NSF Contract Numbers:

Submitted on 02/24/2010 by Deborah Winslow
BCS: Approved 03/01/2010 by Mark L. Weiss
SBE: Approved 05/05/2010 by Lisa L. Jones

Gratitude and Paying it Forward

Highlight ID: 20945, Version: AC/GPA

A team of researchers, led by David DeSteno (Northeastern University), has found that emotions, thought to aid humans in meeting adaptive challenges, play an important role in fostering honest exchange and cooperative social living. For example, in economic exchanges, people are often guided by rational self-interest to maximize their own gains in the absence of direct costs for not cooperating. However, this work reveals that gratitude, a moral sentiment that functions as a feeling of thankful appreciation, enhances cooperative economic outcomes.

The research team conducted an experiment to understand how gratitude leads to cooperative as opposed to self-interested action. First, in a laboratory setting, research participants either received assistance with a problem that was staged by the experimenters (to induce the emotion of gratitude) or encountered no problem. Afterwards, the research participants played a game in which they were given 4 tokens to keep or give. In this game, each token they keep is worth $1 but tokens received from another are worth $2. Rational self-interest is served by keeping all of one's own tokens and hoping for money from the other player, for a possible $12. Optimal cooperation is for each individual to give all $4 to the other player, for a mutual profit of $8 each. However, this strategy opens the possibility of receiving $0 if the other player decides to keep all their tokens.

The researchers found that the experience of gratitude predicts increases in cooperative giving. Indeed, these findings show that gratitude not only causes individuals to give more money in the game, but also that this increased giving occurs irrespective of whether individuals are playing with a person who helped them or with a complete stranger. Consequently, the effects of gratitude cannot be attributed to a reciprocity norm. Rather, gratitude functions to engender a communal orientation, thereby increasing upstream reciprocity or "paying it forward."

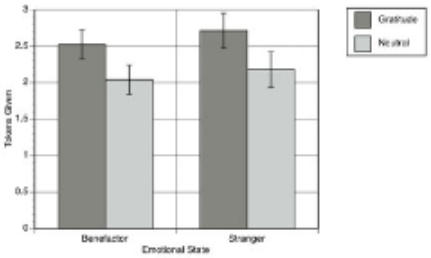
Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals:

What is the intellectual merit of this activity?

This work argues strongly against the view that emotions always



Number of dollar tokens given to another individual in expectation of reciprocation as a function of the presence or absence of gratitude. Note that gratitude leads to increased giving even when interacting with a complete stranger (as opposed to solely with a benefactor to whom one feels grateful).

Credit: David DeSteno

Image Provided by: d.desteno@gmail.com

Can I trust you? Gratitude encourages economic

inhibit cooperation in economic decision-making. Contrary to the general view, cooperation need not only occur through tamping down emotional cravings for immediate reward. These findings demonstrate the existence of socially-oriented emotional responses designed to increase social and economic capital.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *What may be the benefits of the proposed activity to society?*
- *Will the results be disseminated broadly to enhance scientific and technological understanding?*

These findings demonstrate the importance of cultivating moral emotional responses (e.g., gratitude) as a strategy to foster cooperation among individuals. Findings from this work have begun to be disseminated in the mass media (e.g., Newsweek).

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008* *and* *Important Notice 130: Transformative Research*

Yes

Most theories of economic decision making posit that emotions always enhance desires for immediate gains. That is, emotions must be tamped down or controlled in order for cooperation to occur. These findings raise important questions for this view. If emotions increase adaptive behavior, then it makes great sense that specific, socially-oriented emotions (e.g., gratitude) should exist that foster cooperative living. These are some of the first findings that demonstrate emotion-guided decision-making aimed at increasing cooperative economic exchange.

SBE/BCS 2010

Program Officer: Kellina Craig-Henderson

NSF Award Numbers:

0645384

Award Title:	Gratitude as Elicitor of Reciprocity and Social Capital
Start Date:	06/01/2007
Expires:	05/31/2011
Awarded Amount to Date:	$339,788
PI:	David DeSteno, d.desteno@gmail.com
Institution Name:	Northeastern University
State Code:	MA
PE Codes:	1332, 1321

NSF Contract Numbers:

Submitted on 02/24/2010 by Kellina Craig-Henderson
BCS: Approved 03/01/2010 by Amber L. Story
SBE: Approved 04/27/2010 by Lisa L. Jones

decisions that favor communal benefit over selfish profit.

Credit: David DeSteno

Image Provided by: d.desteno@gmail.com

U.S. Immigration Policy Resulting in Unintended Consequences in New Orleans

Highlight ID: 20946, Version: AC/GPA

Researchers Anita Drever and Sarah Blue surveyed over 200 Latino workers and with a variety of professionals who work with them in order to gain insight into how the settlement of Latino workers is transforming post-Katrina New Orleans.

Nearly three quarters of the workers they interviewed were undocumented. As a result Drever and Blue not only were able to gather valuable information regarding how this difficult-to-survey population is adapting to life without the rights and privileges accorded to legal residents-but were able to draw clear linkages between the fate of New Orleans' new Latino community and immigration reform at the national level.

Findings indicate that current U.S. immigration policy is having a range of unintended consequences on both communities and immigrants. The research found that undocumented immigrants' inability to open a bank account or draw credit is 1) curtailing reinvestment of their earnings in New Orleans due to obstacles in starting businesses, buying homes and making large purchases; 2)contributing to long-term disability because they cannot draw on savings accounts or credit for major non-emergency medical expenses; and 3)increasing crime rates in communities because theives assume persons who appear Latino are likely to have large amounts of cash on their person or in their home.

Drever and Blue also found that undocumented workers were highly dependent on middlemen/women including 1) subcontractors who were often responsible for bringing workers to New Orleans in the

A New Orleans laundromat typical of where the PIs conducted surveys

Credit: photo by Anita Drever

Image Provided by: adrever@uwyo.edu

Form 1515

first place and frequently arranged housing, transportation, and acquired falsified documents and 2) 'landlords' who would rent an apartment or house, and then sublet the home, for a profit, to undocumented migrants unable to sign a formal lease. The large number of undocumented migrants in post-Katrina New Orleans has meant that these middlemen/women are transforming the local labor and housing market.

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Latino workers painting a hurricane damaged house in New Orleans

Credit: Anita Drever

Image Provided by: adrever@uwyo.edu

Form 1515

Secondary Strategic Outcome Goals:

What is the intellectual merit of this activity?

The scientific literature on Latino migration into areas of the US that have little recent history of foreign-born immigration tends to provide few details regarding the experience of undocumented immigrants. Drever's and Blue's research, by contrast, looks specifically at the challenges faced by undocumented immigrants and the communities where they reside. Drever's and Blue's research also illuminates the labor recruitment system that is at least partially responsible for the recent diversification of Latino settlement patterns in the United States.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*
- *Will the results be disseminated broadly to enhance scientific and technological understanding?*

Drever and Blue have presented their research to community groups in New Orleans, Tennessee, and Illinois and to students at their respective institutions. They have also given interviews to newspaper reporters and local news stations. The results of the research have been published in academic journals and presented at more than ten academic conferences.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008* *and* *Important Notice 130: Transformative Research*

No

SBE/BCS 2010

Program Officer: Ezekiel Kalipeni

NSF Award Numbers:

0723397

Award Title:	Collaborative Research: Latino Labor Migration and the Transformation of Post-Katrina New Orleans
Start Date:	08/01/2007
Expires:	01/31/2009
Awarded Amount to Date:	$41,679
PI:	Anita Drever, adrever@utk.edu
Institution Name:	University of Tennessee Knoxville
State Code:	TN
PE Codes:	1352, 1331

0723398

Award Title:	Collaborative Research: Latino Labor Migration and the Transformation of Post-Katrina New Orleans
Start Date:	08/01/2007
Expires:	07/31/2009
Awarded Amount to Date:	$38,486
PI:	Sarah Blue, sblue@niu.edu
Institution Name:	Northern Illinois University
State Code:	IL
PE Codes:	1352, 1331

NSF Contract Numbers:

Submitted on 02/22/2010 by Ezekiel Kalipeni
BCS: Approved 03/02/2010 by Mark L. Weiss
SBE: Approved 05/03/2010 by Lisa L. Jones

Ethics and Geospatial Privacy

Highlight ID: 20950, Version: AC/GPA

Professor Paul Zandbergen from the Department of Geography at the University of New Mexico has found that current technologies that enable the input of locations (x and y coordinates) into online digital mapping systems can compromise individual rights to privacy. This input of coordinate data, called geocoding, is a widely employed technique used by businesses and organizations in both the public and private sector. When locations of individuals and/or households are made public in these online geographic information systems, users can employ a technique called "reverse geocoding" to discover the addresses associated with these coordinates, thereby compromising the privacy of individuals. Recently, a broad suite of techniques designed to preserve geospatial privacy, called "geographic masking," have been developed.

Zanbergen Used a high-resolution of building-level address data that have been geocoded using six different geocoding techniques. Initial findings indicate that the ability to use reverse geocoding to indentify personal information varies greatly with the quality of the originally geocoded data, and that knowledge of the geocoding process used enhances the ability to use reverse geocoding, thereby facilitating breaches in privacy. This study has also shown that the accuracy of free, online geocoders and reverse geocoders has increased, providing widely available hacking tools to those with an internet connection and basic computer skills.

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Graduate Education and Graduate Student Research

What is the intellectual merit of this activity?

This project illustrates the importance of considering ethics and the individual's right to privacy when conducting analysis on geospatial information that is readily available online.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *What may be the benefits of the proposed activity to society?*
- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*
- *Will the results be disseminated broadly to enhance scientific and technological understanding?*

As the use of devices that provide access to real-time, location-based services continues to increase exponentially (e.g., the iPhone), the need for understanding the ethical use of this data as it bears on the user's right to privacy becomes increasingly important. This project is also mentoring a graduate student in data collection (geocoding) and analysis (reverse geocoding,) as well as the ethics of using geospatial data. The results of this work have been published in a relevant refereed journal, and presented at a national conference.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008* *and* *Important Notice 130: Transformative Research*

No

SBE/BCS 2010

Program Officer: Scott Freundschuh

NSF Award Numbers:

0814537

Award Title:	Reverse Geocoding, Geographic Masking, and Geospatial Privacy
Start Date:	09/01/2008
Expires:	02/28/2011
Awarded Amount to Date:	$121,980
PI:	Paul Zandbergen, zandberg@unm.edu
Institution Name:	University of New Mexico
State Code:	NM
PE Codes:	8800, 1352, 1333

NSF Contract Numbers:

Submitted on 02/22/2010 by Scott M. Freundschuh
BCS: Approved 04/15/2010 by Mark L. Weiss
SBE: Approved 05/05/2010 by Lisa L. Jones

Are Tax Incentives a Cost-effective Means of Stimulating State Economic Growth?

Highlight ID: 20951, Version: AC/GPA

Professor Alan Peters of the University of Iowa and Timothy Bartick of Upjohn Institute for Employment Research have created a tax simulation model that shows no association between lower marginal business tax rates and higher state economic growth.

Previous estimates of business taxes' influence on economic growth have relied on broad average tax measures, such as state taxes as a percent of state personal income. However, spatial economic theory indicates that marginal costs, not

average measures, are more meaningful for understanding profit-maximizing investment behavior. This project develops and uses a marginal tax rate, in this case the additional taxes resulting from new business investment in a state, that is derived from a representative firm model that incorporates apportionment formulas, state and local tax incentives, and other features of the state and local tax system. Peters and Bartick modeled the state and local tax law and tax rates for 20 states that had the highest total manufacturing employment for the years 1990, 1992, 1994, 1996, and 1998. Because the marginal business tax measures in this project differ considerably from commonly used measures, this research facilitates a better understanding of the impact of tax incentives for businesses on public revenue. A growing body of research suggests that the relationship between economic growth and business taxes to be small, implying that tax incentives do not stimulate sufficient growth to offset the public revenue losses from the tax incentives. Incentives are good policy, then, only if the public benefits exceed the tax losses. Public economic development officials, on the other hand, continue to believe that incentives not only create jobs but augment revenue. This project helps to refocus the debate on replicable findings about the impact of state and local business taxes on economic growth.

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Undergraduate Education and Undergraduate Student Research
- Graduate Education and Graduate Student Research

What is the intellectual merit of this activity?

This project will foster the development of more robust and replicable economic models that facilitate a better understanding between tax incentives for business and regional economic growth.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*
- *What may be the benefits of the proposed activity to society?*
- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*
- *Will the results be disseminated broadly to enhance scientific and technological understanding?*

In addition to providing compelling models for the regional economic development community, this project mentors two graduate students and two undergraduate students in data collection and analysis. In addition, this project broadens participation of women in research because two of the graduate students and one of the undergraduates are female. The results of this work have been published in relevant refereed journals and presented at a national meeting.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008 and Important Notice 130: Transformative Research*

No

SBE/BCS 2010

Program Officer: Scott Freundschuh

NSF Award Numbers:

0751615

Award Title:	Collaborative Research: The Impact of State and Local Taxes on Growth Using Improved Tax Measures
Start Date:	03/15/2008
Expires:	08/31/2010
Awarded Amount to Date:	$126,301
PI:	Alan Peters, alan-peters@uiowa.edu
Institution Name:	University of Iowa
State Code:	IA
PE Codes:	1352

0751609

Award Title:	Collaborative Research: The Impact of State and Local Taxes on Growth Using Improved Tax Measures
Start Date:	03/15/2008
Expires:	02/28/2010
Awarded Amount to Date:	$37,492
PI:	Timothy Bartik, bartik@upjohn.org
Institution Name:	W E Upjohn Institute for Employment Research
State Code:	MI
PE Codes:	1352

NSF Contract Numbers:

Submitted on 03/03/2010 by Scott M. Freundschuh
BCS: Approved 04/15/2010 by Mark L. Weiss
SBE: Approved 04/29/2010 by Lisa L. Jones

International Conference on Joint Attention

Highlight ID: 20953, Version: AC/GPA

An international, interdisciplinary conference on Joint Attention took place at Bentley College in October 2009. The event, organized by Axel Seemann, Assistant Professor of Philosophy at Bentley, drew over seventy participants from around the globe. The conference brought together researchers in developmental and comparative psychology, philosophy of mind, and social neuroscience, to participate in a wide array of discussions around the issue of joint attention, the capacity of human and possibly other primates to focus on the same object while being mutually aware of sharing this focus. There were fifteen invited and twenty submitted presentations, complemented by a poster session with over thirty contributions.

Photo of the Bentley campus.

Credit: Axel Seemann, Bentley College

Image Provided by: aseemann@bentley.edu

Form 1515

The topic of joint attention is of great relevance to developmental psychologists because of their interest in understanding what enables infants, at around nine months of age, to begin to jointly attend to objects with others. The issue is also important for philosophers because it sheds new light on the mind-body problem and other concerns, while the lively recent discussion about mirror neurons and their role in action understanding has a direct impact on the neuroscience of joint attention. The subject is also of interest in connection with autism research.

The event featured a number of leading experts on joint attention. Many of them presented entirely new experimental data and conceptual work, which will be collected in a book, 'Joint Attention: New Developments', edited by Axel Seemann and published by MIT Press. The aim is to create a compendium of state-of-the-art thinking on joint attention, written in a style that makes it accessible to readers from a wide variety of academic backgrounds. The book is scheduled to appear in early 2011.

Photo of a talk at the Joint Attention conference.

Credit: Axel Seemann, Bentley College

Image Provided by: aseemann@bentley.edu

Form 1515

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Broadening Participation to Improve Workforce Development
- Professional and Career Development

What is the intellectual merit of this activity?

Participating philosophers benefited from exposure to recent empirical work and experimental data presented at the conference, while the psychologists and neuroscientists gained an insight into the conceptual ideas related to joint attention.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*
- *Will the results be disseminated broadly to enhance scientific and technological understanding?*

The conference enabled conversations between a number of disciplines, with scholars from around the world. Students from Bentley College, as well as from other institutions, were in attendance.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008 and Important Notice 130: Transformative Research*

No

SBE/BCS 2010

Program Officer: Betty Tuller

NSF Award Numbers:

0838809

Award Title:	Joint Attention and Intersubjectivity: Developments in Developmental and Comparative Psychology, Cognitive Science, and Philosophy of Mind
Start Date:	01/01/2009
Expires:	12/31/2009
Awarded Amount to Date:	$12,000
PI:	Axel Seemann, aseemann@bentley.edu
Institution Name:	Bentley College
State Code:	MA
PE Codes:	7252

NSF Contract Numbers:

Submitted on 02/22/2010 by Kristin E. Kuyuk
BCS: Approved 03/23/2010 by Mark L. Weiss
SBE: Approved 05/13/2010 by Lisa L. Jones

Staying in the Academic Pipeline: Growing Professionally in an Economic Drought

Highlight ID: 20959, Version: AC/GPA

An NSF-funded series of workshops is aimed at increasing the number of women cognitive scientists and providing them with mentorship, networking opportunities, and career information to minimize attrition. NSF has sponsored several workshops of Women in Cognitive Science (WICS), held as satellite meetings at major professional conferences in Psychology. The most recent meeting was held just prior to the Psychonomic Society meeting in Boston, in November 2009. It focused on "Staying in the Academic Pipeline: Growing Professionally in an Economic Drought." The workshop was attended by approximately 200 people and addressed issues of particular relevance to female junior scholars embarking on their careers in a period of limited resources. Discussion focused on strategies for continuing along the academic trajectory. Discussants were selected to include women and men in both junior and senior positions at their universities. Ideas for future panels were derived from evaluations distributed at the end of the session.

The impact of NSF funding for Women in Cognitive Science has been increasing in recent years. Several other professional societies, including the Association for Psychological Science (APS), the Cognitive Science Society (CSS), and the European Society for Cognitive Science are now interested in similar workshops at their annual meetings, highlighting issues facing women scientists today.

The WICS initiative fosters professional development by distributing specific suggestions and modeling how local discussion about best practices can spread to home institutions with which individuals are affiliated. The WICS membership includes more than 550 members (both female and male) from the U.S. and abroad. Their website includes information on the goals of WICS, a form to apply for membership, a summary of programs and events, and announcements of positions, awards, and available professional opportunities.

Primary Strategic Outcome Goal: Learning

- Broadening Participation to Improve Workforce Development
- Professional and Career Development

Secondary Strategic Outcome Goals: Discovery

- Social, Behavioral, and Economic Research

What is the intellectual merit of this activity?

This initiative is aimed specifically at increasing representation of women in the cognitive sciences with a focus on strategies for maintaining visibility and productivity during current economic realities. The initiative includes assistance with predoctoral, postdoctoral, and early career grant application writing as well as the creation of opportunities to optimize mechanisms to sustain research productivity.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*

This workshop should help women in cognitive science find creative ways to stay visible and to fund new and potentially transformative lines of research.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008 and Important Notice 130: Transformative Research*

No

SBE/BCS 2010

Program Officer: Betty Tuller

NSF Award Numbers:

0939909

Award Title:	Conference proposal: Title: Staying in the Academic Pipeline: Growing Professionally in an Economic Drought
Start Date:	09/01/2009
Expires:	08/31/2010
Awarded Amount to Date:	$39,900
PI:	Laurie Feldman, lf503@albany.edu
Institution Name:	SUNY at Albany
State Code:	NY
PE Codes:	7252

NSF Contract Numbers:

Submitted on 02/23/2010 by Kristin E. Kuyuk
BCS: Approved 03/23/2010 by Mark L. Weiss
SBE: Approved 05/13/2010 by Lisa L. Jones

What makes a firm or a commodity 'Islamic'?

Highlight ID: 20977, Version: AC/GPA

Geographers Banu Gökariksel and Anna Secor (PIs) find that the 'Islamic-ness' of a commodity and the firms that produce it consists less in adherence to an Islamic code of business ethics than in their participation in particular socio-spatial networks.

The production, marketing, and sales of Islamic fashions for women (veiling-fashion) has become a conspicuous part of the Turkish apparel industry in the past thirty years. Its growth has taken place within the wider and highly contested rise of political Islam and the 'Islamicization' of the Turkish economy through Islamic banking, business associations, and consumer culture. Representing both piety and fashion, commodities such as headscarves, overcoats, and other items of women's modest attire play an important role in changing social relations in Turkey and the political debates that surround them.

To what extent is veiling-fashion an Islamic commodity? Gökariksel and Secor's NSF funded research addresses this question using a multi-method research design: a survey of 174 veiling-fashion firms in Turkey, case study interviews with three of these firms, and focus groups and interviews with salespeople, garment workers, and consumers in Istanbul and Konya. Gökariksel and Secor analyzed the various types of data to understand what role Islam plays at different points in the production of veiling-fashion from the perspectives of different actors in the veiling-fashion industry.

One of the findings from this research suggests that veiling-fashion firms engage in a wide range of practices, from using Islamic finance to closing for Friday prayer hour, that have less to do with adherence to religious codes than with the milieu in which they operate. For example, Gökariksel and Secor find that a firm's choice to use Islamic finance is most often *not* made based on Islamic principles such as those forbidding interest, but instead is occasioned by knowing somebody working in such an institution. Further indicating the importance of socio-spatial context, firms located in Konya, a center for Islamic entrepreneurialism, are more likely to use Islamic financing than those located in Istanbul. Veiling-fashion as a commodity participates in a wide set of lateral linkages that together produce particular material and symbolic landscapes in Turkey - including more-or-less Islamic spaces such as the retail environment in Fatih, a conservative district in Istanbul where veiling-fashion outlets are concentrated.

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals:

What is the intellectual merit of this activity?

Findings from this research challenge the generally accepted idea that "Islamic-ness" is best understood in terms of adherence to the moral codes of Islam. Instead, this research shows that the relationship to Islam is more often mediated by social environments and milieus. Practices associated with Islamic economics are adopted partially, pragmatically, and contingently, with socio-spatial networks playing an important role in their diffusion. This finding leads to a different way of understanding the economic and cultural dimensions of the Islamic revival in the Middle East and beyond.

Percentage of firms (N=174) using some Islamic finance (yes) or using no Islamic finance (no) by city

Credit: Map by Jeff Levy, Gyula Pauer Center for Cartography and GIS, University of Kentucky

Image Provided by: ajseco2@email.uky.edu

Armine store front on Fevzipasa Caddesi, Fatih, Istanbul

Credit: Gökar1ksel and Secor

Image Provided by: ajseco2@email.uky.edu

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*
- *What may be the benefits of the proposed activity to society?*
- *Will the results be disseminated broadly to enhance scientific and technological understanding?*

This research outcome demonstrates that veiling-fashion and its producers cannot be taken as inherently and purely Islamic. This study is thus a corrective to reductive portrayals of Islamic movements. Gökar1ksel and Secor see their research as fostering cross-cultural understandings and more nuanced approaches to questions of Islam, economy, and culture.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008 and Important Notice 130: Transformative Research*

No

SBE/BCS 2010

Program Officer: Ezekiel Kalipeni

NSF Award Numbers:

0722825

Award Title:	Collaborative Research: The Veiling-Fashion Industry: Transnational Geographies of Islamism, Capitalism, and Identity
Start Date:	08/01/2007
Expires:	01/31/2011
Awarded Amount to Date:	$98,328
PI:	Anna Secor, aiseco2@pop.uky.edu
Institution Name:	University of Kentucky Research Foundation
State Code:	KY
PE Codes:	1352

NSF Contract Numbers:

Submitted on 02/24/2010 by Ezekiel Kalipeni
BCS: Approved 03/01/2010 by Mark L. Weiss
SBE: Approved 04/29/2010 by Lisa L. Jones

What Kind of Social Networks are Best for Helping People Cope with Natural Disasters?

Highlight ID: 20978, Version: AC/GPA

Researchers supported by the NSF Cultural Anthropology Program have been investigating what kinds of social support best help people to cope with the aftermath of natural disasters. They have discovered that one key variable is the structure of personal networks. Different kinds of network structure have different consequences for post-disaster well-being. Tight or closed networks help people to sustain good mental health (absence of depression and anxiety) when faced with the challenges of post-disaster relocation, but these "everybody-knows-everybody" networks are less helpful to people who do not have to relocate away from imminent or actual disaster.

The research was carried out by Dr. Arthur D. Murphy and Dr. Eric C. Jones (University of North Carolina Greensboro) and Dr. Graham A. Tobin and Dr. Linda M. Whitehead (University of South Florida) in Mexico and Ecuador where residents live near active volcanoes. In the field, the researchers identified four different kinds of network structure (see illustration): (i) closed networks where everybody regularly interacts with everybody else; (ii) extending networks that have relatively closed cores but also ties to other more loosely connected individuals; (iii) subgroup networks with at least two distinct groups that are usually connected; and (iv) sparse networks with low densities and relatively few ties between individuals.

In a Mexican village, the researchers found that people who were part of networks with sub-groups (type iii) had the best mental health. They benefitted from the support of their own group and also from the greater diversity of resources they could tap through the bridging ties with others. In Ecuador, the situation varied by whether or not people had left their village after an eruption. Ecuadorians who were living in a relocation settlement had better mental health if they were part of closed networks (type i). But villagers affected by the volcano but not relocated, were best off with extending types of networks (type ii). Like the Mexican villagers, they seemed to benefit from networks that were not completely closed. Diversity and openness in networks, which has been called "the strength of weak ties," appears to be associated with less stress in moderately stressful situations, but to be inadequate in more extreme settings, where challenges to coping are better met with close-linked ties.

Primary Strategic Outcome Goal: Discovery

- International
- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals:

What is the intellectual merit of this activity?

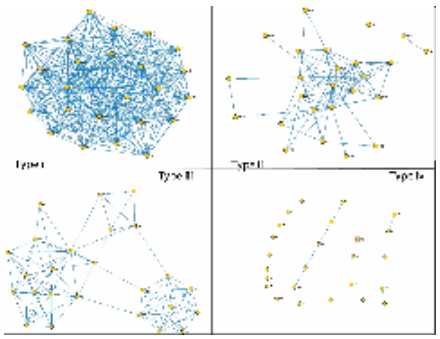
The research is significant in showing the importance of social networks in how people cope with highly stressful situations.

What are the broader impacts of this activity?

Tungurahua Volcano, Ecuador, August 16, 2006. People who live near this active volcano use personal networks to cope with the aftermath of eruption and displacement.

Credit: Graham Tobin

Image Provided by: gtobin@usf.edu



Types of personal networks found among people facing chronic threat from active volcanoes. Which type supports better coping and mental health depends on whether or not people are relocated from their home villages. Type (i): Closed. Type (ii): Extending. Type (iii): Sub-group. Type (iv): Sparse.

Credit: Eric C Jones

Image Provided by: ecojones@uncg.edu

Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *What may be the benefits of the proposed activity to society?*
- *Will the results be disseminated broadly to enhance scientific and technological understanding?*

The research findings have direct application to preparing people for the aftermath of natural disasters. The researchers are making their findings available to both the research community and to policy makers through publication in appropriate journals and presentations in a broad array of venues.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008 and Important Notice 130: Transformative Research*

No

SBE/BCS 2010

Program Officer: Deborah Winslow

NSF Award Numbers:

0620264

Award Title:	Collaborative Research: Social Networks and Mitigation in Areas of Chronic Disasters
Start Date:	08/01/2006
Expires:	05/31/2009
Awarded Amount to Date:	$133,381
PI:	Linda Whiteford, lwhiteford@acad.usf.edu
Institution Name:	University of South Florida
State Code:	FL
PE Codes:	1390

0620213

Award Title:	Collaborative Research: Social Networks and Mitigation in Areas of Chronic Disasters
Start Date:	08/01/2006
Expires:	06/30/2010
Awarded Amount to Date:	$271,741
PI:	Arthur Murphy, admurphy@uncg.edu
Institution Name:	University of North Carolina Greensboro
State Code:	NC
PE Codes:	1390

0751265

Award Title:	Collaborative Research: Social Networks in Chronic Disasters - Exposure, Evacuation, and Resettlement
Start Date:	09/01/2008
Expires:	08/31/2010
Awarded Amount to Date:	$206,333
PI:	Eric Jones, ecjones4@uncg.edu
Institution Name:	University of North Carolina Greensboro
State Code:	NC
PE Codes:	1638, 1390

NSF Contract Numbers:

Submitted on 02/24/2010 by Deborah Winslow
BCS: Approved 03/01/2010 by Mark L. Weiss
SBE: Approved 04/27/2010 by Lisa L. Jones

Those at Risk for Avian Flu in India Seek Medical Aid Outside Official Networks

Highlight ID: 20979, Version: AC/GPA

Dr. Ronald Barrett (Macalester College), with support from NSF, is collaborating with The Centre for Social Studies in Surat, India, to investigate how poor, low-caste laborers perceive and respond to influenza-like illnesses (ILI's). Researchers have discovered that despite their poverty and independent of their health or religious beliefs, the poultry workers in the study community have a strong preference for private biomedical ("western") health care, when they can afford it. These decisions also involve personal support

networks. The significance of these findings is that, although local, private care-providers are well-placed to detect an influenza epidemic at its earliest stages, they are not part of official disease-reporting networks.

In Phase I of the research, investigators collected demographic, economic, and health history data from 134 of 143 households in they study community. Health histories included household members who had been sick with serious illnesses within the previous six months as well as hospitalizations or deaths within the past year. In addition, social network data were obtained concerning the total family ties between households within the community (figure 1). In Phase II, investigators conducted in-depth interviews with a subsample of 40 households that had experienced an ILI or serious illness within the past six months. Interviews included health beliefs regarding influenza-like illnesses in both humans and poultry, specific health seeking decisions, and the nature and role of ego-based social support networks when accessing medical services.

In 2006, this region of India experienced an H5N1 avian influenza epidemic. Because of their proximity to poultry and impoverished living conditions, the low-status residents studied by Barrett and his team represent those who are most at risk for infection should the virus evolve human-to-human transmissibility. Understanding their health seeking patterns is essential for early detection and control of future outbreaks. These findings have applicability for any kind of service provisioning for marginalized populations who may not be part of official networks of surveillance. The research is also significant for its innovative use of social network techniques.

Primary Strategic Outcome Goal: Discovery

- International
- Social, Behavioral, and Economic Research

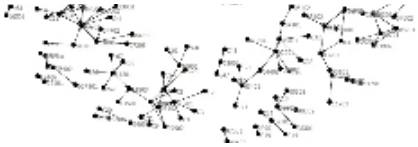


Figure 1: Whole network of inter-household kinship ties in a poor community at high risk for influenza infection.

Credit: Ronald Barrett

Image Provided by: rlbarrett2@gmail.com

Ronald Barrett (Macalester College) and his research team in India.

Credit: Ronald Barrett

Image Provided by: rlbarrett2@gmail.com

Secondary Strategic Outcome Goals:

What is the intellectual merit of this activity?
The research contributes to the development of social network analysis theory, and to understanding decision making under conditions of risk and uncertainty.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*
- *What may be the benefits of the proposed activity to society?*
- *Will the results be disseminated broadly to enhance scientific and technological understanding?*

The researcher is making his findings widely available through professional publicataions and presentations. The research will facilate the provision of services to marginalized but threatened populations.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008* *and* *Important Notice 130: Transformative Research*

No

SBE/BCS 2010

Program Officer: Deborah Winslow

NSF Award Numbers:

0753638

Award Title:	Social Networks among Marginalized Populations at Risk for Avian Influenzas
Start Date:	08/15/2008
Expires:	01/31/2011
Awarded Amount to Date:	$125,378
PI:	Ronald Barrett, rbarrett@macalester.edu
Institution Name:	Emory University
State Code:	GA
PE Codes:	1390

NSF Contract Numbers:

Submitted on 02/24/2010 by Deborah Winslow
BCS: Approved 03/01/2010 by Mark L. Weiss
SBE: Approved 04/29/2010 by Lisa L. Jones

Aging and Attitude Change: Clarifying the Dynamics of Attitude Strength

Highlight ID: 20991, Version: AC/GPA

Penny Visser (University of Chicago) and colleagues have identified a number of social contextual factors that vary with age and contribute to the strength and durability of people's attitudes. As people move from young adulthood into the middle adult years, their attitudes become more rigid and less open to change, and as people transition from middle adulthood to late adulthood, their attitudes become more malleable again.

The researchers noted that midlife is typically characterized by the possession of social power. In the home, in the workplace, and in the community, positions of power are disproportionately occupied by individuals in middle adulthood. In their work, Visser and colleagues have demonstrated that the norms for power holders to be resolute and unyielding translate into greater resistance to change among the powerful, and that the prevalence of powerful social roles during mid-life is partially responsible for the heightened attitude strength observed among this age group.

Similarly, relative to younger and older adults, middle aged adults tend to be embedded within social networks that are large, stable, and quite homogenous, leading Visser and her colleagues to speculate that these stable social forces may serve to cement people's attitudes, increasing their resistance to change. Indeed, initial findings from this program of research show that being embedded in large, attitudinally congruent social networks strengthens peoples' attitudes, rendering them less open to attitude change. These types of social networks, composed of people with similar attitudes, also result in people having more stable attitudes that are more predictive of their behavior.

Rather than simply describing the relation between age and openness to attitude change, this work has begun to elucidate the social and psychological mechanisms responsible for this relation, illuminating the dynamics of age-related changes in thinking, evaluating, and action and enriching our understanding of the psychology of aging. Further, this work has broken new ground by linking openness to change to various features of people's immediate social context, including the roles that they occupy, the social networks in which they are embedded, and their position relative to significant endpoints.

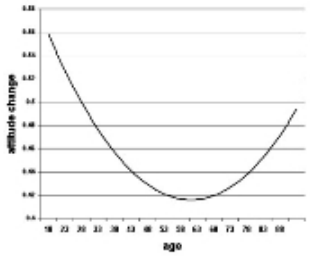


Figure 1: Attitude change across the life span.

Credit: Penny Visser

Image Provided by: pvisser@uchicago.edu

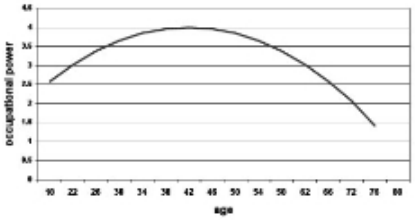


Figure 2: Average level of workplace power across the life span.

Credit: Penny Visser

Image Provided by: pvisser@uchicago.edu

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals:

What is the intellectual merit of this activity?

This work has begun to unravel the mystery of age-related fluctuation in susceptibility to attitude change, and in so doing, it has shed new light more generally on a wide range of social and psychological factors that make some people relatively easy to persuade and others highly resistant to change. Because the hypotheses tested in this line of research address mechanisms at multiple levels of analysis (i.e., biological, cognitive, and social), the findings have helped to expand the scope of attitude change theory in social psychology, yielding valuable new insights into the fundamental nature of attitudes and attitude strength.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *What may be the benefits of the proposed activity to society?*

The broader impacts of this work are many. For example, the major threats to public health today involve not infectious disease but preventable illnesses that can be significantly reduced through behavior modification. Changing behavior often begins with changing attitudes, and a better understanding of the factors that regulate resistance to attitude change provides promoters of public health with new leverage for developing more effective interventions. In particular, understanding the sources of attitude strength at various points along the life span will foster the development of interventions that will be particularly effective for targeted age groups. More generally, given the changing demographics of the U.S. population (with older Americans composing an increasingly large portion of the nation), this work is valuable for its illumination of the dynamics of aging-induced changes in patterns of thinking, evaluating, and action, and for the greater clarity it provides regarding the psychology of aging.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008* *and* *Important Notice 130: Transformative Research*

No

SBE/BCS 2010

Program Officer: Kellina Craig-Henderson

NSF Award Numbers:

0242194

Award Title: Social and Psychological Mechanisms of the Relation between Age and Openness to Attitude change

Start Date:	09/01/2003
Expires:	02/28/2009
Awarded Amount to Date:	$411,925
PI:	Penny Visser, pvisser@uchicago.edu
Institution Name:	University of Chicago
State Code:	IL
PE Codes:	7266, 1332

NSF Contract Numbers:

Submitted on 02/24/2010 by Kellina Craig-Henderson
BCS: Approved 03/01/2010 by Amber L. Story
SBE: Approved 04/29/2010 by Lisa L. Jones

Someone to Lean On: Psychosocial Factors Affect How the Physical World is Perceived

Highlight ID: 21001, Version: AC/GPA

Gerald Clore (University of Virginia) and collaborators, Dennis Proffitt (University of Virginia) and Simone Schnall (University of Plymouth, UK), conducted studies to determine the extent to which spatial perception of the environment is shaped by social and affective factors. They found that psychosocial resources affect perception, and that invasion of personal space influences distance estimates to an object.

Having friends nearby affects perceptions and estimates of unrelated stimuli.

Credit: Abimelec Olan

Image Provided by: Khenders@nsf.gov

Research has shown that geographical slant perception (e.g., the perceived steepness of a hill) is influenced by the physical properties of the perceiver, such as being encumbered or feeling fatigued. Clore's research team found that participants who were encumbered with a heavy backpack estimated a hill to be less steep when they had a friend at their side, compared to participants who were alone. Similarly, participants who thought of a significant other during an imagery task found the hill less steep than participants who either thought of a disliked person or a neutral person. Artifacts such as mood and social desirability did not account for these effects, but the quality of the supportive relationship did. These findings show that psychosocial resources affect how the physical world is perceived.

Additionally, space is a function of social relationships. People maintain an area of personal space around them and are sensitive to violations of this space. An experiment was conducted in which a can of Coke was placed immediately in front of a participant (at a distance of 10-45 cm), either after the experimenter drank from the can (invasion condition), or after the experimenter pulled an unopened can out of a briefcase using the words "this is for you for participating" (control condition). Participants whose space had been invaded with the experimenter's open can, estimated the can to be significantly closer than participants who had their own can within their personal space. Thus, when personal space was invaded another person's object was experienced as "too close."

These findings support the notion that not only physical, but also social properties of the context can influence perception of spatial layout.

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals:

What is the intellectual merit of this activity?

The Intellectual Merit of the proposed research program is two-fold: First, by examining the relationship of affect, cognition and perception the goal is to work toward a comprehensive account of judgment processes that unifies findings from social and cognitive psychology. Second, building on this beginning, an additional outcome of the proposed research is the development of novel measures of implicit attitude.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*
- *Will the results be disseminated broadly to enhance scientific and technological understanding?*

The Broader Impact of the project includes educational experiences for the persons involved in the research, such as for the undergraduate and graduate students working on the project, as well as for research participants (undergraduate students, and participants recruited from the community for the field studies) who will receive detailed information about the research as part of their debriefing after participation. Findings from the project will be broadly disseminated to the public media, because previous research by the investigators involved in the project has attracted considerable attention in the popular press. Findings involving participants' gender, racial and ethnic background will be informative in investigating the extent to which cultural differences in spatial behavior are associated with differences in spatial perception.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008* *and* *Important Notice 130: Transformative Research*

No

SBE/BCS 2010

Program Officer: Kellina Craig-Henderson

NSF Award Numbers:

0518835

Award Title:	Affective Space: Social Influences in Perception
Start Date:	09/01/2005
Expires:	08/31/2009
Awarded Amount to Date:	$574,806
PI:	Gerald Clore, gclore@virginia.edu
Institution Name:	University of Virginia Main Campus
State Code:	VA
PE Codes:	1332

NSF Contract Numbers:

Submitted on 02/24/2010 by Kellina Craig-Henderson
BCS: Approved 03/01/2010 by Amber L. Story
SBE: Approved 04/27/2010 by Lisa L. Jones

Young Children's Causal Inferences Indicate Sophisticated Computational Abilities

Highlight ID: 21004, Version: AC/GPA

Dr. David Sobel of Brown University is conducting research on how children reason about cause and effect. He found children as young as three were able to make causal inferences, and these inferences are consistent with complex algorithms from computer science.

When people make causal inferences, they must combine two pieces of information, knowledge they possess about the situation and the data they observe. Dr. Sobel and his colleagues have proposed that particular algorithms from computer science might help describe this process. In previous work, he showed that these algorithms describe 4-year-old, but not 3-year-old, children's reasoning about a novel causal environment. In the current studies, he examined what may have accounted for such age-related differences. He found differences between 3- and 4-year-olds' understanding of *mechanisms* - the properties of objects that allow those objects to effect change in the world. For example, 4-year-old children recognized that what an object was made of allowed it to activate a machine. To investigate further, Dr. Sobel introduced 3-year-old children to a "blicket machine" (a box that lit up and played music when certain objects were placed on it) or to "Mr. Blicket" (the same box, with cardboard eyes on it, which lit up when the experimenter talked to it and when objects it "liked" were placed on it). Three-year-olds understood the causal consequences of Mr. Blicket's desire, though not of the machine, and seemed to recognize that what Mr. Blicket liked was related to a mechanism. It appears that these children could reason rationally about desires but not about physical properties that they did not understand. The investigator also found that 3-year-olds' causal inferences about desires were consistent with the computational algorithms that motivated this work.

Mr. Blicket, a device used to study young children's causal reasoning.

Credit: David Sobel, Brown University

Image Provided by: sobel@cog.brown.edu

These findings suggest that when they have the relevant background knowledge, children as young as 3 can combine their existing causal knowledge with whatever data they observe to make inferences and learn new pieces of causal information.

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Undergraduate Education and Undergraduate Student Research
- Graduate Education and Graduate Student Research

What is the intellectual merit of this activity?

This project demonstrates that children as young as 3 engage in complex causal reasoning and have a representation of causal knowledge in line with the predictions of a sophisticated computational model (based on Bayesian inference). The work also helps to support a view of cognitive development that suggests children form and revise theories about the world.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*

- *Will the results be disseminated broadly to enhance scientific and technological understanding?*

Advancing discovery while promoting teaching, training, and learning: This project provides training in research in cognitive and developmental psychology for graduate and undergraduate students.

Results disseminated broadly to enhance scientific understanding: In addition to publishing for professional audiences, the investigator maintains a website where results are posted and sends newletters to the families of the children who have participated.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008 and Important Notice 130: Transformative Research*

No

SBE/BCS 2010

Program Officer: Amy Sussman

NSF Award Numbers:

0518161

Award Title:	Children's Causal Learning and Developing Knowledge of Mechanisms
Start Date:	09/01/2005
Expires:	08/31/2010
Awarded Amount to Date:	$276,543
PI:	David Sobel, sobel@cog.brown.edu
Institution Name:	Brown University
State Code:	RI
PE Codes:	1698

NSF Contract Numbers:

Submitted on 02/23/2010 by Kristin E. Kuyuk
BCS: Approved 03/23/2010 by Mark L. Weiss
SBE: Approved 04/29/2010 by Lisa L. Jones

Healing the Racial Divide May Begin with a Touch

Highlight ID: 21012, Version: AC/GPA

A simple touch has a big effect on White's hidden feelings about ethnic minorities.

Credit: Brett Pelham

Image Provided by: bpelham@nsf.gov

Eliot Smith (Indiana University) and colleagues have recently focused on the central role that emotions and social relationships play in the development and maintenance of positive and negative feelings about social groups. This includes both ingroups ("us") and outgroups ("them"). A consistent finding in the past two decades is that most people who express little or no prejudice toward outgroups (e.g., Whites who say they harbor no ill will towards Blacks) show strong evidence that their gut feelings about outgroups are predominantly negative.

These findings suggest that most people harbor more prejudice than they realize. However, recent work by Smith and colleagues shows that something as simple as a touch can reduce implicit racial prejudice. Along with collaborators Charles Seger and Diane Mackie, Eliot Smith recently conducted a series of elegant experiments in which ethnic minority *experimenters* either casually touched or refrained from touching White research participants who filled out implicit measures of prejudice toward the experimenter's ethnic group. A simple touch from the ethnic minority experimenter reduced implicit prejudice toward the experimenter's ethnic group (but not to other ethnic minority groups). Interestingly, this effect was stronger than usual for participants who did not remember being touched. This suggests that something as simple as a touch can temporarily reduce racial prejudice.

This work is consistent with other emerging trends in work on prejudice and intergroup relations. It supports recent work on the "contact hypothesis" suggesting that exposure to the members of another group can reduce a person's conscious and unconscious biases against that group. It is also consistent with additional work from Smith's NSF-funded model emphasizing the crucial role of emotions in intergroup relations.

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals:

What is the intellectual merit of this activity?

The Intergroup Emotions Theory framework has proven theoretically and empirically generative. To date work on this general framework has produced at least 12 peer-reviewed journal articles and 16 book chapters, which have collectively garnered more than 200 citations.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity,*

disability, geographic, etc?)
- *What may be the benefits of the proposed activity to society?*
- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*

The impact of this work can be ameliorative. Ultimately, it provides solutions for how to enhance the quality of intergroup and race relations in society. In addition, Smith and colleagues' experiments not only focus on people's attitudes about underrepresented and/or stigmatized groups, they often employ graduate and undergraduate experimenters who are themselves members of underrepresented groups. Thus, they are not only educating the public about the nature of intergroup relations but also training future generations of scientists, many of whom come from underrepresented groups.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008* *and* *Important Notice 130: Transformative Research*

Yes

Experiments such as these are transformative in that they enrich understanding about the nature of automatic social beliefs. The first step was to show that people's conscious and unconscious beliefs about social groups often diverge. The second round of research is now turning some of these initial insights on their head by showing that rather than being rigidly cast in stone, unconscious beliefs about self and others are dynamic and highly flexible, changing rapidly from one social situation to the next.

SBE/BCS 2010

Program Officer: Brett Pelham

NSF Award Numbers:

0719876

Award Title:	Collaborative Research: Intergroup Emotions Theory: New Strategies for Prejudice Reduction through Categorization and Personal Contact
Start Date:	09/01/2007
Expires:	08/31/2010
Awarded Amount to Date:	$299,992
PI:	Eliot Smith, esmith4@indiana.edu
Institution Name:	Indiana University
State Code:	IN
PE Codes:	1332

NSF Contract Numbers:

Submitted on 03/02/2010 by Brett W. Pelham
BCS: Approved 03/02/2010 by Amber L. Story
SBE: Approved 05/03/2010 by Lisa L. Jones

Time-Sensitive Documentation of Muniche, an Amazonian Language on the Edge of Extinction

Highlight ID: 21013, Version: AC/GPA

Dr. Lev Michael (University of California, Berkeley) and his collaborators collected crucial linguistic data on Muniche, an indigenous language of Peruvian Amazonia on the edge of extinction. The Muniche Language Documentation Project (MLDP) created reference materials for this minimally documented language that will serve both community language revitalization and valorization needs and linguistic research purposes. The MLDP developed and tested methodologies for the rapid documentation of languages in the final stages of language attrition. Involving three rememberers of the language (the most fluent speaker was approximately 90 years old, but had not spoken the language with any regularity since she was 14) and four linguists, the MLDP developed a dictionary, a grammatical sketch, and language-learning materials during two intense months of fieldwork. These materials were completed for the members of the heritage community prior to the departure of the research team, and together with basic audio and textual data collected during fieldwork, they are now serving as the basis for the technical linguistic description of this language.

Data gathered by the MLDP shows that the sound system of the language is considerably more complex than previously thought. It shows types of phonological contrasts that are extremely unusual in Amazonian languages. Muniche also exhibits a typologically rare system of subject marking, whereby the subject appears not in a consistent position with respect to the verb, but appears attached to the end of the first element in the sentence, whatever it may be.

Muniche is not known to be related to any other language, but with the materials and analyses from this project, it will be possible to evaluate previous hypotheses connecting it with the Arawak linguistic family, the largest language family of the Americas.

Primary Strategic Outcome Goal: Discovery

Caption 1

MLDP researcher Stephanie Farmer presents Muniche speaker Donalia Icahuate Baneo with the materials they created together.

Credit: Christine Beier

Image Provided by: levmichael@berkeley.edu

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Graduate Education and Graduate Student Research
- International Research Experiences for Undergraduate & Graduate Students

What is the intellectual merit of this activity?

This project carried out extremely time-sensitive research on a language on the edge of extinction. The documentary materials developed by this project will allow linguists to incorporate this historically important language into accounts of relations of linguistic descent among Amazonian languages and of contact between linguistic communities in Amazonia.

MLDP researchers Gregory Finley and Stephanie listen to a recording of a Muniche conversation

Credit2

Credit: Christine Beier

Image Provided by: levmichael@berkeley.edu

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*
- *To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships?*

By prioritizing the preparation of materials for the heritage community in the context of time-sensitive language documentation, the Muniche Language Documentation Project was able to deliver materials for Muniche language learning by the end of the two month fieldwork period. These materials will be useful for language revitalization and valorization activities in the community school, providing an important link to the community's roots.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008 and Important Notice 130: Transformative Research*

No

SBE/BCS 2010

Program Officer: Susan Penfield

NSF Award Numbers:

0941205

Award Title:	RAPID: Muniche Rapid Documention Project
Start Date:	07/15/2009
Expires:	06/30/2010
Awarded Amount to Date:	$9,998
PI:	Lev Michael, levmichael@berkeley.edu
Institution Name:	University of California-Berkeley
State Code:	CA
PE Codes:	7719

NSF Contract Numbers:

Submitted on 03/03/2010 by Johnny Casana
BCS: Approved 03/03/2010 by Amber L. Story
SBE: Approved 05/03/2010 by Lisa L. Jones

International Young Scientist Network for Aggression Research

Highlight ID: 21015, Version: AC/GPA

With support from the Social Psychology program, Deborah Richardson (Augusta State University) and colleagues of the International Society for Research in Aggression (ISRA) recently integrated a series of activities into the Biennial World Meeting of the International Society for Research on Aggression, the only interdisciplinary and international organization dedicated to the dissemination of information regarding the causes and consequences of, and solutions to, aggressive behavior.

The program they developed was designed to provide a sustained approach to nurturing interdisciplinary appreciation and expertise among young scientists interested in the problems of aggression and violence. The investigators identified promising young graduate and post-doctoral researchers in aggression and provided support for their attendance to the meeting, which was held in Budapest, Hungary. Each of the students participated in a series of activities designed to foster an interdisciplinary awareness of and appreciation for research in aggression. The experience for the young investigators also included a plenary talk by an established scientist working on the cutting edge of interdisciplinary research as

well as a mentoring program coupled with networking opportunities that emphasized interdisciplinary connections for interested young researchers.

Ares, Greek god of war.

Credit: Theoi Project Copyright © 2000 - 2008, Aaron J. Atsma, New Zealand

Image Provided by: Khenders@nsf.gov

Primary Strategic Outcome Goal: Learning

- Graduate Education and Graduate Student Research
- Postdoctoral Education and Fellowships
- International Research Experiences for Undergraduate & Graduate Students
- Professional and Career Development

Secondary Strategic Outcome Goals:

What is the intellectual merit of this activity?

Given the complex and pervasive effects of aggression throughout the world, understanding the causes of aggressive and violent behavior is critical and requires a concerted, interdisciplinary effort. The answer to the problem is not likely to reside in one disciplinary focus but on concentrated interdisciplinary research that recognizes the complexity of the problem. Social psychologists have long taken a lead in seeking the causes and correlates of aggressive behavior; however, researchers in the areas of cognitive, developmental, and biological psychology also have made important advances in our understanding of aggression. These advances have provided a solid foundation for sophisticated, interdisciplinary research.

It is critical that young scientists are encouraged to develop an appreciation of interdisciplinary approaches to aggression and violence, and develop the knowledge that will allow them to conduct or collaborate on interdisciplinary research projects. The activities of this integrative program were designed to stimulate and cultivate a sustained approach to nurturing interdisciplinary appreciation and expertise in agression research among young scientists interested in the problem of violence.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*
- *What may be the benefits of the proposed activity to society?*
- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*

This program has the potential to strengthen and fortify interest in pursuing professional research careers in aggression and violence, as well as direct this inclination toward interdisciplinary research. Student participation in the sponsored activities resulted in creating a small network of young researchers who are now well situated to capitalize on interdisciplinary opportunities in aggression research. This small investment will yield important benefits over the long run, helping to advance understanding of aggression and allowing us to better prevent and control this costly behavior. More immediately, the impact of this program also includes an increase in research linking different disciplinary domains.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008* *and* *Important Notice 130: Transformative Research*

No

SBE/BCS 2010

Program Officer: Kellina Craig-Henderson

NSF Award Numbers:

0749218

Award Title:	Interdisciplinary Young Scientist Network for Aggression Research; Budapest, Hungary; July 2008
Start Date:	09/01/2007
Expires:	02/28/2009
Awarded Amount to Date:	$30,099
PI:	Deborah Richardson, drichardson@aug.edu
Institution Name:	AUGUSTA STATE UNIVERSITY
State Code:	GA
PE Codes:	1332

NSF Contract Numbers:

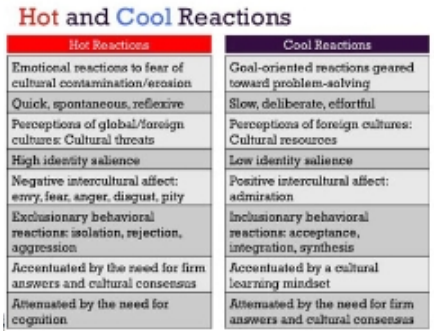
Submitted on 02/24/2010 by Kellina Craig-Henderson
BCS: Approved 03/23/2010 by Mark L. Weiss
SBE: Approved 05/10/2010 by Lisa L. Jones

Globalization Has its Ups and Downs

Highlight ID: 21016, Version: AC/GPA

Chi-Yue Chiu (University of Illinois at Urbana-Champaign) and collaborators conducted cross-cultural research to examine the positive and negative cultural effects of globalization, particularly when people confront icons from their own culture and one or more foreign cultures simultaneously.

Chiu devised a theory of "hot" and "cool" reactions toward globalization (figure 1), wherein the presentation of symbolic representations of two cultures simultaneously causes people to use culture as a way of framing their social perceptions. Hot reactions refer to emotional reactions to fears of cultural contamination and erosion. In contrast, cool reactions are more thoughtful reactions geared toward sharing, learning or problem solving.



Hot and Cool Reactions in a Cultural Context

Credit: Chiu

Image Provided by: cychiu@uiuc.edu

Although anyone is capable of having a hot or cool reaction to information about another culture, Chiu's research has uncovered some important lessons about the likelihood of hot versus cool reactions. First, *both* hot and cool reactions are more likely when people are exposed to information about *two cultures at the same time*. Second, hot reactions are more likely among people who express stronger identification with their own culture. For example, in one recent study, Chinese participants reacted most negatively toward McDonald's when they perceived McDonald's to be a symbol of American culture and when the McDonald's logo was superimposed on a picture of the Great Wall of China. Like other studies, this effect was more pronounced among participants with higher levels of cultural identification.

Chiu and colleagues' experiments have also shown that exposure to multi-cultural information can interact with a person's current goals to influence creativity and problem solving. When the goal of *intercultural learning* was highlighted, joint culture presentation facilitated immediate and delayed creative performance, whereas single presentation of a foreign culture did not. According to these findings, Chiu argues that once culture becomes a central theme in social perceptions following a joint culture presentation, having a multicultural learning mindset encourages individuals to synthesize ideas from seemingly diverse cultures to generate creative ideas.

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals:

What is the intellectual merit of this activity?

Chiu's research on hot and cool reactions to globalization shows that people's responses to globalization vary widely from a beneficial state of accepting, celebrating and benefitting intellectually from exposure to information about multiple cultures to a potentially harmful state of rejecting another culture and defending one's own. Importantly, both individual differences in identification with one's own culture and recent social experiences can determine which reaction people have.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*
- *What may be the benefits of the proposed activity to society?*
- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*

The cross-cultural nature of this research means that Asians and Asian Americans are heavily involved in the research process. Perhaps more important, Chiu's research provides essential insights that could facilitate multi-cultural cooperation and reduce intergroup hostility and misunderstanding. As China emerges as a global superpower, this application of the research will likely increase in importance.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008* *and* *Important Notice 130: Transformative Research*

Yes

Although we all think of ourselves as living in a specific culture, Chiu and colleagues have shown that culture is richer, more flexible, and more dynamic than researchers have previously realized. For instance, the finding that simultaneous exposure to two cultures has a unique effect on how people think and feel suggests that one cannot understand globalization without understanding social identity. Being American, for example, means something different than usual when an American has been thinking about both the U.S. and China.

SBE/BCS 2010

Program Officer: Brett Pelham

NSF Award Numbers:

0743119

Award Title:	Psychological Reactions to Foreign Cultures: Effects of Simultaneous Activation of Cultures
Start Date:	03/01/2008
Expires:	02/28/2011
Awarded Amount to Date:	$314,931
PI:	Chi-Yue Chiu, cychiu@uiuc.edu

Institution Name: University of Illinois at Urbana-Champaign

State Code: IL

PE Codes: 1332

NSF Contract Numbers:

Submitted on 02/24/2010 by Brett W. Pelham
BCS: Approved 03/01/2010 by Amber L. Story
SBE: Approved 05/06/2010 by Lisa L. Jones

Endangered Structures of Endangered Languages: Athabascan Spoken Language Corpora: Ahtna and Navajo

Highlight ID: 21021, Version: AC/GPA

With NSF funding, Dr. Marianne Mithun (University of California, Santa Barbara) is documenting endangered Athabascan languages in Alaska and the American Southwest. The Athabascan languages have tremendous linguistic potential for contributing to our scientific understanding of language. Typologically, they are strikingly different from the better-described languages that have served as the foundation for linguistic theory. There now exist dictionaries for both Ahtna and Navajo, and their basic grammatical structures are generally understood. The missing piece of the picture is how the words and grammar structures are actually used. The documentation of spontaneous speech in natural settings is a crucial step at this point in the history of these languages and in the field of linguistics. This project establishes substantial record of spontaneous connected speech, particularly conversation in natural settings, in two languages indigenous to North America. The targeted languages represent the two major branches of the large Athabascan group. Ahtna, a Northern Athabascan language, is spoken in Alaska, and Navajo, a Southern Athabascan language, is spoken over a wide area in the Southwest. The outcomes are two searchable language corpora, consisting of audio and video recordings and time-aligned transcriptions with translations.

Andrea Berez with speaker Virginia Pete, Tazlina, Alaska.

Credit: Siri Tuttle

Image Provided by: andrea.berez@gmail.com

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Research Infrastructure

- Research Resources (minor facilities, infrastructure and instrumentation, field stations, museum collections, etc.)

What is the intellectual merit of this activity?
Especially critically endangered is the kind of speech to be documented. Unscripted, interactive speech is significantly richer and ultimately more systematic than elicited sentences, sentences constructed out of context, or translations can ever be. The corpora will provide open-ended records of the languages, records that will not become obsolete as theoretical concerns evolve and new questions come to the fore. The documentation will be of a kind often not available from focused questioning, making available the larger contexts in which forms and constructions are used, relative frequencies of speaker choices, the prosodic patterns accompanying grammatical structures, and styles of interaction. Such corpora are crucial to advancing our knowledge about a wide range of issues that are already at the center of current research in linguistics and many more that have not yet come to our attention.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*
- *To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships?*

The project integrates research and education in two ways. The corpora serve as the basis for both scholarly research and language teaching and revitalization. The corpora also serve as the foundation for two doctoral dissertations of graduate students who are participating in the project, one of whom is Navajo. The participation of under-represented groups is at the core of the project. The project outcomes related to the documentation of two languages indigenous to North America, are useful not only for scholars but also for the heritage language communities now and in the future.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008 and Important Notice 130: Transformative Research*

Yes

The collection of unscripted and interactive speech, which will be fully transcribed and presented in time-aligned fashion, is new to the field of language documentation and transformative in the types of comparison and corpora development engaged in for this project.

SBE/BCS 2010

Program Officer: Susan Penfield

NSF Award Numbers:

0853598

Award Title:	Athabascan Spoken Language Corpora: Ahtna (aht) and Navajo (nav)
Start Date:	08/15/2009
Expires:	07/31/2012
Awarded Amount to Date:	$278,144
PI:	Marianne Mithun, mithun@linguistics.ucsb.edu
Institution Name:	University of California-Santa Barbara
State Code:	CA
PE Codes:	5221

NSF Contract Numbers:

Submitted on 02/23/2010 by Johnny Casana
BCS: Approved 03/01/2010 by Mark L. Weiss
SBE: Approved 05/03/2010 by Lisa L. Jones

Sign Talk: Plains Indian Sign Language Fieldwork/Documentary Linguistics Project

Highlight ID: 21022, Version: AC/GPA

With NSF funding, Jeffery Davis (University of Tennessee) and Melanie McKay-Cody (Chickamuauga Cherokee/Choctaw) are leading a linguistic documentation project on Plains Indian Sign Language (PISL). Classified in the Sign Language family, PISL (also called Sign Talk) is distinct from American Sign Language (ASL) that is used in deaf communities of the U.S. and Canada. This historical case of a *signed lingua franca* was unparalleled, spanning a large geographic area and once used among members of more than 40 linguistic and cultural groups of Native North America. Today, PISL is an endangered language due in part to its replacement by English and ASL in some instances.

The project is the first linguistic approach of its kind to study PISL, and focuses on the signing of women and deaf tribal members. PISL is still being used within Native groups in traditional storytelling, rituals, and conversational narratives, which demonstrates the role it continues to serve as an *intertribal signed lingua franca*. Working closely with the most adept signers from these Native communities, linguistic documentation and analyses (lexical and grammatical descriptions) are underway. These findings are being integrated into the project's website/online digital archive of American Indian sign language documentary materials.

Left to Right: James Woodenlegs (Northern Cheyenne, hearing impaired), Melanie McKay-Cody (Cherokee/Choctaw, co-PI, hearing impaired), and Loretha Rising Sun Grinsell (Northern Cheyenne, hearing impaired) during August 2009 documentation of PISL, Busby, Montana.

Credit: Anne Brunelle

Image Provided by: jdavis49@utk.edu

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Graduate Education and Graduate Student Research
- Public Understanding of Science and Lifelong Learning

What is the intellectual merit of this activity?

Preliminary linguistic analyses suggest that PISL is typologically similar to other signed languages--e.g., spatial-grammatical features, verb inflections, and classifier-like constructions. This is an important study, because sign language research contributes significantly to our understanding of the linguistic and cognitive underpinnings of human languages, and PISL is a non-verbal language which has never been studied with scientific rigor.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*
- *To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships?*
- *Will the results be disseminated broadly to enhance scientific and technological understanding?*

These findings are being integrated into the project's website/online digital archive of American Indian sign language documentary materials. This offers dissemination to as broad an audience as possible and contributes to PISL revitalization.

The project is also training Deaf and American Indian students and linguistic students to use emergent technologies for the transcription, translation, and annotation of PISL (e.g., ELAN, Max Planck Institute).

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008 and Important Notice 130: Transformative Research*

No

SBE/BCS 2010

Program Officer: Susan Penfield

NSF Award Numbers:

0853665

Award Title:	EPSCOR: Plains Indian Sign Language: Fieldwork and Digital Archive Project
Start Date:	09/01/2009
Expires:	08/31/2010
Awarded Amount to Date:	$100,365
PI:	Jeffrey Davis, jdavis49@utk.edu
Institution Name:	University of Tennessee Knoxville
State Code:	TN
PE Codes:	9150, 7719, 1545

NSF Contract Numbers:

Submitted on 03/03/2010 by Johnny Casana
BCS: Approved 03/03/2010 by Amber L. Story
SBE: Approved 05/03/2010 by Lisa L. Jones

New Insights on Language Acquisition Among Toddlers

Highlight ID: 21074, Version: AC/GPA

Toddlers may learn more from overhearing our sentences than we think. Professor Cynthia Fisher and graduate students Sylvia Yuan and Rose Scott at the University of Illinois discovered that young children learn grammatical facts about unknown verbs simply from listening to people talk.

In their study, two-year-olds watched short videos that showed two women conversing. Some children watched a video in which one woman said "You know what? Jane blicked the baby!", to which the other replied "Really? She blicked the baby?" Children watching this dialogues could have no idea what it meant to 'blick'. But they could learn from this experience that 'blick' is a transitive verb, one that occurs in sentences with two noun phrases. Other children watched videos in which they encountered the new verb in intransitive sentences, with only one noun phrase ("Jane blicked!" " Really? She blicked?"). Information about transitivity is crucial for figuring out what 'blick' means. Knowing that a verb is transitive tells the child that its meaning involves roles for two participants. In contrast, hearing evidence that a new verb is intransitive tells the child that its meaning requires only one participant-role.

Next, the children heard the verb in isolation ("Find blicking!") while they watched side-by-side videos depicting a one-participant action and a two-participant action. Children's interpretations of the novel verb were guided by their memories of the dialogues. Those who had heard the verb used in transitive sentences looked longer at the two-participant event than those who had heard the verb used in intransitive sentences. This dialogue effect held even when the children were tested a day or two later, which shows children's impressive memory for new information about the grammatical properties of an unknown verb. The findings dramatize children's ability to encode and remember linguistic evidence about new words.

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- K-12 Education
- Graduate Education and Graduate Student Research

What is the intellectual merit of this activity?
The central goals of the research are to understand the basic processes by which all typically developing children become native speakers of languages.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*
- *What may be the benefits of the proposed activity to society?*
- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*

A child identifies the transitive nature of an unknown verb.

Credit: Cynthia Fisher

Image Provided by: cfisher@cyrus.psych.uiuc.edu

Form 1515

Examples of stimuli indicating transitive and non-transitive verbs.

Credit: Cynthia Fisher

Image Provided by: cfisher@cyrus.psych.uiuc.edu

Form 1515

Understanding basic processes of language acquisition is essential for a number of very practical purposes, including the early identification of learning and language problems, and ultimately the development of therapies for these problems. Our research also involves scientific training for a number of graduate students and postdocs in computer science, linguistics, and psychology.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008 and Important Notice 130: Transformative Research*

No

SBE/BCS 2010

Program Officer: Eric Potsdam

NSF Award Numbers:

0620257

Award Title:	Verb Learning and The Early Development of Sentence Comprehension: Experimental and Computational Studies
Start Date:	08/01/2006
Expires:	07/31/2010
Awarded Amount to Date:	$391,357
PI:	Cynthia Fisher, clfishe@uiuc.edu
Institution Name:	University of Illinois at Urbana-Champaign
State Code:	IL
PE Codes:	7252, 1698, 1311

NSF Contract Numbers:

Submitted on 02/24/2010 by Johnny Casana
BCS: Approved 03/03/2010 by Amber L. Story
SBE: Approved 05/03/2010 by Lisa L. Jones

NSF Research on Ancient Human Ancestor Named Science magazine's 2009 'Breakthrough of the Year'

Highlight ID: 21082, Version: AC/GPA

Science magazine's prestigious 'Breakthrough of the Year,' an annual award given for the most significant development in scientific research, recognized for 2009 the NSF-funded work on *Ardipithecus ramidus* . This early hominid has revolutionized and challenged how scientists understand human evolution.

The findings represent over fifteen years of highly collaborative and international research and derive from eight separate awards from the Division of Behavioral and Cognitive Science. *Science* highlighted this research with an unprecedented special feature in the October 12, 2009 issue, where findings related to this fossil were unveiled for the first time in eleven individual scientific papers. These papers not only describe the anatomy and functional significance of the skull, dentition, and skeleton of this fossil, but also detail the geological dating, depositional environments, and its paleoecology.

Ar. ramidus was discovered in the Middle Awash region of Ethiopia, by an international scientific team led by Dr. Tim White (University of California-Berkeley), Dr. Berhane Asfaw (Rift Valley Research Service, Ethiopia), and Dr. Gidday Woldegabriel (Los Alamos National Laboratory, NM). Unfortunately, the fossil was recovered in terrible condition; falling apart whenever anyone would touch it. The researchers spent three field seasons extracting every possible piece from the locality. Then, it took 12 years of painstaking work to put the skeleton together so it could be scientifically analyzed. The fossil is suggested to be a female and has been nicknamed "Ardi." She is significant because she is the oldest known, relatively complete skeleton of a human ancestor, and her anatomy is unexpected as it is not similar to either living African apes or other early hominid fossils as reported by Dr. Owen Lovejoy (Kent State University, OH). She had an opposable toe, and spent time both walking on the ground as well as climbing in trees. Her bones suggest that she walked with a primitive form of bipedalism on the ground, but supported herself on her palms and feet when in the trees. This is surprisingly different from what scientists expected in an ancestral hominid, because prevailing thought predicted that an ancestor would have evidence of either suspensory locomotion or knuckle-walking, similar to living African apes. Dr. Gen Suwa (University of Tokyo, Japan) and other researchers note that upper canine height was reduced compared to chimpanzees and there was no evidence, as there is in apes, of a sharpening mechanism on the lower premolar.

Cover of the AAAS *Science* journal, December 18 2009, depicting Ardiapithecus ramidus. Collective findings from several NSF-funded awards related to this fossil were hailed as the 2009 "breakthrough of the year."

Credit: J. Matternes, AAAS

Image Provided by: science_editors@aaas.org

These findings allow new interpretations of diet and habitat that were perhaps unexpected for this biped. First, research confirms that early bipedalism did not occur because of an adaptation to more open habitats as previously hypothesized by some scientists. The fauna recovered with *Ar. ramidus* indicate that she existed in woodland with forest patches. Second, an omnivore with a slight focus on fruit is indicated through isotopic, enamel thickness, and dental wear analyses. This differs from foods eaten by later hominids, such as Australopithecus afarensis (Lucy) that required heavier chewing due to possible abrasivness or the eating of harder foodstuffs.

These transformative findings have sparked controversy over where *Ar. ramidus* fits in the human family tree, and what it means for our relationship to other primate species. There is, however, unanimous consensus in the field of human evolution that these fossils are among the most important ever discovered.

For further detailed information see:
http://www.aaas.org/news/releases/2009/1001sp_ardi.shtml

Ardipithicus ramidus fossils recovered from the Middle Awash region of Ethiopi, and reconstructed for scientific analysis.

Credit: Tim White

Image Provided by: timwhite@berkeley.edu

Related BCS Awards:

Award ID	PI	Title
8210897	Clark	Paleoanthropological Research in the Middle Awash, Ethiopia
9318698	White	Pliocene Paleontology and Geology of the Middle Awash Valley Ethiopia
9512534	White	Acquistion of Vechicle for Paleontology and Geology Research Middle Awash, Ethiopia
9632389	White	The Mio-Pliocene of the Middle Awash Valley, Ethiopia
9729060	Lovejoy	Description and Analysis of the Ardipithecus Ramidus Postcranium
9727519	Simpson	Microstructural and Development Anatomy of the Dentition of Ardipithecus Ramidus
9910344	White	Field Research in the Middle Awash Valley, Ethiopia
0321893	White	Revealing Hominid Origins

Primary Strategic Outcome Goal: Discovery

- Biology
- Geosciences
- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Undergraduate Education and Undergraduate Student Research
- Graduate Education and Graduate Student Research
- International Research Experiences for Undergraduate & Graduate Students
- Public Understanding of Science and Lifelong Learning

What is the intellectual merit of this activity?

These findings represent the collective effort of over 50 highly qualified researchers, in different fields across 15 separate countries. The results are significant to many disciplines, and have been identified overall as pivotal to the broad discipline of human evolutionary biology.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*
- *What may be the benefits of the proposed activity to society?*
- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*
- *To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships?*

The PIs are diligent about developing research infrastructure and training students from host countries. The collaboration is also presents a research model that can be emulated for other critical periods in human evolution.

Databases contain information that is very important for training and future research and when made publicly accessible, will help to democratize the science.

Finally, the widespread publicity of this work through both the AAAS Science special issue in October 2009, as well as the honor of "Breakthrough of the Year" are significant strides to enhancing public understanding and appreciation of the science.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008* *and* *Important Notice*

130: Transformative Research

Yes

These findings raise questions about, and may contradict longstanding theories about the earliest stages of human evolution. They provide groundbreaking evidence, the discussions of which promise to transform the scientific discourse of human evolutionary biology.

SBE/BCS 2010

Program Officer: Weiss Mark

NSF Award Numbers:

0321893

Award Title:	Revealing Hominid Origins
Start Date:	07/15/2003
Expires:	06/30/2010
Awarded Amount to Date:	$2,514,100
PI:	F. Clark Howell, fchlhes@socrates.berkeley.edu
Institution Name:	University of California-Berkeley
State Code:	CA
PE Codes:	5282
Award Title:	Revealing Hominid Origins
Start Date:	07/15/2003
Expires:	06/30/2010
Awarded Amount to Date:	$2,514,100
PI:	Tim White, timwhite@socrates.berkeley.edu
Institution Name:	University of California-Berkeley
State Code:	CA
PE Codes:	5282

9727519

Award Title:	Microstructural and Developmental Anatomy of the Dentition of Ardipithecus Ramidus
Start Date:	05/01/1998
Expires:	04/30/2002
Awarded Amount to Date:	$88,848
PI:	Scott Simpson, sws3@po.cwru.edu
Institution Name:	Case Western Reserve University
State Code:	OH
PE Codes:	1392

9729060

Award Title:	Description and Analysis of the Ardipithecus Ramidus Postcranium
Start Date:	05/15/1998
Expires:	04/30/2002
Awarded Amount to Date:	$109,118
PI:	C.Owen Lovejoy, olovejoy@aol.com
Institution Name:	Kent State University
State Code:	OH
PE Codes:	1392

NSF Contract Numbers:

Submitted on 02/25/2010 by Johnny Casana
BCS: Approved 02/26/2010 by Mark L. Weiss
SBE: Approved 05/05/2010 by Lisa L. Jones

Babies as Statisticians: Evidence that Infants Engage in Sophisticated Statistical Learning

Highlight ID: 21203, Version: AC/GPA

Multiple lines of research supported by NSF provide converging evidence that a powerful and complex learning mechanism, based on the ability to track statistical probabilities, is present in infancy. Infants learn about their world with amazing rapidity. For example, young children learn language quickly despite the limited and variable input to which they are exposed. They hear the speech from the adults around them and generalize what they've learned to form completely new speech not yet heard. One way to account for such rapid learning is through statistical learning. Infants appear to be readily able to identify patterns in their environment. Statistical learning goes beyond simple associations (e.g., one sound always goes with another sound) to generalize rules by detecting the statistical probability of sequences (e.g., likelihood that certain speech sounds will appear together). Investigations of this sophisticated learning mechanism in infants have expanded greatly in the past decade. Such investigations, many supported by NSF, have demonstrated infants' complex statistical learning in different domains, including language, visual events, and even understanding causality.

A TV monitor displays a video camera image a 9-month-old infant on his father's lap in a sound-proof room during their participation in Dr. Saffran's auditory language study.

Credit: Jenny Saffran

Image Provided by: jsaffran@wisc.edu

One of the great problems infants must solve is how to segment speech streams into meaningful units. Though they hear a fluid stream of speech, they must parse the sounds to determine where words begin and end. Although adults can do this easily in the language with which they are familiar, think about the difficulty of segmenting words when listening to fluent speech in an unfamiliar foreign language. Dr. Saffran [1] examined infants' ability to segment syllables by introducing 8-month-old infants to nonsense words, which were spoken in a particular order but in monotone speech without pauses (e.g., *golabupabikututibugolabu...*). Infants were then exposed to new speech, where some sequences fit the previously heard speech patterns and some did not. If infants recognized, and therefore learned, the speech patterns, they would focus their attention differentially between the speech that fit the pattern and did not fit the pattern. This is exactly what happened, as infants spent more time focusing attention to the parts of the speech that did not fit the pattern (displaying a preference for novelty). Related findings demonstrated that infants treat these statistically-coherent sequences as candidate words, readily mapping them to potential meanings, and can also learn such sequences when they are non-linguistic (e.g., sequences of tones).

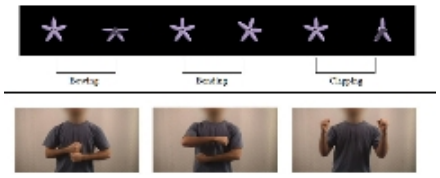
An infant in the lab of Dr. Gomez before testing for language retention. The actiwatch on his left ankle has been measuring his body movements to determine how long the infant slept after the initial learning experience.

Credit: R. Gomez

Image Provided by: rgomez@u.arizona.edu

Form 1515

Dr. Rebecca Gomez [2] has focused her research on the statistical learning of words within a sentence and the role of sleep in consolidating this learning. In this work, researchers played quietly with the 15-month-old infants individually in their homes while a novel, nonsense language played in the background (e.g., "pel-wadim-rud" as a sentence). Four hours later, after some of the infants took naps, infants came to the lab to listen to sentences that either followed the rules of the language or did not, and time spent listening to each was measured. Results indicated that infants who did not sleep learned specific details of the language (specific word dependencies within sentences) but only those who slept abstracted the more general rules of word order in the language, a key role of language learning since learners rarely encounter scenarios that are identical to the ones they have encountered before.



The simple and complex dynamic visual stimuli used in the research of Drs. Hirsh-Pasek and Golinkoff. The first row represents one unit of animated actions, comprised of three different actions. The second row represents one unit of realistic human actions, comprised of three different actions.

Credit: Kathy Hirsh-Pasek

Image Provided by: khirshpa@temple.edu

Speech streams must be segmented at an even more basic level of sound. For example, "dog" and "bog" have different meanings because /d/ and /b/ are meaningfully different sounds -- called phonemes. Because phonemes differ among languages, infants must discover which differences are meaningful in their own language. Dr. Erik Theissen [3] examined whether infants' substantial gains in discovering native phonemes between 12 and 18 months is the result of learning a wide variety of words that provide information about the importance of particular phonemes. In the study, one group of 14-month-old infants learned about a novel object called a "daw" and two additional objects called "dawgoo" and "tawgoo." These infants had the chance to learn that a single phoneme caused the latter two words to refer to different objects. A second group learned about three objects called a "daw," "dawbow," and "tawgoo." These infants had the chance to learn that /d/ and /t/ occur with different words (like "diaper" and "teddy"). Infants were then presented with the "daw" object while paired with the same word "daw" on half the trials and the new label "taw" on the other trials. If the infants learned that the difference between "daw" and "taw" was informative, they should distinguish between correct and incorrect trials (measured by time spent looking at the object while hearing the label). Only those infants who learned "dawbow" and "tawgoo" were successful, suggesting that the distribution of phonemes within words can serve as implicit cues to help infants identify which sounds are informative.

Statistical learning appears to play a role in language production as well as comprehension. Before infants produce words, their babbling begins to incorporate the sound patterns (phonemes) of the language to which they are exposed. To investigate such early speech production, Drs. Michael Goldstein and Jennifer Schwade [4] exposed English-learning 8- to 10-month-old infants to a novel vowel-consonant-vowel (VCV) speech form (e.g., "aga") from the unfamiliar Nigerian

language of Yoruba. (English words contain relatively few such words and the VCV pattern is uncommon in the babbling of infants exposed to English.) After infants' baseline babbling was established, mothers were instructed to respond to their infant's babbling in certain ways with VCV-structured Yoruban words: One group responded with a different word to each instance of infant babbling, a second group responded with the same word each time, and a third group spoke these words on a fixed schedule rather than in response to infant babbling. Only infants in the first group learned to produce the VCV-structured sounds. In fact, infants did not just imitate their mothers; they learned the pattern and generalized by producing new words. This is the first evidence of socially-guided statistical learning in vocal production, indicating that adult feedback must be both contingent on the infant's babbling and contain variable examples of the vocal pattern.

In an effort to examine infants' learning of verbs specifically, Drs. Kathy Hirsh-Pasek [5] and Roberta Golinkoff [6] studied their ability to track statistical probabilities in dynamic visual events. Such tracking would offer infants a potential tool for verb-learning, helping them bind actions together in a sequence. Two studies -- one with simple animated stimuli and one with complex, realistic stimuli -- tested this idea. In both studies, 7- to 9-month-old infants were familiarized to an actor performing actions, with three sets of actions grouped together as units, always appearing together but in varied order. Infants were then shown intact units matching what they had seen and part units (2 unit actions plus a random third action). Infants responded differentially to the intact versus part units, indicating that they had tracked statistical probabilities of the events. In the case of simple stimuli, the infants displayed novelty preference (attending longer to violations of learned probabilities in the part units) but in the case of the more complex, realistic actions, they displayed familiarity preference (attending longer to the intact units). This provided evidence that infants may use statistics to find the boundaries of dynamic events.

Statistical learning of visual events may represent one of the mechanisms behind infants' learning of cause and effect. If two events are causally related, then it is likely that they will co-occur. Dr. David Sobel, [7] in collaboration Dr. Kirkham, presented 5- and 8-month-olds with a sequence of visual events, each event consisting of a moving picture within a particular frame of a display. Initially, these events contained ambiguous causal information: Among a sequence of four events, two events (A and B), which occurred together, reliably predicted a third event (C). Infants were then shown information that disambiguated the sequence--one of those two candidate events alone (B) predicted or did not predict the third event (C). Event A was then presented on the screen, and the investigators examined whether infants believed the C event or another event (D) would occur next by determining the location to which the infants directed their gaze. Eight-month-olds, but not five-month-olds, reliably demonstrated the ability to predict which event caused C: When A and B together predicted C, but B alone did not, they expected C to occur after A; however, when B alone did predict C, they did not expect C to occur after A. Therefore, the 8-month-olds appeared to reason beyond just the simple pattern of association they observed.

These studies, and related research, on infants' statistical learning provide evidence that infants engage in sophisticated computations to track statistical probabilities of sequences. This powerful learning mechanism is involved in a variety of domains, including language (from phonemes to word order), dynamic visual events, and even cause and effect. The work may also help us understand what happens when such learning goes awry, and may have applications for interventions to help children with delayed language acquisition or atypical development more generally.

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[1] NSF Award #9983630, Jenny Saffron, CAREER: Statistical Learning in Language Acquisition

[2] NSF Award #0238584, Rebecca Gomez, CAREER: The trajectory of early learning and its roots in early social interactions

[3] NSF Award #0642415, Erik Thiessen, CAREER: Infants' Statistical Learning of Systems with Multiple Levels of Organization

[4] NSF Award #0844015, Michael Goldstein, Social and Statistical Mechanisms of Prelinguistic Vocal Development

[5] NSF Award #0642529, Kathy Hirsh-Pasek, Collaborative Research: The Path to Verb Learning

[6] NSF Award #0642632, Roberta Golinkoff, Collaborative Research: The Path to Verb Learning

[7] NSF Award #0518161, David Sobel, Children's causal learning and developing knowledge of mechanisms

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Graduate Education and Graduate Student Research
- Postdoctoral Education and Fellowships
- Public Understanding of Science and Lifelong Learning

What is the intellectual merit of this activity?

This research adds to our knowledge of how infants are able to divide up events they experience through various senses (auditory, visual) and determine event boundaries, allowing the infants to rapidly learn about world around them.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *What may be the benefits of the proposed activity to society?*
- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*

Benefits to society: Understanding the learning process can provide knowledge about what happens when learning mechanisms go awry. Such knowledge may inform interventions for children with language delays, social or communication disorders, or other forms of atypical development.

Advancing discovery while promoting teaching, training, and learning: These research projects have provided research training experiences for undergraduate and graduate students in various laboratories around the country.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see*

Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008 and *Important Notice 130: Transformative Research*

Yes

This line of research provides an understanding of the powerful mechanisms involved not only in early language learning, but also in learning more generally, demonstrating complex processes in the minds of infants. The research may serve as a foundation for understanding learning in new domains of knowledge not yet investigated.

SBE/BCS 2010

Program Officer: Amy Sussman

NSF Award Numbers:

0238584

Award Title:	CAREER: The trajectory of early learning and its roots in early social interactions
Start Date:	07/01/2003
Expires:	06/30/2009
Awarded Amount to Date:	$415,485
PI:	Rebecca Gomez, rgomez@u.arizona.edu
Institution Name:	University of Arizona
State Code:	AZ
PE Codes:	1698, 1311

9983630

Award Title:	CAREER: Statistical Learning in Language Acquisition
Start Date:	08/01/2000
Expires:	07/31/2006
Awarded Amount to Date:	$500,000
PI:	Jenny Saffran, jsaffran@wisc.edu
Institution Name:	University of Wisconsin-Madison
State Code:	WI
PE Codes:	1397, 1358, 1311

0642415

Award Title:	CAREER: Infants' Statistical Learning of Systems with Multiple Levels of Organization
Start Date:	08/15/2007
Expires:	07/31/2010
Awarded Amount to Date:	$262,179
PI:	Erik Thiessen, thiessen@andrew.cmu.edu
Institution Name:	Carnegie-Mellon University
State Code:	PA
PE Codes:	7252, 1698

NSF Contract Numbers:

Submitted on 02/26/2010 by Amy Sussman
BCS: Approved 03/02/2010 by Amber L. Story
SBE: Approved 04/29/2010 by Lisa L. Jones

Appalachian English, It Is a-changin'

Highlight ID: 21282, Version: AC/GPA

Professor Kirk Hazen and a team of undergraduate and graduate research assistants from West Virginia University are recording and analyzing the speech of English speakers in Appalachia. They have found that changes are taking place in the region's speech patterns. The researchers, under the auspices of the West Virginia Dialect Project (WVDP), are studying such changes to determine the current status of English in West Virginia, i.e., regional affiliations, relative degree of vernacularity, sociolinguistic divisions, and current direction of change.

The most recent work focused on analysis of individual language features, including ten features which occur with varying frequency in West Virginia, including: *a*-prefixing ("She's a-working"); (ING) ("She's workin' "); pleonastic pronouns ("My cousin, she's a nurse"); *was* leveling ("We was there"); demonstrative *them* ("Them apples are expensive"); consonant cluster reduction ("best ape" pronounced as "bes' ape"); and quotative *like* (*He was like, "I'm not going"*). From the research accomplished to date, it is clear that many of the traditional features of English in Appalachia are fading from West Virginia. For example, *a*-prefixing has been a classic feature for decades, but new results concur with work from the early 1970s which indicates the feature is quickly fading. In contrast, other features are quite stable and have become badges of identity for some natives. For example, the vernacular feature remains a stable part of English in Appalachia and clearly illustrates sociolinguistic boundaries between socio-demographic categories. Findings from this research reveal how Appalachians use English and how this usage is changing in the 21st century.

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Undergraduate Education and Undergraduate Student Research
- Graduate Education and Graduate Student Research

What is the intellectual merit of this activity?

English in Appalachia has received little empirical scholarly attention, despite it being one of the United State's most widely-recognized vernaculars. Outside of this current project, the last comprehensive sociolinguistic investigation of English in Appalachia was published in 1976. To correct the gap in scholarship and provide an empirically-grounded description of English in Appalachia at the cusp of the twenty-first century, the principal investigator and associates of the West Virginia Dialect Project have engaged in scientific analysis to develop a sociolinguistic baseline for English in Appalachia.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*
- *What may be the benefits of the proposed activity to society?*
- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*
- *Will the results be disseminated broadly to enhance scientific and technological understanding?*

This project integrates research and education by advancing discovery and understanding for university students. It is training students to better conduct linguistic analysis and providing results which can be used in education for and about the state of West Virginia. At the same time the principal investigator promotes better language awareness for the general public and teachers in K-12 schools through Dialect Awareness Programs. Perhaps this awareness and training is most important for language attitudes internalized by too many Appalachians. Most Appalachians, even those proud of their heritage, apologize for their language. They have been lead to believe that it reflects some underlying inadequacy. Unfortunately, such myths are ubiquitous and deeply entrenched in West Virginia. Unearthing and confronting these linguistic misconceptions will require a thorough understanding of the state's language variation and a state-wide effort to teach its legitimacy and value.

This project provides the means for helping West Virginians to avoid the self-effacing loathing of their language diversity. It is part of a national effort by sociolinguists to fill the urgent need for formal and informal education about the relation of language differences to culture and ethnicity--for educators, policy makers, and the general public. In all, this research will contribute to the public understanding of language diversity in American society, especially the role of Appalachia within that society.

Despite the pervasive myths, language in Appalachia is changing. Teachers, especially teachers of language arts, should understand how the language is changing and what the new norms are. They should also understand changes to the cultural heritage. Through teacher training, at both the undergraduate and post-graduate level, the WVDP uses results from this project to provide this kind of information.

The PI has provided several talks to public audiences using information from this project.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008* *and* *Important Notice 130: Transformative Research*

No

SBE/BCS 2010

Program Officer: Eric Potsdam

NSF Award Numbers:

0743489

Award Title:	A Sociolinguistic Baseline for English in Appalachia
Start Date:	02/01/2008
Expires:	01/31/2012
Awarded Amount to Date:	$258,243
PI:	Kirk Hazen, Kirk.Hazen@mail.wvu.edu
Institution Name:	West Virginia University Research Corporation
State Code:	WV
PE Codes:	1311

NSF Contract Numbers:

Submitted on 03/02/2010 by Eric Potsdam
BCS: Approved 04/15/2010 by Mark L. Weiss
SBE: Approved 05/03/2010 by Lisa L. Jones

Neural Basis of Binocular Rivalry

Highlight ID: 21294, Version: AC/GPA

Dr. Sabine Kastner and graduate student Michael Arcaro at Princeton University made important discoveries about the neural underpinnings of conscious perception in the human brain. When participants viewed visual stimuli that competed for access to awareness, neural signals in the thalamus and early stages of cortical processing correlated with the subjects' percept rather than the physical input to the visual system.

A fundamental issue in understanding brain function is becoming aware or conscious of sensory information. What is the relationship between 'awareness' and neural activity in the brain? An intriguing paradigm to study the neural basis underlying visual awareness is binocular rivalry. In binocular rivalry, the subjects' perceptual experiences of two dissimilar inputs to the two eyes change over time, while the retinal stimulus remains constant (Fig. 1A). In Kastner's and Arcaro's studies, participants viewed pictures of varying complexity (e.g., gratings, faces, houses) in binocular rivalry conditions, while undergoing functional magnetic resonance imaging (fMRI). The percieved pictures were indicated by a button press. Brain activity was recorded in a large-scale visual processing network that included areas of the thalamus, occipital, temporal, parietal, and frontal cortex. Kastner and Arcaro discovered that, across the visual processing network and regardless of stimulus complexity, neural activity correlated strongly with the participants' reported percepts (Fig. 1B, C). Such neural correlates of binocular rivalry were notably found in early visual cortex and thalamus, suggesting that binocular rivalry is largely resolved at early visual processing stages. These studies contribute to the discovery of the neural mechanisms that give rise to conscious perception.

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Undergraduate Education and Undergraduate Student Research
- Graduate Education and Graduate Student Research

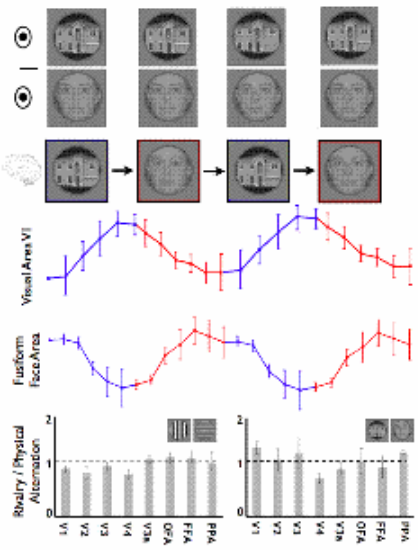
What is the intellectual merit of this activity?

These studies suggest that even the earliest stages of visual processing reflect a subject's percept, that is, an interpretation of the physical input to the visual system, rather than the input itself. The paradigms developed in Kastner and Arcaro's studies currently serve also to probe the large-scale network mediating binocular rivalry in non-human primates using fMRI. In combination with physiology methods, these studies yield the promise to uncover the neural mechanisms that give rise to conscious perception.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *What may be the benefits of the proposed activity to society?*
- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*

The results of these studies may be of interest to other fields outside neuroscience such as philosophy.



Top Row: Participants viewed pictures of contrast-modulated face, house, and grating (not shown) stimuli in binocular rivalry conditions. In a given experiment, two stimuli were displayed, with each stimulus only visible to one eye (e.g., house to the right eye and face to the left eye). Participants experienced binocular rivalry and reported switches in perception between high-contrast house (blue frame) and low-contrast face stimuli (red frame). Middle Row: Neural responses within visual area V1 increased when subjects perceived the high-contrast stimuli regardless of stimulus type. Neural responses within the fusiform face selective area increased when subject perceived the low-contrast face stimuli. Bottom Row: The responses obtained during rivalry were compared to responses evoked by physical (monocular) stimulus alternations and are plotted as the average ratio of the signal differences across all subjects for visual areas V1/2/3/4, V3a, the occipital face area (OFA), the fusiform face area (FFA), and the parahippocampal place area (PPA). Ratios around 1 indicate similar amplitudes between rivalry and physical alternation conditions and suggest that rivalry is fully resolved. Regardless of the complexity of stimulus material (i.e., object vs. grating stimuli), rivalry appears to be largely resolved at early processing stages.

Credit: Sabine Kastner

Image Provided by: Sabine Kastner (skastner@Princeton.EDU) [skastner@Princeton.EDU]

The combination of neuroimaging in humans and monkeys is performed only in few laboratories in the world and offers a unique training opportunity for trainees at all levels of education, including undergraduate and graduate students.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008 and Important Notice 130: Transformative Research*

Yes

This work will result in a better understanding of one of the most fundamental issues in cognitive neuroscience, the neural substrates underlying conscious perception.

SBE/BCS 2010

Program Officer: Lynne E. Bernstein

NSF Award Numbers:

0633281

Award Title:	Neural Correlates of Binocular Rivalry
Start Date:	04/15/2007
Expires:	08/31/2010

Awarded Amount to Date: $410,139

PI: Sabine Kastner, skastner@princeton.edu

Institution Name: Princeton University

State Code: NJ

PE Codes: 1699

NSF Contract Numbers:

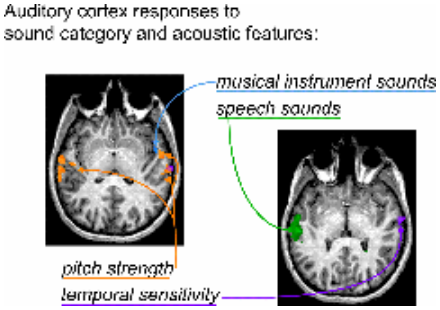
Submitted on 03/02/2010 by Lynne E. Bernstein
BCS: Approved 04/15/2010 by Mark L. Weiss
SBE: Approved 04/29/2010 by Lisa L. Jones

Neural Bases of Speech Perception in the Human Auditory Cortex

Highlight ID: 21347, Version: AC/GPA

In the Laboratory of Integrative Neuroscience and Cognition (LINC) at Georgetown University Medical Center, Dr. Josef Rauschecker and his colleagues investigate how the brain makes sense of the auditory world, including the complex sounds that make up speech and music. A recent study led by Dr. Rauschecker's graduate student Amber Leaver demonstrated that different parts of auditory sensory cortex seem to be specialized for processing different categories of sound, especially human speech sounds and the timbre of different musical instruments.

Using functional magnetic resonance imaging (fMRI) to measure the correlates of neural activity in the human brain, the researchers explored how the auditory cerebral cortices of humans process different individual sounds, or auditory "objects." Although speech and music appear to be processed by different parts of auditory sensory cortex, not all sound categories (for example, birdsong and other animal sounds) seem to have such specialized subregions. Leaver and Rauschecker suggest that these types of sound may instead be processed by coincident activity in parts of auditory cortex that process the acoustic features, or "building blocks," that comprise these complex natural sounds. Specifically, they demonstrate that subregions of auditory cortex seem to be sensitive to the building blocks of strength of a sound's pitch and the degree of temporal modulation present in these sounds.



The figure shows with fMRI that different regions of auditory cortex are involved with speech sound processing versus musical instruments, and that basic building blocks of sound, pitch strength and temporal attributes are processed in different regions.

Credit: Josef Rauschecker

Image Provided by: Josef Rauschecker [rauschej@georgetown.edu]

Primary Strategic Outcome Goal: Discovery

- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Graduate Education and Graduate Student Research

What is the intellectual merit of this activity?

While most of what we understand about object recognition comes from visual neuroscience, it is still unclear how the brain accomplishes the discrimination and identification of auditory "objects," or individual sound events. Knowledge of this very basic process is critical to understanding more complex auditory phenomena like speech and music.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*
- *What may be the benefits of the proposed activity to society?*

This research has implications for our understanding of language disorders, including possible interventions as well as educational approaches to language learning in general. Understanding the neural mechanisms of speech recognition could also aid with the development of improved speech recognition algorithms in computers and robots, which would have a far-reaching impact on the life of individuals with physical disabilities by enabling voice-controlled devices.

This particular research project has involved a female graduate student, who will stay on in the lab as a postdoc for further training. Two other current graduate students are from underrepresented minorities (one Hispanic, one African-American); A third student has a disability.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008* *and* *Important Notice 130: Transformative Research*

Yes

This research helps us understand how our brains analyze the acoustic structure of sound in the service of recognizing the different types of sound we encounter in our environments. Among other things, this work suggests that parts of the brain thought to be specific to analysis of speech may be involved in analyzing other types of sound as well.

SBE/BCS 2010

Program Officer: Lynne E. Bernstein

NSF Award Numbers:

0519127

Award Title:	Neural Bases of Speech Perception in Human Auditory Cortex
Start Date:	07/01/2005
Expires:	06/30/2010
Awarded Amount to Date:	$795,485
PI:	Josef Rauschecker, rauschej@georgetown.edu
Institution Name:	Georgetown University
State Code:	DC
PE Codes:	1699

NSF Contract Numbers:

Submitted on 03/10/2010 by Lynne E. Bernstein
BCS: Approved 04/15/2010 by Mark L. Weiss
SBE: Approved 04/29/2010 by Lisa L. Jones

The Art of "Overhead 'Bots" Teaches Kids About Science

Highlight ID: 21351, Version: AC/GPA

Dr. John Spencer, Director of the Delta Center at the University of Iowa, and Dr. Christian Faubel, an artist and scientist at the Institute for Neurocomputing at the Ruhr University in Bochum, Germany, created a series of workshops entitled "Overhead 'Bots" to introduce 5- to 12-year-old children to basic ideas of cognition, development, and engineering through active learning and play. The children built small robots by soldering parts, including a solar panel and a simple motor, to a circuit board. They decorated the 'bots with colored wax paper, ribbons, and other embellishments. When placed on an overhead projector, which provided the light source for the solar panel, the 'bots came to life and started moving around in interesting ways, projecting lively, unpredictable art on the walls of the museum.

This activity illustrated central concepts that Spencer and Faubel use in their research on cognitive and developmental science. The first is *autonomy*. As in complex living organisms, the actions of the 'bots are not hard-wired or pre-programmed. Rather, their behavior is new, inventive, and spontaneous. This also illustrates a second concept: *embodiment*. There is no central processor or brain telling the 'bot what to do. Movement and art come to life as "brain" and "body" work together. Third, the 'bots show *emergence*. As the 'bots move around, new and unpredictable behaviors occur. And with multiple 'bots on the same overhead projector, new, complex interactions can take place. Art created from these motions and interactions was projected onto the wall for all to enjoy.

The Overhead 'Bots workshops were offered at the Iowa Children's Museum and the 2009 Iowa ARTS festival in downtown Iowa City. The project reached over 200 children, including children from the Neighborhood Centers of Iowa City, which serves lower income families. Workshops were made possible with support from the National Science Foundation, the Iowa Children's Museum, the Delta Center at the University of Iowa, the Spelman-Rockefeller Fund, and the Obermann Center for Advanced Studies at Iowa.

Primary Strategic Outcome Goal: Learning

- K-12 Education

Secondary Strategic Outcome Goals: Discovery

- Social, Behavioral, and Economic Research

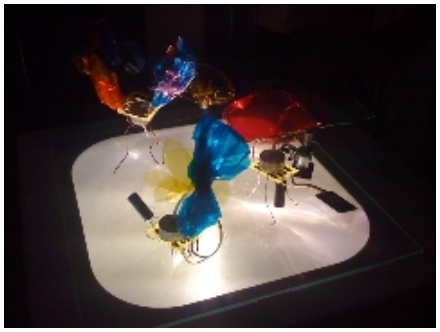
What is the intellectual merit of this activity?

This aspect of the project gave children and parents first-hand experience with the concepts of embodied cognition, emergent behaviors, and autonomous dynamical systems in a way that was creative and fun.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*
- *Will the results be disseminated broadly to enhance scientific and technological understanding?*

These workshops reached more than 200 young children and their families, including children from the Neighborhood Centers of Iowa City, which serves lower income families. Brochures were



'Bots on the overhead projector. Each child could add their own embellishments to create the "body" of their tiny robot.

Credit: Evelina Dineva, University of Iowa; Christian Faubel, Ruhr University, Bochum, Germany

Image Provided by: john-spencer@uiowa.edu

Form 1515

Watching 'bots come to life. The light from the projector powers the solar panel on the tiny 'bot.

Credit: Evelina Dineva, University of Iowa; Christian Faubel, Ruhr University, Bochum, Germany

Image Provided by: john-spencer@uiowa.edu

Form 1515

distributed that explained the science behind the children's bot creations.

Does this highlight represent potentially transformative research? *If so, please explain why. For more information, see Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008 and Important Notice 130: Transformative Research*

No

SBE/BCS 2010

Program Officer: Betty Tuller

NSF Award Numbers:

0527698

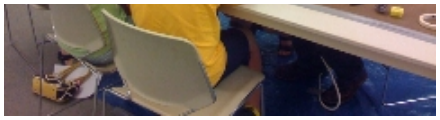
Award Title:	DHB From Where to What: The Dynamics of Spatial Cognition
Start Date:	12/01/2005
Expires:	11/30/2009
Awarded Amount to Date:	$624,006
PI:	John Spencer, john-spencer@uiowa.edu
Institution Name:	University of Iowa
State Code:	IA
PE Codes:	7319

0925248

Award Title:	Dynamic Field Theory Summer School
Start Date:	06/01/2009
Expires:	05/31/2010
Awarded Amount to Date:	$10,000
PI:	John Spencer, john-spencer@uiowa.edu
Institution Name:	University of Iowa
State Code:	IA
PE Codes:	7252

NSF Contract Numbers:

Submitted on 03/23/2010 by Kristin E. Kuyuk
BCS: Approved 03/23/2010 by Mark L. Weiss
SBE: Approved 05/10/2010 by Lisa L. Jones



Children receive instruction on how to build their 'bots.

Credit: Evelina Dineva, Univeristy of Iowa; Christian Faubel, Ruhr University, Bochum, Germany

Image Provided by: john-spencer@uiowa.edu

Form 1515

Using Optical and Polarmetric Radar Platforms to Analyze Land Cover/Land Use

Highlight ID: 21356, Version: AC/GPA

Professors Emilio Moran and Dengsheng Lu from the Department of Geography at Indiana University, in collaboration with Professors Luciano Dutra and Corina Freitas from the Brazilian National Institute of Space Research in Brazil, have discovered that vegetation indices that integrate shortwave infrared data with Landsat Thematic Mapper satellite imagery provide better vegetation identification than Thematic Mapper imagery alone. Results from their work also indicate that using three or more vegetation indices does not significantly improve vegetation identification, a finding that will save both time and processing costs in land use analyses using remotely sensed imagery. Using textural analysis that combines polarimetric radar and orbital satellite data, advances in vegetation classification were achieved using dual L band polarized data. Incorporation of textural images into dual L band data is especially valuable in improving vegetation classification. Figure 1 provides a comparison of Landsat TM and ALOS L-band images as well as textural images. It clearly indicates that textural images can provide some new features that the original images do not have. This implies that incorporation of textural images may improve land cover classification performance.

The major contribution of this project is to advance understanding of land use and land cover change, particularly in rain forest regions where cloud cover makes annual and seasonal monitoring of changes in land cover a challenge. Through the analysis of ALOS/PALSAR and RADARSAT2 in combination with existing optical sensors (TM/ETM+, ASTER) for land cover classification and assessment of land cover dynamics, seasonal and intra-annual

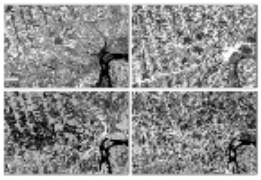


Figure 1. A comparison of Landsat TM and ALOS PALSAR L-band images

(a - Landsat TM near-infrared band; b - textural image based on TM green band with dissimilarity and window size of 9 by 9 pixels; c - ALOS PALSAR L-band HH image; and d - textural image based on L-band HH image with entropy and window size of 25 by 25 pixels)

Credit: Emilio F. Moran

Image Provided by: moran@indiana.edu

observations of changes in vegetation on a year-round basis in the humid tropics can be greatly improved.

Primary Strategic Outcome Goal: Discovery

- International
- Social, Behavioral, and Economic Research

Secondary Strategic Outcome Goals: Learning

- Undergraduate Education and Undergraduate Student Research
- Graduate Education and Graduate Student Research
- Postdoctoral Education and Fellowships

What is the intellectual merit of this activity?

This project will enable the continual imaging and monitoring of any part of the world that experiences constant cloud cover, a feat not possible with current remote sensing technologies.

What are the broader impacts of this activity?
Merit Review Broader Impacts Criterion: Representative Activities, July 2007

- *How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc?)*
- *How well does the activity advance discovery and understanding while promoting teaching, training, and learning?*
- *To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships?*
- *Will the results be disseminated broadly to enhance scientific and technological understanding?*

The results of this work with provide useful tools for land cover and land use analysis to the broader land-management community. This project is an international collaboration that broadens participation of Brazilian researchers. This project is also mentoring a post-doctoral research assistant, two graduate students and one undergraduate student in field data collection and analysis of remotely sensed data. The results of this work have been presented in four different papers at an international conference; these papers are available on the Web.

Does this highlight represent potentially transformative research?*If so, please explain why. For more information, see* *Report to Congress: Transformative Research at the National Science Foundation, April 16, 2008* *and* *Important Notice 130: Transformative Research*

Yes

Results from this study will provide automated approaches for year-round monitoring in rain forest regions, which currently cannot be observed due to cloud cover, thereby hiding processes of land change and deforestation, making it nearly impossible to adequately monitor deforestation in the tropics.

SBE/BCS 2010

Program Officer: Scott Freundschuh

NSF Award Numbers:

0850615

Award Title:	Advancing Land-Use and Land-Cover Analysis by Integrating Optical and Polarimetric Radar Platforms
Start Date:	06/01/2009
Expires:	11/30/2011
Awarded Amount to Date:	$199,613
PI:	Emilio Moran, moran@indiana.edu
Institution Name:	Indiana University
State Code:	IN
PE Codes:	1352

NSF Contract Numbers:

Submitted on 03/15/2010 by Scott M. Freundschuh
BCS: Approved 03/21/2010 by Mark L. Weiss
SBE: Approved 05/10/2010 by Lisa L. Jones