



McNAIR RESEARCH JOURNAL
UNIVERSITY OF OREGON
2010

University of Oregon McNair Scholars Program Research Journal

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**University of Oregon
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Research Journal**

2010

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**Abstracts by McNair Scholars
at the University of Oregon**

**The Effect of De-noising fMRI Data:
Using Independent Component Analysis**

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Economics and Mathematics

Faculty Mentor: William (Bill) Harbaugh
Economics

Functional magnetic resonance imaging (fMRI) data is an important technique for non-invasive study of human brain activity, but its signal to noise ratio is quite low. Researchers have applied different statistical methods to de-noise fMRI data, identify the signal, and correlate that signal with the stimuli and responses from behavioral experiments. We used Independent Component Analysis (ICA) to decompose the fMRI time series from a behavioral experiment into independent components. We then manually inspected each component and rated it on the likelihood that it was an actual signal or a physiological, signal-related, or scanner-related noise. We then showed how the statistical maps of brain activation under several different stimuli changed as we dropped different proportions of the noise component from the data.

Allocation of Attentional Resources When Presented with a Dual-Task

Jason Dooley

Psychology

Faculty Mentor: Dare Baldwin

Psychology

Graduate Student Mentor: Jeff Loucks

University of Washington

This study looks at two different types of action, featural and configural. To test how participants allocate attention, we used a dual-task design. This made it possible to investigate whether the detection of featural changes requires more attentional resources than the detection of configural changes. Participants watched two videos, the first of which depicted an actor doing an everyday action. The second video depicted the same basic action but with a change in the featural information of the action or a change in the configural information of the action. Half of the participants completed a subsequent task for which they paid attention to four rectangles changing around the video on the computer screen. We found that when presented with a dual-task, participants' detection of featural changes did not decrease more significantly than configural changes, $F(1,24) = .335$, $p = .568$. These results suggest that there are attentional components in processing both featural and configural information.

The Prison Within the Prison: An Inside Look at Oregon State Penitentiary's Intensive Management Unit

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Philosophy and Classics

Faculty Mentor: Steven Shankman
English and Classics

Since the creation of the first “super-maximum” security prison in the U.S. in 1983, the number of Americans living in long-term solitary confinement has grown rapidly. Today, more than 30,000 inmates in over 40 states are living under these extreme conditions. What prompted the creation of these “super-max” facilities? What is their effect on inmates and on the larger prison culture? What are conditions like inside? Can negative effects be mitigated and positive ones be fostered through education? I explored these questions through my volunteer work at the Oregon State Penitentiary's Intensive Management Unit, a super-max facility. I taught a course on mindfulness, meditation, and creative writing, created information packets and essay prompts on a number of self-improvement topics, and responded individually to written work completed by inmates. I have approached this work through the ethical framework of philosopher Emmanuel Levinas.

Ring-Opening Polymerization of a Cyclopentadienyl-bridged Dimeric Molybdenum Complex

Dawn Marie Jennings

Chemistry

Faculty Mentor: David Tyler

Chemistry

Graduate Student Mentor: Ginger Shultz

Chemistry

Graduate Student Mentor: Sarah Brady

Chemistry

Ring-opening polymerization (ROP) was investigated as a method for the preparation of organometallic polymers containing metal-metal bonds in the main chain. Early steps involved synthesizing the $(\text{CH}_3)_2\text{Si}(\text{CpMo}(\text{CO})_3)_2$ ring complex as a substrate for this polymerization technique and verifying the structure of this complex through X-ray crystallography. Later steps used anionic ring-opening polymerization and thermal ring-opening polymerization techniques. Both *n*-butyl lithium and platinum(II) chloride failed to initiate the polymerization of the dimeric molybdenum complex. Tests of thermal ring-opening polymerization used differential scanning calorimetry (DSC) and a 150°C oil bath. This resulted in the formation of an oligomer ($M_n = 1252$, $M_n/M_w = 1.03$) with metal-metal bonds in the oligomer chain.

Encoding Schemes in Rat Primary Auditory Cortex

Nathan Montgomery
Psychology and Biology

Faculty Mentor: Michael Wehr
Psychology

The use of information theory in neuroscience opened the door to new models of brain activity but has remained theoretical with few experimental tests of predictions. Our test focuses on the B-G shift, which depends on the existence of an alternate encoding scheme to that traditionally predicted for neurons. This alternate scheme places the most informative neural responses on the flanks of the tuning curve rather than the peak. Therefore, neurons have at least two possible encoding schemes and choose which to use based on neuronal variability. By varying the intensity of sound stimuli we should be able to observe the B-G shift in neurons of the rat auditory cortex. This research may provide a new tool for analyzing cortical properties and a deeper understanding of the underlying functions of the auditory cortex.

Sexual Dimorphism in Manual Digit Proportions Growth Patterns and the Digit Ratio

DeAnna Morris

Anthropology

Faculty Mentor: Stephen Frost

Anthropology

Manual digit sexual dimorphism, specifically the ratio of the second digit to the fourth digit (2D:4D), is linked to health, attractiveness, and reproductive factors. The 2D:4D ratio, if shaped by exposure to sex hormones in-utero as believed, should be observable early. Alternatively, sexual dimorphism in 2D:4D may be a consequence of normal patterns of hand growth that differ between the sexes. Radiographs from Oregon Health and Science University were used to measure the lengths of metacarpals and phalanges for fifteen males and fifteen females, first when the subjects were aged 2-3 and again when they were aged 17-18. Hand bone radiographs, traced onto acetate paper, were measured with digital calipers. The 2D:4D ratio was calculated by summing phalangeal lengths for the second digit and dividing the result by the comparable sum for the fourth digit. Despite overlap, males and females differed in 2D:4D ratio, females having higher values in both age classes. The difference was stronger in the adult age class. Results support that 2D:4D dimorphism is established by age 2-3 and that age is a factor in hand shape variation.

Characterization of a Gene Required for Specifying the Fate of *Drosophila* Photoreceptors

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Biology and Biochemistry
Honors College

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Biology, Institute of Molecular Biology

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During development, cells undergo differentiation in order to perform specialized tasks. To understand how cells differentiate as neurons, our research focuses on identifying genes required for the development of photoreceptor neurons in *Drosophila*. In this study, we used a technique known as Mosaic Analysis with a Repressible Cell Marker (MARCM) to create mosaic flies in which undifferentiated photoreceptor precursors were homozygous for a new mutation, *z6*. We then characterized the phenotype caused by the *z6* mutation and observed that in mutant *z6* adults, R1/R6s adopted an R8 fate but not an R7 fate. Through a series of complementation tests we were able to create a preliminary map of the location of the gene that *z6* disrupts.

Reaching Ability in Infants: Contribution of Spinal Control

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Human Physiology

Faculty Mentor: Marjorie Woollacott

Human Physiology

Graduate Student Mentor: Sandra Saavedra

Human Physiology

The present study investigated the involvement of thoracic trunk control in infants' ability to reach. Nine typically developing infants (aged 4-6 months) sat on a bench supported by leg straps with external support at two different levels of the spine (mid-ribs and pelvis). Magnetic tracking of head, trunk and both arms, video documentation, and standardized tests of motor ability (AIMS) and trunk control (SATCo) were used to determine the influence of spinal motor control on reaching ability. All subjects reached less with pelvic support than with mid-ribs support. Our data also suggest that there is a positive correlation between the numbers of reaches and level of trunk control but not necessarily with mobility level. We conclude that the level of trunk control is a critical factor in successful reaching and that a test of trunk control such as the SATCo may be more useful than motor ability tests in prioritizing treatment goals for infants or children who have difficulty reaching.

Tim Burton's Grotesquerie

Naomi Schwartz

Theatre Arts

Faculty Mentor: Forest Pyle

English

The grotesque is a natural compulsion of human nature that finds itself manifested over and over in all forms of expression. It is subversive. It is errant. It is revolutionary. It is neo-culture no matter when or by whom it is used. The grotesque represents that part of human nature that questions and protests the accepted order of society. Among the many artists who wield the power of the grotesque, Tim Burton is the most well-known contemporary propagator and a highly skilled master of the grotesque. His work brings the viewer to a place of impossible possibility and fairytale wonder that, combined with simple, trivial contexts, serves as a guise for complex grotesquerie and social criticism. By systematically exploring the stock characteristics of the grotesque and then posing them against the vast body of Burton's known works, their deep connection easily emerges and the grotesque and Burton become inextricably bound. Contemporary grotesque art cannot be fully discussed without the inclusion of Burton's work, and Burton's art cannot be fully appreciated without an admiration for its arrangements of the grotesque.

Height Dependence of Like-Charge Attraction in Colloidal Systems

Richard Suhr

Physics, Mathematics, and CIS

Faculty Mentor: Raghuveer Parthasarathy

Physics

For over a decade, the phenomenon of like-charge attraction between microscopic particles in water has puzzled scientists. Recent research has shown that, as expected, electrostatic interactions between colloidal particles are purely repulsive, but the presence of a nearby confining wall can induce inter-particle attractions. We investigate the dependence of the interactions on the distance from a confining wall, in this case, the height above an underlying substrate. The colloidal particles used in this study are silica microspheres $4.74\text{ }\mu\text{m}$ in diameter. Particle height can be controlled both by varying the ionic strength of the medium and by coating the particles in lipid membranes of differing charge densities. The height of the particles above the substrate is determined using the method of Reflection Interference Contrast Microscopy, from which we can extract information about the energy of inter-particle interactions.

Canoe Journey as a Model for Language Revitalization: Experiences with the Grande Ronde Canoe Family

Jerome Viles
Linguistics

Faculty Mentor: Janne Underriner
Northwest Indian Language Institute

Canoe Journey is a yearly event that serves to preserve traditional Northwest Native life-ways and traditions, while also facilitating language and culture revitalization. The Journey is structured around Canoe Families comprising members of one or more tribes. The Families provide members a place to experience their culture and language. The Journey has been discussed in the literature as an important social, cultural, and political event for the tribes of the Pacific Northwest, but its potential use as a model for language revitalization has received little attention. This study seeks to describe the Canoe Journey as a unique cultural event that holds a variety of features that could foster an effective language learning environment. I will describe the Journey in general terms, as a member of the Grand Ronde Canoe Family, and as it relates to language revitalization. Given the rapid language loss experienced in the Pacific Northwest, use of the Canoe Journey as a model for language revitalization is ideal.

Emotion Regulation and Interpersonal Perception: How Emotion Regulation Affects How People Are Seen by Others

Adrian Yupanqui

Psychology

Faculty Mentor: Sanjay Srivastava

Psychology

Emotion regulation allows people to use strategies that alter emotional experiences and expressive behavior. Prior research has explored the effects of emotion regulation strategies on social relationships, showing that different strategies have different consequences for closeness and social support. The present study examined the role of interpersonal perception in explaining these effects. Specifically, it examined how emotion regulation strategies affect the way the regulator perceives the personalities of other people during a social interaction. Participants were put into small groups for a facilitated social interaction. After the interaction, we assessed the participants' perceptions of one another's personalities. Expressive suppression, an emotion regulation strategy in which people try not to show the emotions that they feel, predicted the perceptions others had of the suppressor. Specifically, we found that people who suppress their emotions are seen as less extraverted, less agreeable, and more neurotic. These perceptions may help explain why suppressors often receive less social support from others.

Selected Papers

Encoding Schemes in Rat Primary Auditory Cortex

Nathan Montgomery
Psychology and Biology

Faculty Mentor: Michael Wehr
Psychology

Introduction

Since the 1940s, researchers have used information theory to create models that describe neural physiology (MacKay and McCulloch, 1952). Claude Shannon, in his work for Bell Laboratories, developed a mathematical framework for information theory (Shannon, 1948) and introduced a powerful new tool for analyzing neural communication. Researchers have attempted multiple applications of Shannon's model to neural coding (Butts, 2003). The main motivation behind the development of these models was to quantify the information contained in unique sets of responses. The limitations of the computations involved (such as the need for a large data set to be collected or generated) have meant that many of the most interesting phenomena predicted by information theory based models go untested in live experiments.

One commonly used characterization of neuronal responses is the tuning curve. Originally, researchers believed that the characteristic stimuli of tuning curves were also the most informative responses because they correspond to the largest response of the neuron. With further investigation researchers found that more relevant responses could come from lower firing areas. These lower firing areas would then represent a

better encoding of stimuli other than the characteristic stimulus (Butts and Goldman, 2006). Such high information, non-characteristic stimuli could be predicted using models developed with different decompositions of Shannon's original equations. By integrating the entropy of the stimulus with a decomposition of Shannon's mutual information called specific information, Dan Butts (2003) developed Stimulus Specific Information (SSI). Because it calculates the information transmitted by a single neuronal response, SSI is a single response model. Single response models of information have the interesting property of showing distinct information curves for different scenarios (Butts and Goldman, 2006). In high noise situations, the most obvious response encodes the most information, much like traditional interpretations suggest. In low noise scenarios, however, high information responses shift to lower firing regions of the tuning curve. We refer to the separate high and low noise scenarios as encoding schemes because they represent different patterns of information encoding in the neuron.

The encoding scheme was found to shift depending on the level of "neuronal variability" (Butts and Goldman, 2006). Neuronal variability measures noise from various sources. The source of neuronal variability can be within the neural circuitry, the response, or the stimuli, and SSI shows a transition no matter the type of variance used to manipulate noise level. Another useful aspect of single response models is that they can be applied to both linear and nonlinear neurons. The rise in complexity in transitioning from a model to a biological system requires powerful tools to obtain comprehensible results. Therefore, we chose SSI to explore experimentally the existence of multiple encoding schemes in neurons. Our test focused on the B-G shift, the transition between the traditional and alternate encoding scheme. Knowing that neuronal variability can be varied based on properties of the stimulus we carried out *in vivo* experiments to

attempt to observe the B-G shift. By increasing the intensity of tones we expected to raise the signal to noise ratio of the neuronal response, and shift the area of highest SSI from the peak (low intensity, high noise) to the slopes (high intensity, low noise).

Methods

Activity was recorded from the primary auditory cortex (A1) using tungsten electrodes. Stimulus tones were 25 ms pure tones at twenty-two frequencies ranging from 1 kHz to 32 kHz and four intensities from 20 to 80 dB. By establishing a tonotopic gradient we ensured that recordings came from A1. The tuning curves used for calculating stimulus specific information came from sites that produced well tuned results. Spikes were extracted to produce a spike rate response field that gave the necessary data for calculating SSI. A spiking window of 100 ms, post-stimulus, was used to identify auditory evoked responses. The stimulus specific information content was calculated using the method described by Dan Butts and Mark Goldman (2006). The resulting curve of the information content was overlaid on the tuning curve. This information represents the informational entropy of the response as it relates to sound frequency. To ensure that the observed B-G shift was not due to noise, the relevant data was split in half and replotted to check that both halves of the data showed the effect. To create error bounds on information curves we used a bootstrapping process. All calculations were done using Matlab.

Results

After calculating the SSI for the collected tuning curves, the B-G shift appeared to be observed in 27.8% (35 of 126) of sites in rat primary auditory cortex (Figure 1). The relative information content in low firing areas varied from site to site. Most of the sites with high information at lower firing areas showed the effect only with very high (80 dB) intensity

stimuli. Cross validation failed to uphold the observation of the B-G shift in any of the recordings (Figure 2). For this reason we conclude from these results that the B-G shift does not occur in the rat primary auditory cortex.

Discussion

In this experiment we sought to explore the possible existence of an alternative encoding scheme in neurons of the rat auditory cortex. Butts and Goldman (2006) demonstrated the existence of such an alternative encoding scheme in the cricket cercal system and the macaque visual system. They generated their data using model neurons, a process that invites questions about the applicability of their findings to biological systems. Our findings show that, for information about sound frequency, the highest information is encoded consistently by the highest firing response. Because the shift to high information at the high slope areas of a tuning curve was shown to depend on the existence of low neuronal variability (Butts and Goldman, 2006) for some set of stimuli, our findings are evidence that when encoding information about sound frequency there is a large neuronal variability to responses in the rat auditory cortex.

To fully explore the possible existence of alternative encoding schemes in the auditory cortex, it will be important to move from multiunit recordings to single unit recordings. Butts and Goldman (2006) found that populations of neurons seem to mitigate noise effects on encoding by individual neurons. Therefore, it is possible that moving to single unit recordings could give the same result, but this cannot be assumed. Also, varying stimulus properties other than frequency and intensity could show that information concerning other attributes of sound do show the B-G shift.

References

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- Butts DA, Goldman MS (2006) Tuning curves, neuronal variability, and sensory coding. *PLoS Biology* 4(4): e92.
- MacKay DM, McCulloch WS (1952) The Limiting Information Capacity of a Neuronal Link. *Bulletin of Mathematical Biophysics* 14: 127-135.
- Shannon CE (1948) A Mathematical Theory of Communication. *Bell System Technical Journal* 27: 379-423.

Figures

Figure 1 - Example of a site showing the B-G shift

Figure 1a - 75 dB

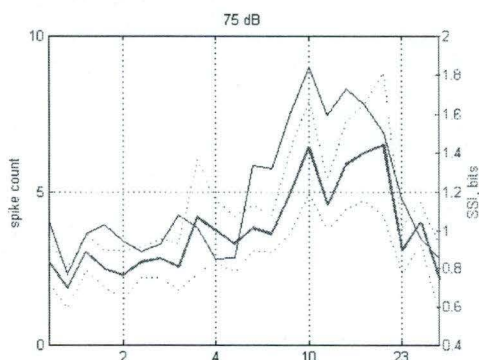


Figure 1b - 57 dB

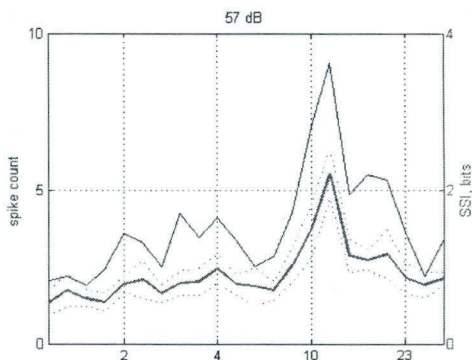


Figure 1c - 38 dB

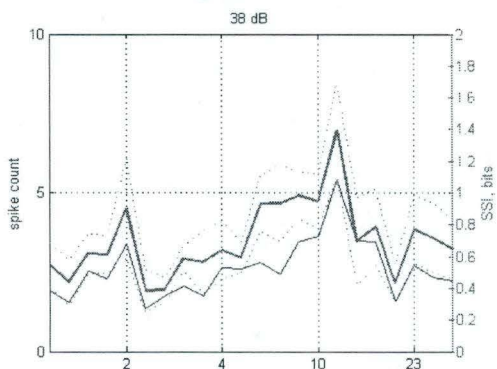
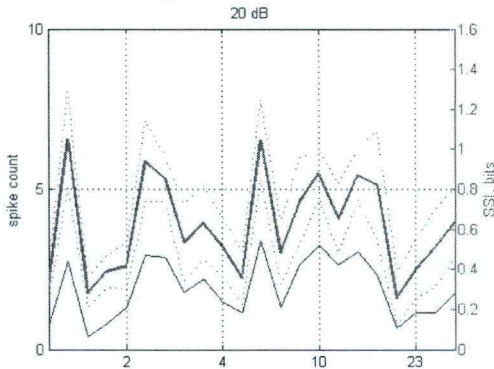


Figure 1d - 20 dB



The high information area on the slope of the 75 dB tuning curve can be seen to be roughly equal to the peak at the highest firing rate. As the intensity of the stimulus drops, and the signal to noise ratio (SNR) drops, the information shifts to be highest at the highest firing rate. The dashed lines are error bounds on SSI calculation (plus and minus one standard deviation).

Figure 2 - Example of a Cross Validation Result

For each decibel level, a and b are halves of the data replotted.

Figure 2a - 75 dB

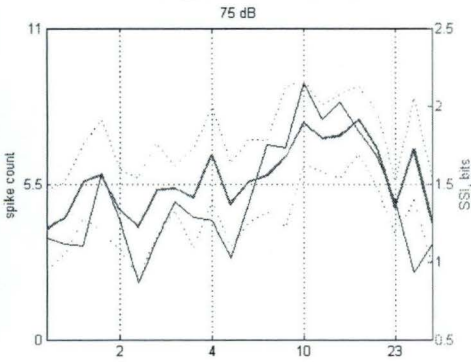


Figure 2b - 75 dB

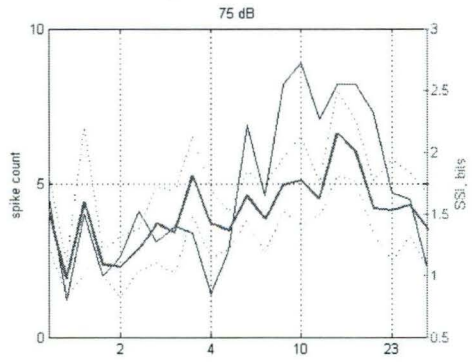


Figure 2a - 57 dB

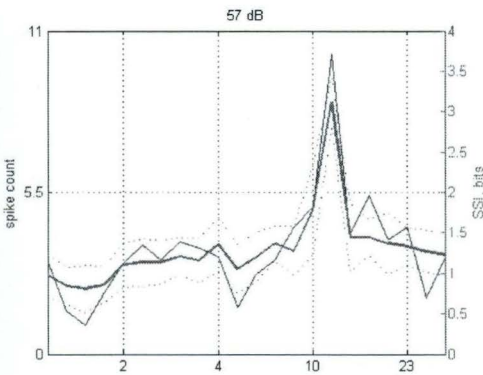


Figure 2b - 57 dB

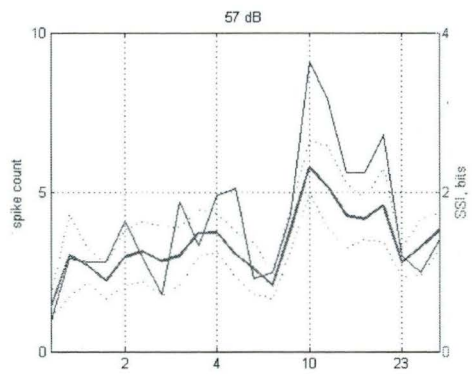


Figure 2a - 38 dB

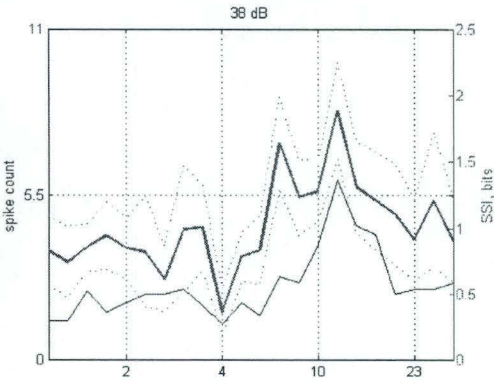


Figure 2b - 38 dB

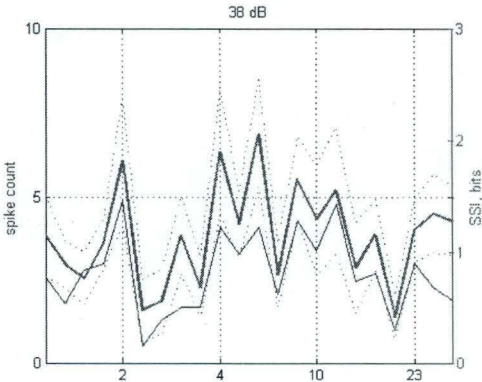


Figure 2a - 20 dB

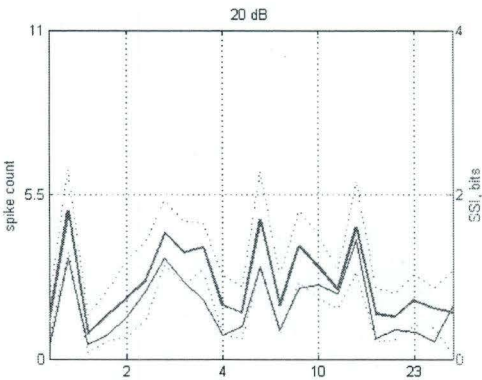
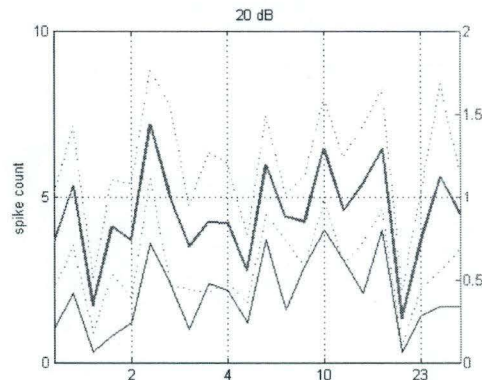


Figure 2b - 20 dB



Each a-b pair represents two halves of a single data set that had appeared to show the B-G shift. The areas of highest information do not appear at areas of high slope on either set of tuning curves. Dashed lines are error bounds (plus and minus one standard deviation)

Sexual Dimorphism in Manual Digit Proportions: Growth Patterns and the Digit Ratio

DeAnna Morris
Anthropology

Faculty Mentor: Stephen Frost
Anthropology

Introduction

Biological variation is an accepted phenomenon in humans. Skin color, blood type, body size, and facial symmetry vary widely among and between populations. Sexual dimorphism is a type of variation that occurs between male and female humans. On average, most males have larger trunks, longer distal segments, and less body fat than females. In the past decade many studies (Manning, 2002; Neave, Laing, Fink, and Manning, 2003; Koehler, Simmons, and Rhodes, 2004) have concentrated on the sexual dimorphism that occurs among the manual digit proportions, specifically the ratio of the second digit vs. fourth digit. The existence of the ratio is established and accepted; the possible consequences and correlations of this ratio are debated and controversial. From perceived attractiveness (Neave et al., 2003) to homosexual proclivity (Manning, 2002), researchers have associated countless characteristics and pathologies with the digit ratio. According to Manning (1998, 2002), the ratio is a product of in-utero exposure to testosterone. After measuring radiographs of children aged 2.5 to 3 years, though I found some overlap in the sexes, the digit ratio difference measurably exists at this early age. This seems to be true across the board; thus defining a ratio in such a way that suggests

causation for the above mentioned characteristics seems arbitrary at best. It is my hypothesis that the digit ratio is simply another sexually dimorphic trait that occurs between males and females. Different digit ratios are not the only such traits that show up early in life. For example, males are born with ulnae that are longer compared to their humeri than are females (Harrison, Tanner, Pilbeam, and Baker, 1993). If my hypothesis holds true, I would expect to see more pronounced ratio differences to occur after puberty, similar to long bone changes. After measuring the same subjects at the age of eighteen, results show that this does occur. Therefore, I believe that although males and females show patterns of sexual dimorphism early in life, they also follow separate growth trajectories, from birth through puberty, and age is highly correlated to hand shape differences.

Background

Manual digit proportions have become a topic of discussion among evolutionary psychologists and biological anthropologists (Manning, Scutt, Wilson, and Lewis-Jones, 1998; Peters, MacKenzie, and Bryden 2002; Neave et al., 2003). To calculate the digit ratio, the second digit (index finger) is measured and then divided by the measurement of the fourth digit (the ring finger). If the result is less than 1, the 2D:4D ratio is low. If the result equals 1, the 2D:4D ratio is even, and if the result is more than 1, the 2D:4D ratio is high (figures 1 and 2). Manning et al. (1998) determined that the 2D:4D digit ratio of men and women was a good predictor of testosterone and estrogen levels in the body. The study concluded that this sexually dimorphic characteristic was evident by the age of two. Neave et al. (2003) found that the 2D:4D ratio was specifically correlated with masculinity but that testosterone levels were not an indicator of this masculinity, and Koehler et al. (2004) found that although testosterone levels and masculinity are related, the 2D:4D ratio is not an indicator of these

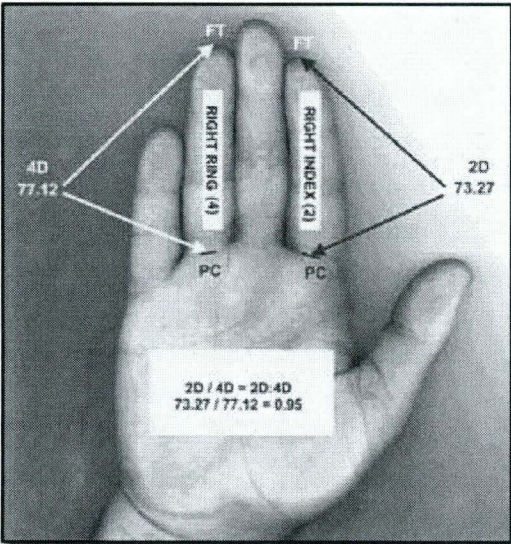


Figure 1: Calculating the Digit Ratio

testosterone levels. Manning (2002), claims to have found over 30 correlations related to digit ratio. These correlations include mother/child relationships, hip to waist ratios, cancer susceptibility, sexual fitness, and athletic ability. Furthermore, in 2006, McIntyre, Cohn, and Ellison found that the third digit was a better indicator of sex than the second when compared to the fourth digit especially in children, suggesting that

manual digit proportions in general are sexually dimorphic, not just the 2D:4D ratio.

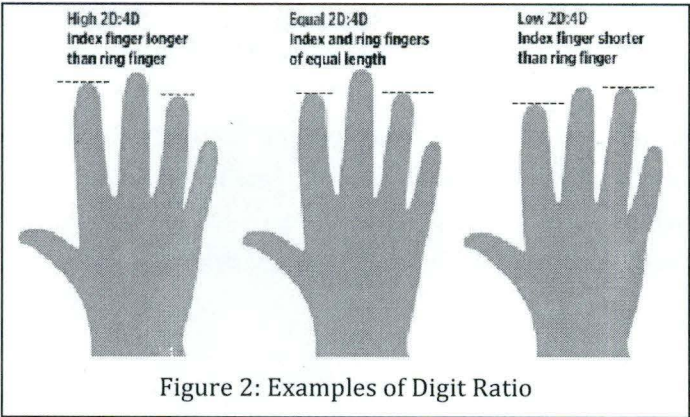


Figure 2: Examples of Digit Ratio

Methodologies

For their analysis, Manning et al. (1998) used measurements of finger lengths of live children aged 2-18 years old. That study measured finger

lengths by having people place their hand flat on a table. The researchers used Vernier calipers to measure the finger lengths from the basal crease to the tip of the finger. Another method used photocopies of the hands of volunteers (Neave et al., 2003). McIntyre, Ellison, Lieberman, Demerath, and Towne (2005) used the Fels Longitudinal Study at Wright State University, which includes radiographs taken of the left hand of children every few years from birth to eighteen. These studies all have the same basic result in common: in general, males have lower 2D:4D ratios and females in general have higher 2D:4D ratios. I measured 30 subjects (15 male, 15 female) from a series of left hand radiographs in a growth study at the Oregon Health and Sciences University, held in the School of Dentistry. The radiographs were taken with subjects in standard position and with standard radiograph parameters. Using acetate paper, pencils, and a tracing box, I traced the hand radiographs and then measured the length of each metacarpal and phalanx separately with digital calipers. This rare method of measuring provides an accurate measure of the bones themselves, setting aside the possibility for confounding variables caused by moving subjects and soft tissue. I measured radiograph images taken of subjects when they were 2.5 to 3 years of age and radiographic images of the same subjects again when they were 16 to 18 years of age. The measurements and digit ratios are shown in Table 1. One-tailed Student's t-tests for unequal samples with unequal variance were used to evaluate the null-hypotheses that males and females had the same mean digit ratio.

Results

The digit ratio difference measurably exists at an early age, although the difference is slight. The average ratio for males at the first age was .89 while the average ratio for females at the first age was .91. The ratio shows a similar pattern after puberty. The average ratio for males at the second age was .92 and the average digit ratio for females at the second age was

.94. The t-tests rejected the null hypothesis in both age groups ($p=0.03$ for the younger age group, 0.01 for the older age group), indicating that differences in male and female means are unlikely to be due to small sample size. The lowest digit ratio was found in subject number seventeen, a male at age 3 with a ratio of .82. The highest ratio found was with subject number ten, a female at age 20, with a ratio of .99. The ratios of the males at the younger age vary from .82 and .94, .12 mm. The younger female subjects vary from .84 to .96, also .12 mm. For the older subjects, the male ratio varies from .86 to .98, .12 mm and the females vary from .91 to .99, .08 mm. While some overlap existed between the digit ratio of males and females, overall ratios for males were lower in both age ranges. The older age range shows that the digit ratio difference indeed increases with age.

TABLE 1: Digit Ratios for Each Subject

Subject/sex	1/male		2/Female		3/Male		4/Male		5/Female	
Age	2	18	3	18	3	18	2	18	2	18
Digit Ratio	0.86	0.93	0.84	0.95	**	0.98	0.91	0.92	0.90	0.91
Subject/sex	6/Male		7/Female		8/Female		9/Male		10/Female	
Age	3	18	2	17	3	18	3	18	3	20
Digit Ratio	0.88	0.93	0.92	0.93	0.96	0.94	0.89	0.90	0.91	0.99
Subject/sex	11/Male		12/Male		13/Female		14/Male		15/Male	
Age	2	17	3	18	4	17	3	18	2	18
Digit Ratio	0.89	0.91	0.89	0.87	0.92	0.97	0.92	0.92	0.89	0.91
Subject/sex	16/Female		17/Male		18/Female		19/Female		20/Male	
Age	3	17	3	17	4	17	3	18	4	18
Digit Ratio	0.94	0.94	0.82	0.96	0.92	0.96	0.91	0.93	0.89	0.93
Subject/sex	21/Female		22/Male		23/Female		24/Female		25/Male	
Age	3	18	3	18	2	18	3	18	3	18
Digit Ratio	0.91	0.92	0.89	0.93	0.94	0.93	0.91	0.96	0.91	0.86
Subject/sex	26/Male		27/Female		28/Male		29/Female		30/Female	
Age	3	16	3	18	3	18	2	18	3	18
Digit Ratio	0.94	0.93	0.90	0.95	0.88	0.92	0.86	0.94	0.91	0.95

**Denotes incomplete information

Discussion

The importance of duplicating research cannot be stressed enough. What one researcher may interpret as a correlation, another may find is coincidence or completely unrelated. While Manning (2002) interprets the digit ratio to be related to personality traits, physical characteristics, and disease prevalence, it is certainly possible the digit ratio plays no distinct role in any of these issues. Because the digit ratio exists fairly consistently across the board, it is difficult, if not impossible to define at what point the digit ratio becomes significant. It is outside the scope of this paper to duplicate Manning's research, but if one wanted to, one could correlate the digit ratio to just about anything. The ratio does not prove causality, nor does a correlation. Age may play a larger role in hand shape variation and with additional measurements I hope to verify this hypothesis.

Future Research

Because males usually have longer distal segments, i.e., longer tibiae vs. femora, more in depth analysis of metacarpal lengths vs. phalanges is worth pursuing to see if the same rule holds true in the hands. I plan to revisit the Oregon Health and Science University and use the radiographs to measure more subjects as well as additional stages of development of the subjects used in this paper to answer such questions as: Does the ratio stay stable during childhood? Does it become more pronounced after puberty? Is overall hand shape more correlated to age or sex? The answers to these questions may prove my proposition that the digit ratio is just another example of growth differences between males and females.

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Height Dependence of Like-Charge Attraction in Colloidal Systems

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Introduction

Understanding how colloidal systems behave is becoming increasingly important as many industries are realizing the power of such systems. Certain colloidal suspensions are now being used to aid the diagnosis of disease. In the pharmaceutical world, for example, colloidal systems are being studied to prepare and deliver medication. Nanotechnology will rely on understanding how systems of metallic colloids behave. Despite over a hundred years of study on the subject, we still do not understand many properties of these systems. How colloidal particles interact with each other under different conditions and with their environments, are still largely unknown.

Over the last two decades several groups have observed that like-charged colloidal particles suspended in water will attract each other. Early work showed that measurements of isolated microspheres exhibited no attraction, but microspheres confined by parallel glass plates did. Yet, there was no explanation for the mechanism that mediated the observed attractions [1]. Researchers later demonstrated that the microspheres did not need to be confined between two walls. Instead, the presence of a single wall induced an attraction between like-charged particles, and the

attraction depended in some way upon the distance of the particles from the wall [2].

To date, there is no experimental data concerning the height dependence of the like-charge attraction phenomenon. Our study is focused on observing the behavior of isolated pairs of colloidal particles over a range of distances from a confining wall. The study and its techniques will allow for the measurement of pair-particle interaction energies which depends only on the distance of the particles from an underlying substrate.

Methods

The particles used in our investigations are silica microspheres with a diameter of 4.74 micrometers, purchased from Bangs Laboratories. The particles are suspended either in de-ionized water or a solution of de-ionized water and varying concentrations of salt (NaCl), which alters the effective electrostatic repulsion between particles and the underlying substrate, thereby allowing control over particle-wall separation. Samples are then observed through a 60x oil immersion lens on an inverted microscope. Our light source is a mercury vapor arc lamp which is filtered to allow only light with wavelengths of 640 ± 15 nm to pass. The filtering allows the use of Reflection Interference Contrast Microscopy (RICM) with which the height of a particle can be determined by analyzing interference patterns created when light reflected from a particle interferes with light reflected from the substrate-medium boundary [3]. The data consist of images collected using a CCD camera recording images at exposure times of 7 ms. The images are then analyzed using homemade image processing programs on MATLAB and compared with a database of theoretical interference patterns to determine the most probable particle height.

Besides varying the ionic strength of the solution, we also control particle height by coating the particles and substrate in lipid membranes

having different charge densities, as depicted in Figure 1. This process alters the surface potentials of particles without changing their physical characteristics [4].

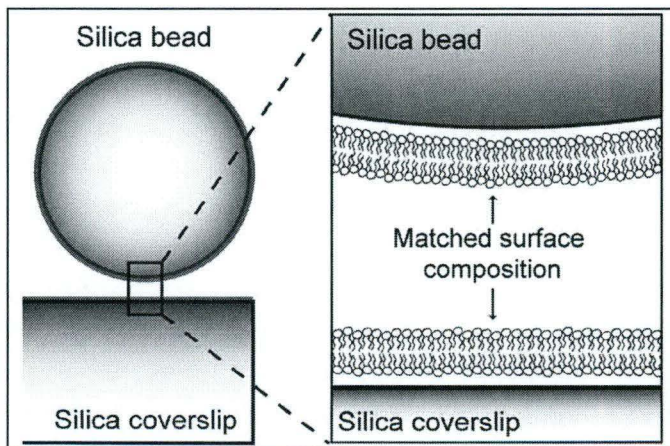


Figure 1: Membrane coated silica microsphere and substrate [5].

The altering of surface potentials leads to a change in magnitude of the electrostatic repulsion between particles and substrate, allowing us to study a wide range of particle-wall separations within a solution of a given ionic strength. Using these two methods of height control in conjunction should result in an analysis of height dependent, inter-particle interactions that are independent of any effects due to the ion concentration of the solution.

To study isolated particle pairs, control of lateral positioning is crucial. The necessary control can be accomplished with the use of a holographic line trap for which a focused laser creates a small force directed toward the center of the beam. This technique allows for precise lateral positioning of the particle, and inhibits lateral Brownian motion. The purpose of the optical trap was to isolate pairs of microspheres so that effects due to other particles would be negligible while also positioning the microspheres at different radial separations. The traps would then be turned off and the behavior of the particles observed. We found, however, that a dichroic lens used to direct the laser into the sample caused an uncorrectable distortion in the RISM images and forced us to abandon that approach.

Data

The experimental data comprise only RICM images such as those shown in Figure 2. The images are analyzed to determine an intensity profile as a function of the particle radius. The resulting profile is then compared against a previously calculated database of intensity profiles to determine the particle height. During this analysis, the lateral position of the ring centers is calculated, which enables us to determine the separation between particle pairs. Repeating this process for a series of images results in a height profile that shows Brownian motion in the z-direction about a mean height (Figure 3). Analyzing the height distribution gives us information as to the accuracy of the RICM technique. Specifically, the deviation in height for a particle stuck to the substrate via Van Der Waals interactions reveals the error in measurement, which is on the order of 1 nm.

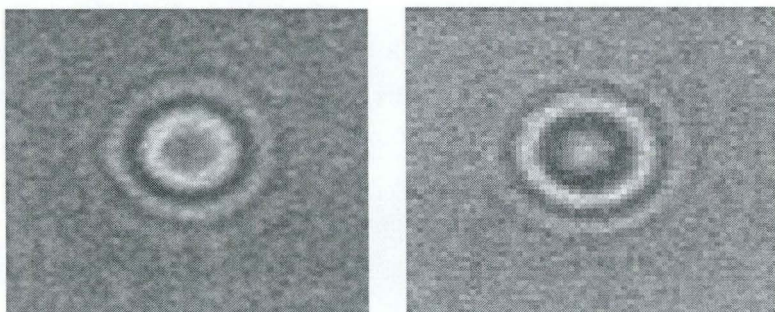


Figure 2: RICM images of particles at heights 0 and ~190 nm (respectively) above a substrate.

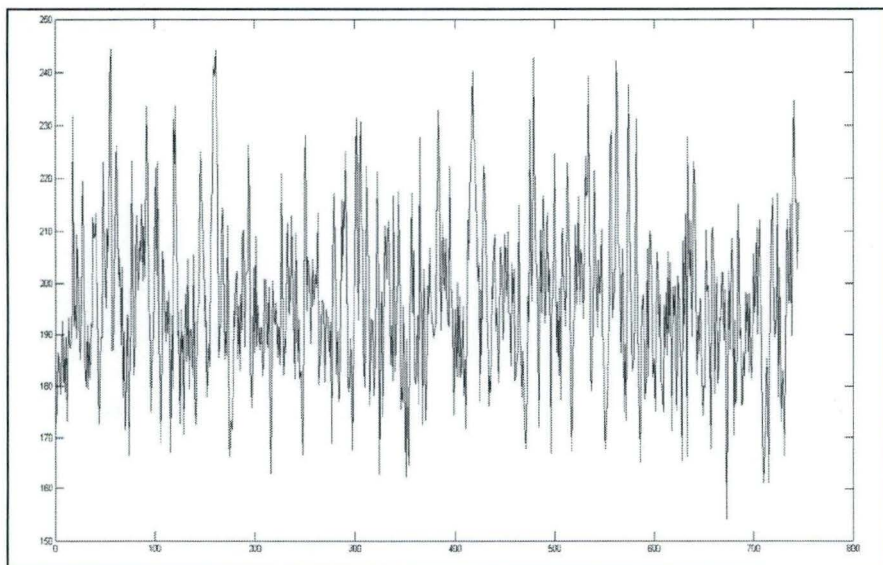


Figure 3: Plot of height vs. time obtained from analysis of RICM images taken over a 20 s time interval (~750 images). Heights range from approximately 170 to 230 nm.

Discussion

Our preliminary work has focused on testing techniques and determining their potential for use in characterizing the height dependence of colloidal, like-charge attraction. The RICM method, while accurate, has drawbacks. The first drawback relates to the “half-lambda” limit. The interference patterns are unique to a height of approximately half the wavelength of the light used. The pattern then repeats, making it difficult to determine the absolute height of a particle. To get around this problem, we have begun cataloguing particle heights for a wide range of ionic strengths. For high ion concentrations, changes in height appear to be small compared to the half-lambda limit so that the calculated height represents the absolute height. For low ion concentrations, however, particle heights may change by more than the half-lambda limit making height measurements unreliable. For

our studies, we are concerned primarily with particles in close proximity to the confining wall and therefore can restrict our experiments to high ionic strength solutions. The second drawback is the sensitivity of the technique to focal depth. Height measurements can fluctuate by 50 nm or more if the microscope focus is not precisely on the substrate-medium boundary. This can be corrected for by ensuring that a particle bound to the substrate is within the field of view, then subtracting the mean calculated height of the bound particle from the calculated heights of particles that are electrostatically levitated above the substrate.

The preliminary determination that RICM and optical trapping could not be used in conjunction proved to be a major setback. Further research into alternative particle manipulation techniques is currently under way. Some possible alternatives are magnetic trapping, wherein particles with a magnetic core can be manipulated via magnetic fields as opposed to laser beams. Another possible technique was developed by Franosch for which a large ($\sim 100\text{ }\mu\text{m}$) particle is confined between two walls, and a much smaller particle ($\sim 3\text{ }\mu\text{m}$) is placed in the vicinity of the larger particle through the use of an optical trap [6]. The larger particle approximates a planar boundary, and the lateral separation between the two now serves as the distance from a confining wall. Implementing the first option would still require RICM to determine particle height, whereas the second option would not.

Assuming that the implementation of an alternative approach is feasible, given our current lab setup and resources, the experimental phase should proceed relatively quickly and provide us with sufficient data to develop a theoretical model of colloidal, like-charge attraction as a function of pair-particle distance from a confining wall.

Addendum

Recently, work on the optical trap setup improved the alignment of the optics and added a new mount for the dichroic lens. The older lens mount may have applied stresses to the dichroic lens that caused it to become warped and distort the RICM images. Although the principal purpose of the improvements was to allow the use of a spatial light modulator, the modifications also allowed the optical trap to be used in conjunction with RICM, a combination that suggested the need for further research. Our research on like-charge attraction will therefore continue in the summer, 2010.

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Canoe Journey as a Model for Language Revitalization: Experiences with the Grande Ronde Canoe Family

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1.0 Introduction:

Canoe Journey is a yearly event that serves to preserve traditional Northwest Native life-ways and traditions, and facilitates revitalization of language and culture. As many as ninety tribal groups are represented, with more than 100 canoes and 10,000 people in attendance (Suquamish Tribe, 2009). The Journey is part of a progressing indigenous social movement known as the Canoe Resurgence (McReynolds, 1996) that is unique to the ocean traversing tribes on the west coast of North America.

The Canoe Resurgence structures itself around Canoe Families that represent one or more tribes from the Pacific Northwest. The Family is a community built around the continuation of Northwest Indigenous life-ways and ceremonies. Canoe Families often establish themselves as groups for youth to experience and live their culture, but participation of families and elders is also highly valued. The focus on youth is valuable in that young people are vessels of linguistic continuity, without whom their languages and cultures will die with their parents and grandparents. Chief Frank Nelson, one of the founders of the Journey, recalls the importance

of youth at the beginning of the movement as “an opportunity to commit ourselves to a healing path for our children” (Neel, 1995). That commitment does not end when the Journey is over, but continues in every aspect of the lives of those involved. The Canoe Resurgence aims to strengthen traditional Northwest values (Red Eagle, 2009), which include life-ways, ceremonies, and languages.

Historically, the Pacific Northwest has been a place of vast linguistic diversity. In Oregon alone more than 30 languages were spoken, with many dialectical variations among each. The arrival of White trappers, traders, military, settlers, and diseases left some languages with few remaining speakers. The forced removal of many tribes from ancestral homelands as part of the reservation process lent itself to further language loss as many linguistically distinct groups were forced to live together. For example, the Siletz and Grand Ronde reservations in Oregon include people from over a dozen different tribes, who speak more than a dozen mutually unintelligible languages. As a consequence, most people spoke Chinuk Wawa, and their original languages fell out of daily use (Underriner, 2010).

The establishment of Indian boarding schools in the United States and Canada further destabilized Northwest indigenous languages. Indian boarding schools actively discouraged and punished the speaking of native languages. While inhumane, these techniques were highly effective in destroying many native languages and instilling negative social views towards passing on indigenous languages and ways of life. Although those views are not as common today, tribes still feel the effects of those policies as they face a lack of knowledgeable tribal elders able to impart traditional life-ways and language.

This study aims to describe Canoe Journey as an effective model for native language revitalization because it provides an extended setting outside of modern cultural influences that allows language to be spoken on

a daily basis. Two main venues exist within the structure of the Journey to facilitate language revitalization: full immersion and traditional language learning. Language learning is time intensive, needing approximately 500 hours of instruction for basic conversational proficiency (Hinton, 1994). Canoe Journey could offer a conservative estimate of 120 hours in a summer.

This paper will discuss the history of canoes in the Pacific Northwest and examine the two predominant types of canoes and their decline. Canoes' importance to tribes of the area along with their importance to the potlatch will also be discussed. The Canoe Journey will be described as the author experienced it with the Grande Ronde and Chinook Canoe Family. Following an examination of canoe protocol, a discussion of obstacles to language revitalization and their adverse effects on language teaching efforts will be addressed. We will then examine language learning and teaching theories and apply them, using the Canoe Journey as a setting. We will return to a discussion of the benefits and limitations of the Canoe Journey as a language learning model to conclude the paper.

2.0 History of Northwest Canoes:

Before European contact, canoes were a vital way of life for Northwest people. Bobby Baker of the Suquamish tribe compares their importance to horses for the plains people: "We're water people. Just as sure as plains people need their horses, water people need their canoes" (Neel, 1995). Leslie Lincoln, a maritime anthropologist, estimates that over 20,000 canoes once paddled the waters of the Pacific Ocean carrying goods, people and culture for hundreds of miles up and down the coast (McReynolds, 1996). The importance of the canoe should not be understated. Not only did it fuel the vast trade networks of the Northwest, it was a vessel of diplomacy between tribes and served to connect people who typically would be

isolated from one another. In the Puget Sound, where canoe culture was particularly strong, travel to other tribal groups would be prohibited if not for the highly developed canoe.

Two types of ocean going canoes, both constructed from the largest cedar trees in the world, were common from Alaska to southern Oregon. The first type, found mostly within Salish speaking communities of the Puget Sound and north into Canada, are known as the Coast Salish canoes. They are distinguished by their almost symmetrical bow and stern. They are usually carved from a single log of cedar that is spread using steam. The Coast Salish canoes often bear intricate painted designs along the sides, which hold specific significance to the tribe or canoe family.

The second type of ocean cedar canoe is known as the West Coast, Nootkan or Chinook canoe. This style of canoe could be found off the coast of Oregon north into Washington. They are generally larger than the Salish canoes sometimes reaching 50 feet in length. Due to the harsher weather conditions faced in the open sea, as opposed to the Puget Sound, the length of the Chinook style canoe gives the vessel greater stability when traversing ocean environments. Traditional Chinook canoes are less elaborate in their designs and limit themselves to black paint on the outside of the hull and red on the interior. This is especially true for tribes south of the Puget Sound, for example those from the Columbia River. Their flat vertical stern, and bow made from a separate piece of wood identify these canoes.

Canoe usage followed in many ways the decline of tribal language and culture. Canoes were widely used into the early part of the twentieth century, but as western economic and cultural power grew, use of canoes diminished until they were almost nonexistent for tribes of the area.

In the 1980s, Northwest Natives started the process of reclaiming the canoe as a central cultural theme. Community leaders who founded the

Canoe Journey in 1989, then under the name Paddle to Seattle, recognized that if something were not done, their culture and languages would continue to degrade at an alarming rate. They chose the canoe as their central icon.

2.1 The Potlatch:

Canoe Journey has its roots in traditional potlatches of the Northwest. Throughout history Northwest tribes used the potlatch as their central method for social cohesion, ceremonies, and inter-tribal diplomacy. Potlatches occur around marriage or naming ceremonies for example. In these instances, gifts are given to the guests expressing thankfulness and recognizing their role as witnesses who legitimize the event. Canoes were a central component of potlatches for coastal people as the primary method of transit for the guests. Just as a parking lot is filled with cars for a wedding, a beach was lined with canoes.

In the early twentieth century, Canada and the United States outlawed native traditional ways, thus prohibiting the practice of potlatches. After the outlawing of potlatches, canoes became almost non-existent on the coast. Yet, potlatches were still practiced illegally until the bans were lifted in the 1950s. Forcing potlatches to be practiced underground prevented the type of mass canoe gatherings characteristic in the past.

3.0 Canoe Journey Today:

In 2009, the Canoe Journey's destination port was Suquamish, Washington. The participating tribes, some from as far away as northern Vancouver Island in British Columbia, used five routes to reach Suquamish. As the tribes traveled towards the host nation they stopped at reservations and village sites to camp and practice traditional protocol. As the visitors left various sites, canoes from those sites joined the Journey. Ultimately, 87 canoes arrived in Suquamish on August 3, 2009. Fifteen or more stops were made with some tribes journeying for more than a month.

3.1 Stages of Protocol:

Canoe Journey protocol consists of traditional doctrines that guide intertribal relations and are central to the Journey. Protocol has three stages: arrival, in the longhouse, and departure. The first stage of protocol involves asking permission to come ashore. It is traditional to humble oneself with statements of need for food, water, and a place to sleep. A visiting nation typically praises the host with good words about a previous visit and how well the host treated them. Once the host grants permission to come ashore, the visiting nation places their canoes on land with the noses facing the water. Often this exchange occurs in each tribe's native language. Once on shore, the paddlers proceed to their campsite. After a brief settling in period, the next stage of protocol commences.

The second stage is preceded by a dinner provided by the host tribe. Afterward, visiting nations share their dances and songs with the host as well as good words that express appreciation for the generosity and kindness they have received. Typically, tribes who have travelled the farthest distance begin the sharing. For example, Maori representatives would take the floor first. The third stage of protocol is marked by the departure of the canoes. As a sign of respect and recognition of the host tribe, the visitors ask permission to leave their host's land. Again the visitors praise the host, and tribal leaders offer speeches ensuring that the host will be honored in the home nations of the visitors.

The end of the actual Journey is celebrated by a week of extended protocol. Speakers extend their orations, visitors sing more elaborate songs, and dancers show respect by wearing their finest regalia. During this week, gifts are exchanged between the visiting tribes and host nation. It is during this extended protocol that thousands of visitors gather to observe and learn about traditional Northwest culture. The week culminates in an elaborate feast followed by a traditional Potlatch.

The arrival of the canoes at the final destination is marked by the Ring Ceremony, led by Phillip Red Eagle, one of the founders of the Journey. During this ceremony participants promise to live by the *ten rules of the canoe* and uphold the canoe culture in their daily lives. The *ten rules of the canoe* outline a commitment centered on curbing the inter-personal abuse that has afflicted Native people and provides motivation for a healthy lifestyle centered on traditional Native values. In promising to uphold traditional values, participants receive a copper ring that symbolizes their commitment. Leather holds the ring and beads that symbolize each year of participation in the Journey; other special beads honor important individuals. Beads placed on the ring itself recognize canoe carvers. This year a yellow bead honoring Emmet Oliver, one of the elders of the Canoe Movement, was placed on the right side of the necklace.

The typical day for a Canoe Family starts before the sun rises, as it is important to catch a good outgoing tide so as not to fight the currents. The mornings usually consist of a quick breakfast before heading to the water to put in the canoes. Once at the water, the third stage of protocol is delivered asking the host tribe permission to leave. When granted, the visiting canoes embark, often paddling as many as eight hours in a day.

4.0 Obstacles to Language Revitalization:

The obstacles to effective language revitalization in the Pacific Northwest are a challenge for all tribes of the area. Loss of fluent speakers is a compounding problem. Most, if not all, of the first language speakers of Northwest languages are elders, and those who pass away without imparting their knowledge to the next generation leave a people unable to communicate in their native languages. Lack of financial, governmental, and social support each hamper effective language teaching programs in Native communities. Tribal governments are modeled after the United

States in their constitutional, educational, judicial, and social systems. The adoption of Western institutions required the use of English to engage the United States and Canadian governments, and has been detrimental to native language use.

Too often tribal language programs are underfunded, surrounded by unsupportive tribal policies, and are sources of controversy within tribal communities. Leanne Hinton (2001) has addressed the devastation such controversy can cause: "Smaller programs such as those on the American mainland are much more likely to fail altogether when leadership becomes split and their positions harden against each other." Negative social attitudes towards academia caused by historical United States educational policies fuels this distrust. Additionally, it is a challenge for communities to cohesively support language programs. Lack of commitment on the part of tribal members cannot be understated as a fundamental reason for the ineffectiveness of many language programs.

With the adoption of Western institutions came the adoption of Western values that place emphasis on economic viability and successful social integration. These prevailing social attitudes prevent many tribal members from investing the time necessary to productively speak their languages. Even in communities with strong immersion and early education, language teaching efforts are hampered by a lack of commitment from parents to foster the language environment in the home. Further compounding this problem is the commonly held attitude that language teachers who learned their indigenous tongue as a second language are not speaking correctly or in the right dialect. This view is extremely detrimental to language programs. As one language teacher argued: "I don't speak like my grandmother, but I speak the language of my grandmother" (Reyhner, 2003).

Negative social attitudes and tribal policies combined with lack of education about effective teaching models suppress language revitalization.

Many well-intentioned tribal leaders have attempted to learn and teach their languages without any formal background or training in language teaching. While that effort is admirable, it is often ineffective. Without a firm understanding of language teaching methods and theories, most language programs do not succeed.

Perhaps the largest obstacle standing in the way of successful language learning is the lack of settings for language use. No matter how much one studies a language, if a speaking environment does not exist, it is impossible to achieve fluency. Canoe Journey offers a unique environment in which to establish a year round speech community rooted in traditional values. It has the potential to serve as a haven for language use removed from overwhelming social, political, and media forces dominated by English. If Canoe Families are able to establish themselves as language nests, in much the same way as the Maoris and Hawaiians have done, they would ensure the continued use of their languages into the generations to come. "Language cannot be perpetuated in a single domain such as school or the church. Children will need to be able to communicate their feelings, hopes, opinions and thoughts in (their language) in all domains of life if the language is to truly survive" (Warner, 2001).

Lack of cultural relevancy in language teaching also deters tribal members from learning. In a traditional setting for language learning, cultural learning is secondary to language, "teachers [are content that] students will be exposed to cultural materials *later*, after they have mastered basic grammar" (Hadley, 1993). While that view is not necessarily negative, it can discourage Natives who are not comfortable in a Western academic environment. In the author's experiences with academic language classes, keeping Natives enrolled in school is a challenge. Canoe Journey offers a solution to this problem by offering an environment of cultural immersion removed from dominant Western society.

5.0 Canoe Journey as a Language Teaching Model:

Canoe Journey can serve as an environment conducive to language learning and will be successful if rooted in theories of language teaching, learning, and acquisition. Traditional Western methods of language teaching have their foundations in explicitly teaching grammar and vocabulary through the learner's first language. Literacy is valued as much as, if not more than, spoken proficiency (Richards & Rodgers, 1986). Through rote memorization and translation of vocabulary lists and texts, students intellectually learn the structure of a language. The limitations of these methods lie in their lack of emphasis in conversational proficiency. While the methods are useful in academic and linguistic contexts, approaches that promote conversational fluency are more valuable to native communities because spoken fluency is the goal. Furthermore, native languages lack a written tradition and their cultures place value on the oral tradition.

Several alternatives that draw from language learning in a natural setting have emerged over the past 30 years as effective methods suited for implementation in the Canoe Journey.

5.1 Approaches to Language Teaching:

In a traditional language learning environment, as experienced in high school or college, material is taught as any other academic subject. Rote memorization, translation, and instruction through the student's first language are typical. At the root of these language teaching methods lies an assumption that adults are unable to learn language in the way a child does, and thus need to learn through the same processes one would learn any other academic subject.

The basis for language immersion techniques lies in the premise that the most efficient way to achieve fluency is through immersion in an environment where the language is spoken. Immersion techniques

recognize the delay of traditional language teaching techniques in achieving communicative proficiency and seek to return to a more natural method of language learning. Immersion promotes learning at a rapid rate through use of contextually based language use. Within the approach of immersion there are various techniques for language teaching.

Interaction between language teachers and learners must be emphasized early on in learning. Wilga Rivers (1984) describes the importance of interaction and its necessity from the early stages of language learning. "Students achieve facility in *using* a language when their attention is focused on conveying information and receiving authentic messages. This is *interaction*." She goes on to describe interaction as a "collaborative activity" that "should be the norm *from the beginning of language study*... Interaction becomes essential to survival in the new language" [emphasis in original] (Rivers, 1984).

5.2 Canoe Journey for Language Revitalization:

The Canoe Journey offers a unique setting, which is its strength for language revitalization. Because it is removed from mainstream United States culture, it can facilitate full or partial immersion learning. Within Canoe Journey and the Canoe Family, several language learning settings hold different potentials for language use, and each has its own distinct advantages and disadvantages.

5.2.1 Language Learning Settings:

The six to eight hour period spent within the canoe each day, provides the most obvious and potentially effective setting for effective language teaching. It is an ideal environment in which to employ psychologist James J. Asher's Total Physical Response (TPR) approach. TPR takes advantage of the silent period of language learning by focusing not on learners speaking, but on them performing a physical task at the request of

a language teacher. This approach provides a low-stress environment ideal for adult language learners with high affective filters (attitudes that impede or block input necessary to language acquisition). Research in several fields has established that when words are associated with actions or images, instead of merely being translated into the learner's first language, a learner will benefit from increased retention of the vocabulary. Once proficiency is established by responding to simple commands, language teachers could elaborate on the complexity of the material by telling stories using the vocabulary learned and making observations about the surroundings from the canoe. There are countless opportunities to teach about wildlife, geography, and the vocabulary of location. For example, while paddling, we observed a bald eagle roosting in a tree. This would be an opportunity for the language teacher to teach the students the words for "eagle," "fly," "on top," and others that would add a depth of understanding.

These approaches could work particularly well in a canoe with a skipper who is a language teacher, as is the case in the Grand Ronde Canoe Family. Skippers could use only their language when giving canoe commands. The environment is rich enough that the skippers could teach canoe vocabulary, personal pronouns, words for the natural environment, locational terms and verbs.

Among tribes with fluent language speakers, full language immersion could be established in the canoe setting. In *How to Keep Your Language Alive*, Leanne Hinton stresses the importance of immersion and argues that "people learn best when we are surrounded by the language, don't hear any English, and don't have the language translated to us. Instead, we learn by hearing the language in such a way that we can understand what the general meaning is through context, gestures, and activities...many hours of immersion are necessary for extensive learning...absorption in the activity is when true learning starts" (2002).

Immersion techniques draw from the theory that language learning is best achieved by creating an environment mimicking that in which a child naturally acquires language. This approach is often referred to as the Natural Method. Full immersion requires that a skipper or language teacher in the canoe is fluent in the language being learned. While this is ideal it is still possible to achieve partial immersion in settings without a fluent speaker using the TPR approach.

The relaxed camp setting would provide more challenges to learning, especially if the goal is full immersion. The wide range of ages and language fluency could prove to be an obstacle for full immersion, but language use could be encouraged as much as possible. When members of the Canoe Family are eating and relaxed it may not be conducive to speaking their native language until conversational proficiency is achieved. Language teachers could, however, use this setting to teach common kitchen, food, and camp vocabulary until members of the Canoe Family are at higher levels of speech ability. A potentially effective technique to do so would be that used by Loren Bommllyn of the Smith River Rancheria of the North California Coast. When learning Tolowa, Bommllyn would reply in conversations first in Tolowa and then in English effectively creating his own environment for language use (Hinton, 2002). This instant translation proved a great tool for language learning and could be adapted by Journey language teachers. Moreover, the technique does not require fluent speakers so that it could be widely implemented.

Protocol offers a setting different from the ones described above in that it would be difficult to encourage language use from the learners. It could, however, serve to increase comprehension skills and motivate learners to succeed. When tribal leaders have knowledge of their language, it is common for them to use it for orations during protocol. Observing influential and esteemed individuals speaking in this way could provide

essential motivation for Canoe Family members to learn their language. In *Nurturing Native Languages*, Reyhner (2003) discussed this potential and emphasized how “one can maximize student motivation through strategic use of Indigenous Languages at special events.”

The year-round commitment required of Canoe Family members provides the opportunity for extended language teaching and learning outside of the Journey itself. Lessons could be learned from the language nests of the Maori and Hawaiian people. In New Zealand, Maori elders recognized language loss as a rapidly growing problem threatening their traditional values. This led to the establishment of language nests that provided settings in which children are at least half-immersed in the Maori language during primary and secondary school and exposed to the language in their homes. The goal is to provide environments for language use. Hawaiian language activists, who also have had success using the model of the Maoris, currently operate dozens of immersion schools and actively maintain settings for using language.

Canoe Families could establish themselves as language nests, using their language in regular Canoe Family meetings. Throughout the year, Canoe Families meet to practice songs and dances, share meals, and prepare for the Journey. These meetings serve to keep the Family as a cohesive social group. If conducted in their native languages, those meetings could serve as a means to accomplish language revitalization. Non-Journey Canoe events are also ideal language settings. Canoe races and various educational events held in the warmer months bring Canoe Families together in the Canoe setting.

6. Conclusion:

Further language loss in the Pacific Northwest is unacceptable. When an indigenous language dies, thousands of years of human experience and

thought evolution die with it. Unique ways of interacting with the world and each other are permanently lost. Culture lives through language, and to teach language most effectively, it must be done through culture.

Canoe Journey offers the opportunity for Native people in the Pacific Northwest to commit to a path of linguistic healing. While teaching settings removed from cultural relevance, e.g. a classroom, are valuable, they will not result in language revitalization. Recognizing the interconnectedness of language and culture and committing fully to it, in the form of the Canoe Journey, will lead language teaching efforts to success. The potential for language immersion and natural language acquisition in the Journey make it a unique and valuable setting for language revitalization.

This paper is meant to serve as a catalyst for language teachers who are unsure of how to implement their language programs. It is not a comprehensive approach to language teaching through the Canoe Journey, but a starting point for a discussion about the Journey as a language teaching tool. Each tribe has specific language needs that only members of that nation can solve. Therefore, each teaching approach will need specific techniques developed by tribal members and tailored to the language and the people. But the Canoe Journey holds the promise of creating a permanent haven for language use in addition to its cultural significance.

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Emotion Regulation Strategies and Interpersonal Perception in Social Interaction

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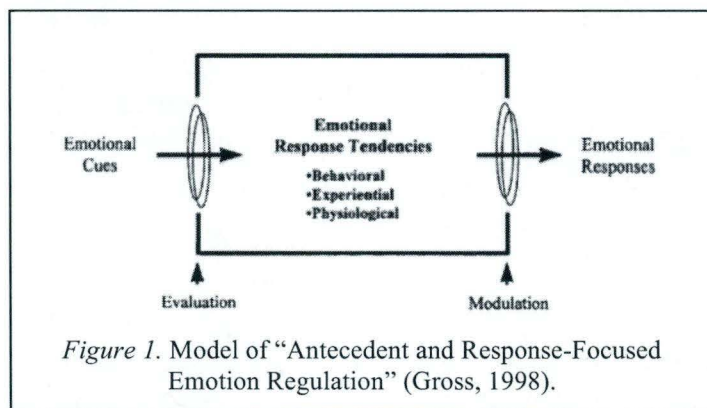
Introduction

As social creatures, the great majority of us need relationships, a feeling of community and some level of companionship. Without relationships, especially for long periods of time, there are negative impacts on a person's well-being that may lead to depression, lower self-esteem, increased perceived stress, and increased difficulty coping with stress (Baumeister, DeWall, Ciarocco, & Twenge, 2005; Buckley, Winkel, & Leary, 2004; Cacioppo, Hawkley, & Berndtson, 2003; Twenge, Baumeister, Tice, & Stucke, 2001). Social interaction is key for relationships to form and bonding to occur.

Important factors affecting the quality of social relation are emotions and their expression because they elicit positive and negative reactions from others. Someone who frequently experiences anger might be more likely to be excluded from social groups, a result that may lead to even more anger. The expression of emotions can affect likability (Labott, Martin, Eason, & Berkey, 1991). Facial expressions, tone, and inflection affect how people perceive meaning in an interaction, affecting its overall quality. A person's social support may be impacted either positively or

negatively with consequences on self-esteem, stress, and mental well-being. While emotions have an impact on social interaction, the way emotions are regulated affect social interaction as well.

To understand the effects of emotion regulation on social interaction, we must first understand the role emotion plays and what exactly emotions are. According to Gross (1998), an emotion is “a flexible response sequence that begins when an individual evaluates or appraises a situation that presents either challenges or opportunities.” Gross’s response-tendency perspective (Figure 1) is one way to better understand the way emotions work. An emotional cue represents the first step in the model and triggers the rest of the sequence. The cue is evaluated as relevant, important, and as something that will result either in a reward or a challenge. Next, the cue activates emotional response tendencies that may be physiological, experiential, or behavioral. After that stage, response modulation occurs, a phase that refers to “various kinds of attempts to influence emotion-response tendencies once they already have been elicited” (John & Gross, 2007). Finally, the emotion response is manifested in behavior.



There are two distinct categories of processes for emotion regulation: antecedent-focused and response-focused. Gross identifies five more

specific facets, four of which correspond to the antecedent-focused category and one to the response-focused category (Figure 2). Antecedent-focused processes refer to the voluntary or involuntary things we do before emotion-response tendencies are fully activated. Response-focused processes, in contrast, are those that occur once an emotion is underway and after the response tendencies have already been triggered (Gross, 1998; Gross & John, 2003; Srivastava, Gross, John, McGonigal, & Tamir, 2009).

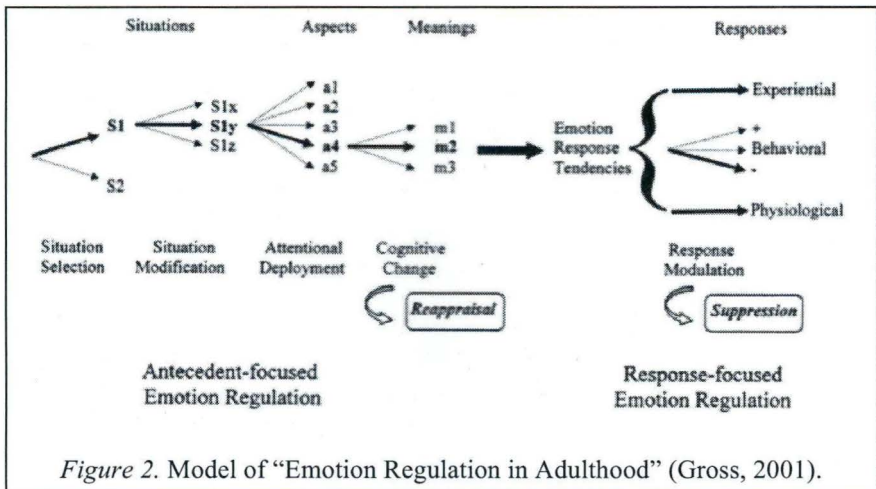


Figure 2. Model of "Emotion Regulation in Adulthood" (Gross, 2001).

In this study, we looked at one antecedent-focused strategy and one response-focused strategy. The antecedent-focused strategy was cognitive reappraisal, which involves actively keeping the emotion-eliciting event in mind while actively seeking other interpretations of its meaning and self-relevance (Gross, 2001). Socially, reappraisal is related to more frequent expression and greater intensity of positive emotions as well as being related to better interpersonal functioning (Gross, 2001).

The response-focused strategy was expressive suppression, which is the process of attempting to inhibit emotional expressions as they occur

(Srivastava et al. 2009; Butler, Eggless, Wilhelm, Smith, Erickson, & Gross, 2003; Gross, 1998). This strategy has different social impacts on the individual including lower social support, less closeness to others, and lower social satisfaction (Butler et al., 2003; Srivastava et al., 2009).

Emotional responses and tendencies affect social interaction directly. The way one person behaves and emotes has an effect on others involved in the interaction. In one study, participants watched a movie in the presence of a confederate who variously laughed, cried, or expressed no emotion. After the movie, a three-minute interaction between the participant and confederate revealed that criers were seen as more emotional and depressed than those who laughed. Generally, men appeared more likable when they cried while women were more likable when they did not (Labott et al., 1991).

To explore how emotion regulation relates to social interaction, a study by Srivastava et al. (2009) looked at the social costs of emotional suppression in students and their transition to college. They found that suppression levels predicted the levels of social support, closeness, and personal satisfaction. The more a person suppressed, the lower the levels on these variables were. A study by Butler et al. (2003) found similar effects of suppression in an experimental setting. Randomly assigning women into dyads, in which a woman was instructed to reappraise, suppress, or act normally, Butler et al. found suppression disrupted communication and magnified the blood pressure responses of the suppressor's partners. Also, Butler et al. found that suppression had a negative impact on the regulator's emotional experience and magnified her blood pressure while reducing rapport and inhibiting the formation of relationships.

Although the role of emotion regulation is clear, exactly how and why it specifically affects these changes is not. The phenomenon we studied to help answer these questions is interpersonal perception. Interpersonal

perception refers to the perceptions people have while interacting with one another; i.e., how people see each other and how they are seen in different ways (Kenny, 1994). These perceptions affect the behavior and impressions people have of each other while interacting. Interpersonal perceptions are partially based on behavior, an arena in which emotions and emotion regulation play important roles. If a person is laughing at a certain moment, it will give a distinct impression that suppressing that expression, for example, would not. Emotion regulation would then have an impact on what someone perceives and how the person reacts.

The Social Relations Model, devised and developed by Kenny (1994), is a helpful tool to understand how these two phenomena affect one another. In Kenny's model, a perceiver's perception comprises three effects: perceiver, target, and relationship. The two relevant effects in this study are target effects and perceiver effects. A target effect refers to how a person is seen by people in general. A perceiver effect refers to how a person sees other people in general. With those ideas in mind, we can find out how emotion regulation affects social interaction by looking at how both reappraisers and suppressers perceive and are perceived by others.

The Present Study

Both suppression and reappraisal have been studied systematically in solitary situations (Gross, 1998; Gross, 2001). In addition to studying solitary situations, researchers have studied suppression in terms of social and personal outcomes in social exchanges between dyads, but not extensively (Butler et al., 2003). Initial interactions sometimes occur in dyads but first-time interactions may occur just as frequently, if not more so, within small groups.

We wanted to measure the individual differences in emotion regulation strategies and their effects on participants' perceptions and behavior in group

interactions with three to five people. The Big Five Inventory (BFI) is used to measure personality through five different dimensions: Extraversion, Agreeableness, Openness, Conscientiousness, and Neuroticism. Participants' perceptions of each other and of themselves were measured using these five traits. We predicted that suppression affects the behavior of suppressors behavior, causing them to be perceived (target effect) as low in openness and extraversion and high in neuroticism. Second, we predicted that suppression will affect how suppressors perceive others, leading them to view others (perceiver effect) as low in agreeableness and conscientiousness. Third, we predicted that reappraisal will have an effect on regulators, who would perceive others as high in agreeableness and conscientiousness (a perceiver effect), and who would be perceived by others as high in agreeableness and conscientiousness (a target effect).

Method

Participants and Procedure

The participants were 255 University of Oregon students who were recruited through the Human Subjects Pool system for which they received class credit. Groups of three to five participants came to the lab space and began by reading and signing the statement of informed consent. They then completed a pre-questionnaire packet that was a compilation of questionnaires, including the Big Five Inventory and Emotion Regulation Questionnaire.

The next part of the study had the participants move to a round table to interact. Name tags were passed out and participants were asked to say their names for the group. Subjects participated in two formats: a Self-Disclosure group and a Leaderless Group Discussion.

In the self-disclosure format, participants were given 12 index cards, each with a question to help them get to know one another. The questions

are drawn from those devised by Aron, Melinat, Aron, Vallone, & Bator (1997) and designed to promote feelings of closeness through reciprocal self-disclosure. Participants had 20 minutes to interact, though it was not necessary for them to finish all the questions in that time limit.

In the Leaderless Group Discussion, there were added measures of hyper-competitiveness in the pre- and post-questionnaires. Also, the interaction was different from the Self-Disclosure group format. Participants were told they were all part of a committee that gave a monetary prize to worthy members of a community. They each were given a person to represent and for whom to lobby for the prize. They were told the money could go to as many people they thought were deserving and could be divided in whatever way they would like. They had 20 minutes to reach a consensus on how they were going to split the prize.

Following the interaction, the participants were asked to give everyone a different numerical rating for each person in each subset of scoring criteria. For example, when participants rated whether others in the group were agreeable, they would assign a different number for each person; there would be no ties. This procedure allowed for a bigger difference in the contrast of rating each person and because people, even if they are similar, do not have equal amounts of a certain trait. Once the questionnaire was completed, participants handed it in to be checked for accidental omissions. Once everyone was finished, they were orally debriefed on the study.

Measures

Participants rated one another on the Big Five personality traits, using two items per trait. Extraversion was measured with the items "Is outgoing, sociable" and "Is reserved," Agreeableness was measured with items "Can be cold and aloof" and "Is generally trusting," Openness was

measured with items “Has an active imagination” and “Has few artistic interests,” Conscientiousness was measured with items, “Does a thorough job” and “Tends to be lazy,” and Neuroticism was measured with items, “Gets nervous easily” and “Is relaxed, handles stress well.” Each item was rated on a scale from 0 to 10, with higher numbers indicating greater agreement.

The perceiver and target effects were calculated using formulas derived by Warner, Kenny, and Stoto (1979). For each individual, the five perceiver effects (one for each personality trait) are based on the average of how that individual rated everyone else in the group. The five target effects are based on the average of how everyone else in the group rated that individual. Self-ratings are excluded from the calculations.

Results

Zero-order correlations between Emotion Regulation and BFI components provided a way to check for replication of previous studies (such as Gross & John, 2003). We then turned to our central research questions, testing whether reappraisal and suppression predicted self, target, and perceiver scores in different models.

Preliminary Analyses

Zero-order correlations between individual differences in emotion regulation and Big Five personality traits (Table 1) provide evidence that the results of the current study replicated previous findings about the effects of reappraisal and reappraisal on the BFI traits of the regulator (Gross & John 2003). As expected, the analysis of the data revealed a significant negative correlation between suppression and extraversion ($r = -.47, p < .05$) and a significant positive correlation between suppression and agreeableness ($r = .19, p < .05$).

Do Reappraisal and Suppression Relate to Self-Perceived Personality?

The study used three models for each perceived personality rating. The first model focused on reappraisal and suppression to see if they predicted participants' self-perceptions. A significant effect of reappraisal or suppression would mean that perceivers generally saw themselves as especially high or low on that personality trait. In the second model we added the pretest BFI variables as controls. With these controls included in the model, a significant effect of reappraisal or suppression would mean that participants saw themselves as especially high or low on the personality trait during the group interaction, beyond how they generally saw themselves. The third model used perceiver and target scores as controls to see if self-perceptions can be predicted by how participants see and are seen by others. With these controls included, a significant effect of reappraisal or suppression would mean that participants see themselves as uniquely high or low in that personality dimension, above and beyond how other people see them and how they see other people (Kwan, Kenny, Robins, John, & Bond, 2004). These analyses are reported in Table 2.

Extraversion. This analysis explored whether emotion regulation variables predicted self-perceptions. In Model 1, reappraisal was not a significant predictor of how participants saw themselves in general. Suppression, however, was significant ($\beta = -.31$, $t = -.10$, $p < .05$) indicating that suppressors see themselves as generally less extraverted. In Model 2, BFI Extraversion (measured at pretest) was a significant predictor of how participants viewed themselves during the interaction. But, reappraisal and suppression did not predict self-perceived extraversion over and above the pretest measure. In the third model, self-reported extraversion was significantly associated with the perceiver effect, which is a measure of the way the regulator typically sees others, and significantly associated with the target effect, which is a measure of how the regulator is typically

seen by others. Furthermore, suppression was significantly associated with self-perceived extraversion ($\beta = -.19$, $t = -3.46$, $p < .05$), indicating that participants saw themselves as less extraverted the more they suppressed during the interaction, independent from how others saw them and how they saw others.

Agreeableness. In Model 1, reappraisal was not significant but suppression ($\beta = -.15$, $t = 2.45$, $p < .05$) was significantly associated with how participants typically saw themselves; that is, suppressors saw themselves as typically less agreeable. In Model 2 of this analysis, BFI Agreeableness was a significant predictor of how participants viewed themselves during the interaction, but neither reappraisal nor suppression were significant predictors. In Model 3, only self-perceived agreeableness was significantly associated with the perceiver effect; neither suppression nor reappraisal was significant in this model.

Openness. In Model 1, reappraisal was not a significant predictor. Suppression, on the other hand, was significant ($\beta = -.09$, $t = -2.73$, $p < .05$), indicating that suppressors saw themselves as generally less open. In Model 2, BFI Openness was a significant predictor. Reappraisal and suppression again were not. In Model 3, self-perceived openness was significantly associated with the perceiver effect and target effect. Self-perceived openness was also significantly associated with suppression ($\beta = -.13$, $t = -2.22$, $p < .05$), showing that as levels of suppression rose, participants saw themselves as less agreeable during the interaction, over and above how they saw and were seen by others.

Conscientiousness. In Model 1, neither reappraisal nor suppression were significant. BFI Conscientiousness was a significant predictor in Model 2, while reappraisal and suppression were not. Model 3 indicated that the perceiver and target effects are significantly associated with self-perceived Conscientiousness. Suppression or reappraisal, however, were

not significant predictors.

Neuroticism. Model 1 showed reappraisal was not a significant predictor, but suppression was significantly associated with how neurotic participants saw themselves in general and indicating that suppressors saw themselves as typically more neurotic. In Model 2, BFI Neuroticism was a significant predictor of how participants viewed themselves during the interaction. Suppression, however, was significantly associated with self-perceived neuroticism ($\beta = .14$, $t = 2.33$, $p < .05$). This indicates that a participant's level of neuroticism rose during the interaction as levels of suppression rose. In Model 3, self-perceived neuroticism was significantly associated with both the perceiver and target effects. In contrast, however, neither reappraisal nor suppression were significant predictors.

Self-perceptions: summary of findings

In these analyses we found reappraisal was not significantly associated with self-perceptions. Also, we found that suppression was associated with seeing the self as less agreeable in general as well as less extraverted, less open, and more neurotic. That finding was consistent both in general and in self-perceptions predicting how participants see themselves and were seen by others.

Do Reappraisal and Suppression Relate to Perceptions of Others' Personalities?

We ran three models for each perceiver personality rating. The first two were similar to the first two models of self-perceptions. The third model used self-perceptions as a control, and reappraisal and suppression as independent variables to see if they predicted participant perceptions of others in relation to participant views of themselves. A significant effect of reappraisal or suppression in this model indicates that perceivers perceive others as uniquely high or low in that personality dimension regardless of

how they see themselves. These three models are presented in Table 3.

We expected suppression to be a significant predictor of whether participants perceived others as having lower levels of agreeableness and conscientiousness. In turn, we expected reappraisal to be a significant predictor of whether participants perceived others as having higher levels of agreeableness and conscientiousness.

Across all traits and models, neither suppression nor reappraisal was significantly associated with any of the perceiver effects. Therefore, we concluded suppression and reappraisal had no significant effect on predicting how participants perceived others.

Do Reappraisal and Suppression Relate to Others' Perceptions of an Individual's Personality?

The study used three models for each target personality rating that were similar to those used in the previous analyses, except that we looked for predictors associated with how participants were viewed by others. (See Table 4.) We predicted that those with higher levels of suppression would be seen as having lower levels of extraversion and openness. We also predicted that reappraisers would be seen as having higher levels of agreeableness and conscientiousness.

Extraversion. In Model 1, reappraisal was not a significant predictor of a target effect. Suppression, however, was significantly associated with how extraverted targets were ($\beta = -.25$, $t = -4.05$, $p < .05$). The finding indicates that those with higher levels of suppression were seen as generally being less extraverted. In Model 2, BFI Extraversion was a significant predictor of target effect, but reappraisal and suppression were not. This meant the target effect was consistent with suppressors' stable self-reports of the initial BFI variables and causing the effect of the BFI to disappear. In Model 3, self-perceptions of extraversion were a significant predictor of

how participants were seen by others in relation to how those perceivers saw themselves and their levels of extraversion.

Agreeableness. In Model 1, reappraisal was not a significant predictor. Suppression, however, was a significant predictor of how targets are seen by others ($\beta = -.20$, $t = -3.20$, $p < .05$), indicating that participants who more frequently used suppression were generally seen as being less agreeable than others. Model 2 showed BFI Agreeableness as significantly associated with how participants were seen by others during the interaction. Reappraisal was not significant but suppression ($\beta = -.19$, $t = -2.95$, $p < .05$) was a significant predictor of a target effect, indicating that others see suppressors as less agreeable during the interaction, a finding distinct from how they generally are seen. In Model 3, self-perceptions were a significant predictor of how participants were seen by others. Reappraisal was not significant while suppression was ($\beta = .16$, $t = -2.63$, $p < .05$), indicating that suppressors were seen as being uniquely lower in agreeableness during the interaction compared with how agreeable perceivers saw themselves.

Openness. In Model 1 neither reappraisal nor suppression were significant. BFI Openness was a significant predictor of how targets were seen during the interaction in Model 2, but reappraisal and suppression were not significant. In Model 3, neither self-perceptions of openness, reappraisal, nor suppression were significant predictors.

Conscientiousness. Neither reappraisal nor suppression were significant predictors in Model 1. In Model 2, BFI Conscientiousness was a significant predictor of how participants were seen by others during interaction but reappraisal and suppression were not. Self-perceptions of conscientiousness was a significant predictor in Model 3 but reappraisal and suppression were not significantly associated.

Neuroticism. In Model 1, reappraisal was not a significant predictor of a target effect but suppression ($\beta = .18$, $t = 2.82$, $p < .05$) was. Model 2

showed neither BFI Neuroticism nor reappraisal as significant predictors but suppression ($\beta = .17$, $t = 2.73$, $p < .05$) was significantly associated with a target effect. This means suppressors were seen by others as having higher levels of neuroticism during the interaction, beyond how they are generally seen. In Model 3, self-perceptions of neuroticism was a significant predictor while reappraisal was not. Suppression, however, was a significant predictor of how targets were seen by perceivers in relation to how perceivers saw themselves. Therefore, suppressors were seen as being higher in neuroticism than perceivers in relation to how perceivers saw their own levels of neuroticism.

Target scores: summary of findings

In these analyses we found suppressors were seen as less extraverted in general and less extraverted than the perceivers saw themselves. Also, suppressors were seen as less agreeable and more neurotic in general, in the interaction beyond how they were seen in general, and in relation to how perceivers saw themselves.

Differences Between the Leaderless Group Discussion and the Self-Disclosure Group

In these analyses, we looked for differences in any of the previous analyses between those in the Leaderless Group Discussion and those in the Self-Disclosure group. Only one difference emerged. In the leaderless group discussion, suppressors were perceived as less conscientious; but in the disclosure condition, suppression was not associated with conscientiousness. This could be attributed to the nature of the hyper-competitive task in the Leaderless Group Discussion, having suppressors seem less conscientious as they were doing what they could to have the outcome be to their favor. This is illustrated in Chart 1.

Discussion

In the analyses, we used three different models to test the predictive capabilities of reappraisal and suppression on self, target, and perceiver scores in each of the Big Five factors. We hypothesized that suppression would affect both target effects and perceiver effects, causing suppressors to be perceived as low in openness and extraversion but high in neuroticism. We also hypothesized that reappraisal would affect both target and perceiver effects, causing reappraisers to be seen as high in agreeableness and conscientiousness and to see others as high in agreeableness and conscientiousness.

Summary of Major Findings

The examination of perceiver effects revealed no effects of emotion regulation. Self-perceptions showed that suppressors saw themselves as less agreeable in general, as well as less extraverted and less open in general and in the interaction. The examination of target effects revealed that suppressors were seen as less extraverted, less agreeable, and more neurotic.

Why were there no effects of emotion regulation on perceiver effects?

We found that emotion regulation showed no effect on perceiver effects. It could be that emotion regulation strategies simply do not have any effect on how people see others. A different mechanism may be used in perceiving others. That mechanism may not be affected by emotion regulation but may only affect behavior and, consequently, how regulators are perceived. It could also be that an effect exists but is subtle. Possibly a larger sample size could yield a more significant relationship.

Why were there no effects of reappraisal on target effects?

The results showed no effect of reappraisal on how participants were

seen by others in any of the models. Reappraisal might have no effect on target effects, or its effect may be difficult to measure because it is so internal that it lacks any external sign for others to detect.

Interpreting effects of suppression on target effects

In the analyses we found that suppressors were seen as less extraverted, more neurotic, and less agreeable. But the differences in self-perceptions and target effects stood out. For extraversion levels, both high and low perceivers saw suppressors in general in ways that were consistent with self-reported stable personality traits. In other words, both groups agreed on the levels of extraversion suppressors exuded in general. Perceivers also saw suppressors as less extraverted compared with the way perceivers saw themselves.

The evidence revealed another type of consistency between perceivers and suppressors and their views about the neuroticism of suppressors based on self-reported behavior during the interaction. Suppressors felt they were more neurotic in the interaction than they are in general. Perceivers, however, saw suppressors as high in neuroticism both in general and as uniquely high during the interaction. Both groups, therefore, agreed that suppressors were high in neuroticism during the interaction. Suppressors, however, felt they were more uncharacteristically neurotic during the interaction than they were in general, while perceivers saw suppressors as being generally neurotic as well. Perceivers also saw suppressors as more neurotic in relation to how perceivers saw themselves.

In contrast to these two types of consistencies, we found none in the relationship between agreeableness and self-reported personality. We found that perceivers saw suppressors as less agreeable in general, uniquely low in agreeableness during the interaction, over and above how perceivers saw suppressors in general, and less agreeable in relation to

how the perceivers saw themselves. Those levels of disagreeableness were inconsistent with levels reported by suppressors who perceived themselves as somewhat low in agreeableness in general but seemed unaware of how low their levels of agreeableness actually were, both in general and during the interaction.

These findings help us understand why suppressors have difficulties in building rapport and forming relationships as well as why suppressors might have lower social support, feel less closeness to others, and have lower social satisfaction (Butler et al., 2003; Srivastava, et al. 2009). As Srivastava et al. found, the more a person suppressed, the lower the levels of social support, closeness, and personal satisfaction. The results of the current study help explain the social difficulties that suppressors encounter. Generally, the more a person suppressed, the more neurotic and less agreeable that person was during interactions. While suppressors might recognize their neuroticism during the interaction, they would have no knowledge of their lack of agreeableness, a factor that made others less likely to continue interactions or seek further interactions with them. These same reasons could explain why suppression inhibited attempts to form relationships and reduced rapport among the participants in the Butler et al. study (2003).

Future Directions

While we found how emotion regulation strategies affect social interaction, more questions were brought up by these findings. A replication would be helpful to check the consistency of these findings. One useful modification might be to add the use of confederates who are instructed to use either strategy during the interaction. A different design might be necessary to look at why reappraisal showed no effect on target effects or why neither emotion regulation strategy showed any effect on perceiver

effects.

Another direction of interest would be to find why there is such a difference between how agreeable suppressors think they are, both in general and in interactions, and how disagreeably they actually behave both in general and in interactions.

A limitation to this study could be the rapidly increasing intimacy for which the questions called during the interaction and the level of acquaintance between participants. Rapidly increasing intimacy might not phase suppressors as much in a comfortable environment, either with people they already know or with less intimate questions. The intimacy of the questions could have caused added anxiety to an already anxious, introverted suppressor.

These findings could also be of use within the mental health fields by helping suppressors recognize that the level of agreeableness they show is different from the level they experience or think they show. An exploration of that difference could help suppressors be better perceived in social interactions, enhance their possibilities of social support, and raise their feelings of closeness to others.

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Charts and Tables

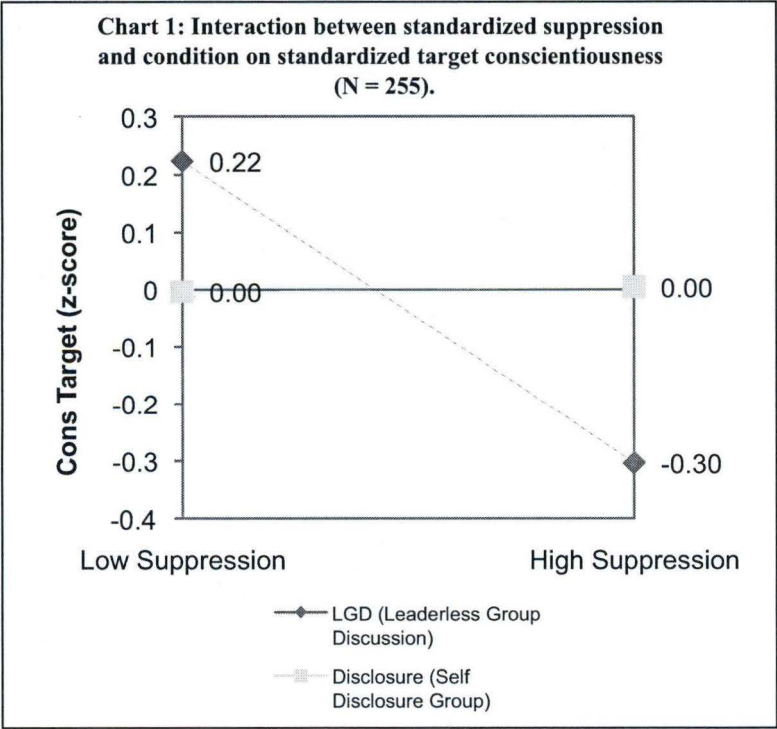


Table 1: BFI and Emotion Regulation Correlations Matrix

	Extraversion	Agreeablenes	Openness	Conscientiousness	Neuroticism
Suppression	-.47*	-.16*	-.14*	-.18*	.12*
Reappraisal	.14*	.19*	.10	.18*	-.36*
N = 255		*p < .05			

Table 2: Coefficients of the relationship between self scores with BFI, emotion regulation, perceiver, and target scores			
Outcome	Predictors	β	t
Extraversion	Model 1		
	Reappraisal	.07	1.17
	Suppression	-.31	-5.10*
	Model 2		
	BFI Extraversion	.55	-5.19*
	Reappraisal	.03	9.49
	Suppression	-.06	-1.04
	Model 3		
	Perceiver Score of Extraversion	.18	3.36*
	Target Score of Extraversion	.41	7.41*
Agreeableness	Reappraisal	.03	.58
	Suppression	-.19	-3.46*
	Model 1		
	Reappraisal	-.15	.88
	Suppression	-.15	-2.45*
	Model 2		
	BFI Agreeableness	.44	7.62*
	Reappraisal	-.02	-.31
	Suppression	-.09	-1.57
	Model 3		
Openness	Perceiver Score of Agreeableness	.30	4.98*
	Target Score of Agreeableness	.16	2.63
	Reappraisal	.03	.46
	Suppression	-.12	-2.03
	Model 1		
	Reappraisal	.05	.71
	Suppression	-.09	-2.73*
	Model 2		
	BFI Openness	.57	10.91*
	Reappraisal	-.00	-.08
Openness	Suppression	-.10	-1.91
	Model 3		
	Perceiver Score of Openness	.17	2.83*
	Target Score of Openness	.25	4.13*
	Reappraisal	.05	.88
	Suppression	-.13	-2.22*

Table 2 continued

Outcome	Predictors	β	t
Conscientiousness	<i>Model 1</i>		
	Reappraisal	.08	1.24
	Suppression	-.08	-1.30
	<i>Model 2</i>		
	BFI Conscientiousness	.50	8.97*
	Reappraisal	.01	.11
	Suppression	-.01	-.12
	<i>Model 3</i>		
	Perceiver Score of Conscientiousness	.30	5.05*
	Target Score of Conscientiousness	.24	4.02*
Neuroticism	Reappraisal	.03	.57
	Suppression	-.07	-1.25
	<i>Model 1</i>		
	Reappraisal	-.10	-1.43
	Suppression	.16	2.60*
	<i>Model 2</i>		
	BFI Neuroticism	.38	6.10*
	Reappraisal	.04	.60
	Suppression	.14	2.33*
	<i>Model 3</i>		
	Perceiver Score of Neuroticism	.17	2.94*
	Target Score of Neuroticism	.31	5.20*
	Reappraisal	-.09	-1.53
	Suppression	.11	1.77
N = 255		*p < .05	

Table 3: Coefficients of relationship between perceiver scores with emotion regulation, BFI, and self scores			
Outcome	Predictors	β	t
Extraversion	<i>Model 1</i>		
	Reappraisal	.06	.90
	Suppression	-.09	-1.47
	<i>Model 2</i>		
	BFI Extraversion	.20	2.90*
	Reappraisal	.04	.65
	Suppression	-.01	-.36
	<i>Model 3</i>		
	Self Score of Extraversion	.29	4.59*
	Reappraisal	.04	.59
	Suppression	-.00	-.06
Agreeableness	<i>Model 1</i>		
	Reappraisal	.08	1.29
	Suppression	-.00	-.02
	<i>Model 2</i>		
	BFI Agreeableness	.00	.17*
	Reappraisal	.05	.83
	Suppression	.02	.38
	<i>Model 3</i>		
	Self Score of Agreeableness	.36	6.00*
	Reappraisal	.62	1.04
	Suppression	.05	.89
Openness	<i>Model 1</i>		
	Reappraisal	-.07	-1.02
	Suppression	-.77	-1.21
	<i>Model 2</i>		
	BFI Openness	.04	.64
	Reappraisal	-.07	-1.07
	Suppression	-.07	-1.12
	<i>Model 3</i>		
	Self score of Openness	.22	3.48*
	Reappraisal	-.08	-1.2
	Suppression	-.04	-.63

Table 3 continued

Outcome	Predictors	β	t
Conscientiousness	<i>Model 1</i>		
	Reappraisal	.11	1.70
	Suppression	.05	.75
	<i>Model 2</i>		
	BFI Conscientiousness	.14	2.15*
	Reappraisal	.08	1.37
	Suppression	.07	1.07
	<i>Model 3</i>		
	Self Score of Conscientiousness	.33	5.53*
Neuroticism	Reappraisal	.08	1.35
	Suppression	.08	1.24
	<i>Model 1</i>		
	Reappraisal	-.10	-1.55
	Suppression	.02	.32
	<i>Model 2</i>		
	BFI Neuroticism	.06	.91
	Reappraisal	-.08	-1.16
	Suppression	.02	.25
	<i>Model 3</i>		
	Self Score of Neuroticism	.22	3.49*
	Reappraisal	-.08	-1.30
	Suppression	-.02	-.24
N = 255		*p < .05	

Table 4: Coefficients of relationship between target scores with emotion regulation, BFI, and self scores

Outcome	Predictors	β	t
Extraversion	<i>Model 1</i>		
	Reappraisal	.07	1.19
	Suppression	-.25	-4.05*
	<i>Model 2</i>		
	BFI Extraversion	.37	5.63*
	Reappraisal	.04	.76
	Suppression	-.09	-1.31
	<i>Model 3</i>		
	Self Score Extraversion	.47	8.15*
Agreeableness	Reappraisal	.04	.73
	Suppression	-.11	-1.84
	<i>Model 1</i>		
	Reappraisal	.02	.35
	Suppression	-.20	-3.20*
	<i>Model 2</i>		
	BFI Agreeableness	.10	1.54
	Reappraisal	.01	.09
	Suppression	-.19	-2.95*
Openness	<i>Model 3</i>		
	Self Score Agreeableness	.03	.25*
	Reappraisal	.01	.13
	Suppression	-.16	-2.63*
	<i>Model 1</i>		
	Reappraisal	.02	.33
	Suppression	-1.00	-1.61
	<i>Model 2</i>		
	BFI Openness	.27	4.37*
Openness	Reappraisal	-.00	.06
	Suppression	-.07	-1.11
	<i>Model 3</i>		
	Self Score Openness	.28	4.62
	Reappraisal	.01	.12
	Suppression	-.05	-.87

Table 4 continued

Outcome	Predictors	β	t
Conscientiousness	<i>Model 1</i>		
	Reappraisal	.06	.92
	Suppression	-.10	-1.53
	<i>Model 2</i>		
	BFI Conscientiousness	.19	2.94*
	Reappraisal	.03	.50
	Suppression	-.07	-.11
	<i>Model 3</i>		
	Self Score Conscientiousness	.28	4.58*
Neuroticism	Reappraisal	.04	.60
	Suppression	-.07	-1.22
	<i>Model 1</i>		
	Reappraisal	.06	.89
	Suppression	.18	2.82*
	<i>Model 2</i>		
	BFI Neuroticism	.08	1.26
	Reappraisal	.08	1.26
	Suppression	.17	2.73*
	<i>Model 3</i>		
	Self Score Neuroticism	.33	5.55*
	Reappraisal	.09	1.43
	Suppression	.12	2.05*
N = 255		*p < .05	

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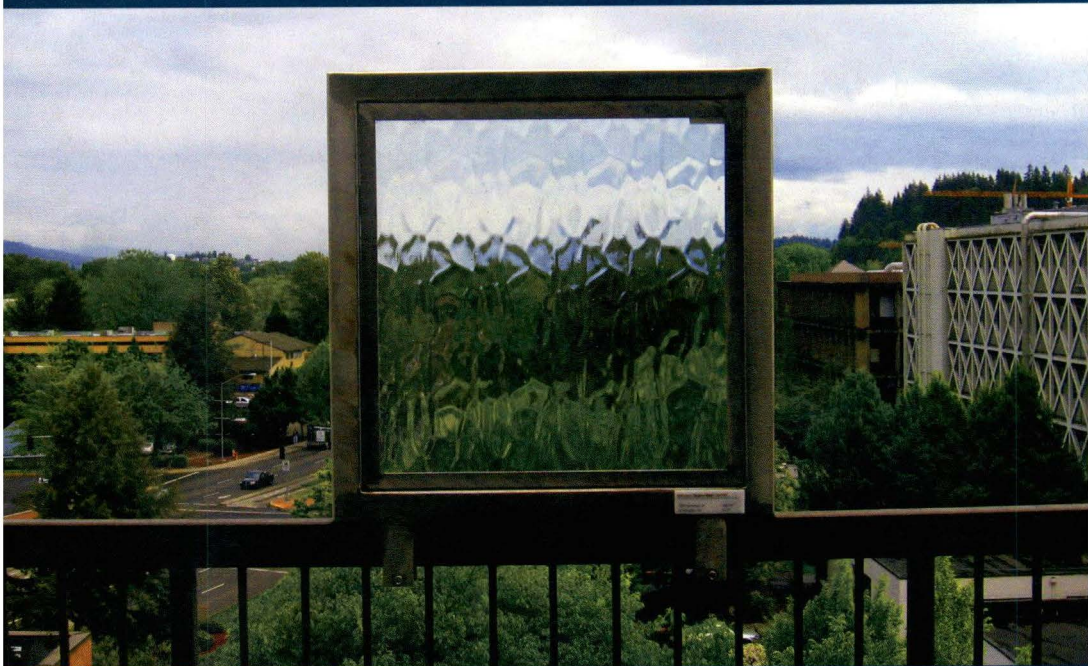
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