Undergraduate Research Journal

University of California, Riverside

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Jazmine Exford

Celeste Navas

Danielle Oleskiewicz

Maria Liliana Ramirez

Kaitlyn Spillane

Siddharth Sai

Kevin Mortazavi

Dulce Wilkinson

Zizhong Xiao

Mellonie Zhang

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From the Administration

As a research university, one of UC Riverside's most important duties is the creation of new knowledge. From exploring the inner workings of the mind to examining the cultural impacts of science fiction literature, UCR is at the forefront of discovery. The *UCR Undergraduate Research Journal*, now in its 11th volume, epitomizes UCR's commitment to ensuring that students at all levels are a part of this effort.

Undergraduate research is a hallmark of UCR's scholarly and educational missions. With more than half of our undergraduate students participating in faculty-mentored research projects before they graduate, UCR provides a wealth of opportunities for students to investigate complex questions and discover the joy of scholarly research. As you will see in this volume of the *UCR Undergraduate Research Journal*, our students are making the most of these opportunities and accomplishing truly inspiring work.

The papers that appear each year in this publication represent scholarship of the highest order. I congratulate all the students who contributed to this edition of the Journal, and I express my sincere gratitude to the faculty mentors who supported these students in their research journeys.

I hope you enjoy this edition of the *UCR Undergraduate Research Journal*.

Kim W. Wilcox
Chancellor

The *University of California, Riverside* has a long history of actively engaging undergraduates in faculty-mentored scholarship endeavors. Each year, we celebrate the very best of those efforts through the publication of the *UCR Undergraduate Research Journal.* In this volume, our students and faculty embody the very ideals of a research university that values creativity, innovation, and dissemination of those efforts. I congratulate all of the scholars, and especially the student researchers, for their accomplishments. I would also like to acknowledge the commitment of our faculty mentors, who have shared their considerable talents while continuing to generate new knowledge and guiding our students through the challenging process of conducting original research. Publication in this journal represents a formal presentation to our community of peers and mentors of that process. It is my sincere wish that through their collective experiences at UCR, each student will be inspired to undertake a lifelong journey of exploration and discovery.

The Student Editorial Board, under the general supervision of the Faculty Advisory Board, has led the peer review process, with the impressive results found throughout this volume. I wish to recognize the conscientious work of the Undergraduate Student Coordinator/Journal Editor-in-Chief, Sierra LaPoint, and the Undergraduate Education Program Assistant, Stephanie Ramirez, who also assisted in the production of the Journal. Finally, I am grateful to Gladis Herrera-Berkowitz, Director of Student Success Programs, for her professional efforts in successfully bringing this edition of the *Journal* to fruition.

Sincerely,

Richard A. Cardullo, Ph.D.
Interim Vice Provost, Undergraduate Education
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UCR Undergraduate Research Journal

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"It is a great pleasure to present UCR's Eleventh Annual Undergraduate Research Journal, which represents the very best undergraduate research conducted on our campus this year. It has been an honor to work alongside such passionate and committed individuals as the student authors, their faculty, the Student Editorial Board, and the Faculty Advisory Board, all of whom are remarkable for their devotion to the pursuit and promotion of undergraduate research and creative activity. Congratulations to the students selected for publication—your excellent work is a testament both to your scholastic achievement and to your growth within UCR's supportive and exploratory academic culture. Congratulations also to the Student Editorial Board— your diligent work reviewing and editing have ensured that the articles here published meet the high standards this journal represents. The UCR's Undergraduate Research Journal is only possible thanks to the collaborative efforts of everyone involved. I am very proud to have worked with such an amazing team of dedicated and enthusiastic individuals, and to have contributed to the legacy of excellent undergraduate research that UCR has cultivated for more than a decade."

Sierra LaPoint — Editor-In-Chief

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Pictured from left to right: Tevin Bui, Danielle Oleskiewicz, Dulce Wilkinson, Dillon McDonald, Julia Krum, Hayden Jackson, Kollan Doan, Sierra LaPoint, Celeste Navas, Jazmine Exford

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From the Faculty Advisory Board

Since UCR's *Undergraduate Research Journal* started, it has published almost 120 scholarly articles across many fields. These papers represent the commitment of many of our undergraduates to performing independent research as part of their experience at UCR. The Journal thus fills a critical need for our students. More often than not, undergraduate research forms part of a larger work with many contributors, which can mean a dilution of the student's contributions as well as a longer wait time between completion of the work and its publication. With the *Undergraduate Research Journal*, our students can write about their specific research findings and get first-author credit. They can publish before the end of the academic year, and gain the experience of seeing their manuscript go through a peer-review and publication process just like articles in a standard research journal. When a paper becomes a part of a student's professional experience, it contributes to their record of scholarly achievement in a special way.

The *Journal* is managed primarily by undergraduates who form the Student Editorial Board, working with members of the Faculty Advisory Board. We owe a debt of gratitude to the students for their professionalism and dedication to the timely review and preparation of the articles you see here. We are also grateful for the participation of the members of the Faculty Advisory Board in guiding the student reviewers.

If you are interested in publishing your undergraduate research at UCR, consider submitting to our next issue!

Dr. Morris F. Maduro
Chair of the Undergraduate Research Journal Faculty Advisory Board
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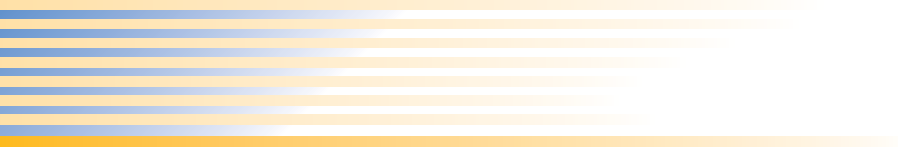|	
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Ivy Son

Department of Art History
Ivy Son is a third-year Art History major. She is currently the Director of Marketing for the Associated Students Program Board and works as an Exhibition Design Assistant at the Artsblock Museum. Ivy's passions are focused on researching Italian Renaissance sculptures and paintings. She plans to pursue a Master's and Ph.D. in Art History and a position in curating.

"Orion Nebula" by Ivy Son

This photo of the Orion Nebula was taken with the assistance of Professor Mario De Leo-Winkler at the University of California, Riverside. As a child, I admired the night sky. When I began learning photography, I wanted to be able to capture the stars in an image. After being a part of Professor Canalizo's Physics class, I was finally able to fulfill that childhood dream. This image is of nature in its most organic form. The lights contrast in a battle against the darks. The bursts of blue and purple are the calming after-effects of a violent explosion. Bursts of light are scattered throughout space, ranging in size and speed. Often times, images of the galaxy are taken for scientific purposes, to document and measure. For me, the cosmos are something to admire. The truth is, both are important; and to the scientist, the data encapsulated in this image is just as beautiful as the colors are to me. As artists and researchers, we seek out different ways to be inspired by our surroundings. Luckily, there will never be a shortage of things to discover. I am very proud of this photo — it stands as a testament to my photographic achievements, made possible through my collaboration(s) here at UCR.

Vienbenidos a San Juan: On the Distribution of Allophonic [v] for Spanish Phoneme /b/

Jazmine Exford

Department of Comparative Literature and Languages and Hispanic Studies

ABSTRACT

This research investigates the pronunciation of Spanish phoneme /b/ by Spanish/English bilinguals in San Juan, Puerto Rico to determine if graphemes v and b are ever pronounced as a voiced labiodental fricative [v]. Presently, the voiced labiodental fricative, [v], is neither acknowledged as an allophone of phoneme /b/ nor as a phoneme of its own in modern Spanish despite its use in discourse. Consequently, the existence of [v] is accounted to language contact and bilingualism, hypercorrectness, and archaic retention. For this study, I use the classification of labiodentals in modern Spanish by Lope Blanch (1988) and assess whether labiodentals appear under conditions that suggest a case of language contact. Native Spanish speaking college students living in San Juan with varying levels of English language proficiency are interviewed performing audio-recorded speaking tasks. Results show that labiodentals are undoubtedly produced for Spanish phoneme /b/, but are done so exclusively for orthographic v, which is comparable to other studies that claim labiodentals are an instance of contact induced change. However, labiodentals appeared independently from cognate status and English language abilities. Additionally, labiodental frequency reduced as speech style became less formal. Ultimately, the results suggests a case of hypercorrectness, as only orthography and speech style appeared to influence high labiodental frequency.

Keywords: Bilingualism, English and Spanish Contact, Language Change, Phonetics, Puerto Rican Spanish

FACULTY MENTOR

Covadonga Lamar Prieto

Department of Hispanic Studies

Covadonga Lamar Prieto specializes in Sociolinguistics of the Spanish in the U.S. Her corpus-based research deals with Historical Spanish in California, with a focus on language change, dialectology and bilingualism. She is currently working on a book length project on the sociolinguistic situation of Spanish in Nineteenth-Century California. As she is also interested in the contemporary consequences of historical language contact, she participates in two young projects, both UCR-funded: "Emotional Bilingualism" and "Siri and the Hispanounidenses." "Emotional Bilingualism" is a collaborative interdisciplinary project (Spanish/Psychology/Sociology/English) that examines how Spanish-speaking children from the Riverside community learn to verbalize negative emotions, especially when joining a school setting mostly in English. "Siri and Hispanounidenses" is a Digital Humanities project that seeks to understand how voice-recognition applications respond to different dialects of Spanish (Spain, Mexico, U.S). She analyzes the impact of Siri's interpretations on our understanding of US Spanish and its speakers. Besides being a Linguist, Covadonga is a Colonialist. She specializes in Colonial Mexico and the cultural production of the first Criollos: how these Criollos defined their new transatlantic identity, and the way they used to examine their society through literature.

Jazmine Exford

Departments of Comparative Literature and Languages and Hispanic Studies

Jazmine Exford is a fourth-year Linguistics and Spanish double major. She is a fellow of the inaugural cohort of the Mellon Mays Undergraduate Fellowship at UCR. Jazmine is working with her mentor, Dr. Covadonga Lamar Prieto, to formulate an R'Course on Bilingualism, Emoji Use, and Interpretation. Jazmine is interested in becoming a professor of Sociocultural Linguistics and will begin a Linguistics PhD program Fall 2017. Her future research will focus on sociocultural linguistics and the maintenance of heteronormative culture through language structure.

1. INTRODUCTION

Many scholars have studied the pronunciation of graphemes v and b in Spanish. In modern Spanish, graphemes v and b are pronounced identically, so they are represented by the same phoneme, /b/, in phonetic transcriptions (e.g. *varios* 'various,' /'baɾjos/, and *basura*, 'trash,' /ba'suɾa/). Currently, the voiced bilabial stop, /b/, has only one official allophone or variant which is the voiced bilabial fricative, [β], and it occurs when graphemes v and b appear in certain phonetic contexts. However, there are many studies that prove native Spanish speakers of various dialects will sometimes produce the voiced labiodental fricative, [v], instead of allophones [b] or [β] for graphemes v and even b (i.e. *varios* 'various,' /'vaɾjos/, and *basura*, 'trash,' /va'suɾa/ (Merz, 1990, Stevens, 2000, Cacoullos & Ferreira, and 2000 Takawaki, 2011). Despite this fact, /v/, remains unrecognized in phonetic textbooks as an active phonetic feature in modern Spanish (Takawaki 2011). This is likely because the conditions under which labiodentals appears in modern Spanish still suggest a range of interpretations. The three most common were classified by Lope Blanch (1988)[1]; they are language contact and bilingualism, hypercorrectness, and archaic retention. Language contact and bilingualism is often assumed because grapheme v is a voiced labiodental fricative, /v/, in English, causing some speakers to transfer this feature into Spanish discourse.

The present research examines this phenomenon in San Juan, Puerto Rico. Currently, there is little to no literature regarding the presence of voiced labiodentals in the Puerto Rican dialect. However, dialects of this demographic are important to examine because most have notable influence from English. If labiodentals are a phenomenon of language contact, it is certain that labiodentals will be existent in Puerto Rican speech. In any event, this data will add to the literature of the presence of labiodentals in modern Spanish varieties. Collecting data from different regions and dialects will further our understanding of what conditions labiodental production and frequency. A better understanding of these conditions will allow scholars to assess if there is a systematic distribution of labiodentals and determine the appropriate status of the voiced labiodental fricative, [v], in modern Spanish varieties.

2. LABIODENTALS IN MODERN SPANISH

As stated, a few interpretations of labiodental production in modern Spanish varieties have been classified by Lope Blanch (1988) and are reinstated below for convenience:

> 1. Class A: Archaic [v]
> 2. Class B: Language Contact [v]
> 3. Class C: Hypercorrect or Pedantic [v]

Archaic [v] means the voiced labiodental is a preserved dialectal feature, which is seen in Judeo-Spanish varieties.[2] According to Lope Blanch (1988), the labiodental phoneme has never left some Spanish dialects, including varieties in northern Mexico, California, southern Arizona, and New Mexico. Consequently, he believes that labiodental production in some Spanish varieties is not a new phenomenon due to language contact, but a preservation of archaic phonetic features. Evidence of Class A has been found by Cacoullos and Ferreira (2000) and Fernandez (2005), predominantly by looking at orthography, cognate status, word frequency, and language abilities. For instance, Cacoullos and Ferreira (2000) gathered 18 participants in New Mexico from ages 18-65 to complete audio-recorded speaking tasks. If labiodentals were induced by language contact, they expected labiodental frequency would be substantially higher for orthographic v, as well as words with low frequency and words with cognate status. Additionally, they expected higher labiodental frequency among younger speakers and those with less Spanish language proficiency. Contrary to their expectations, they found that labiodentals occurred more often in high-frequency words[3] and did so independently from orthography and cognate status. Furthermore, it was younger speakers and those with less formal educational instruction in the Spanish language that were least likely to produce labiodentals. Ultimately, they ruled it as a mixed case of language contact and archaic retention. The present study only collects speech data from young participants of the same generation who have had formal educational instruction in Spanish. If in concordance with the findings of Cacoullos and Ferreira (2000), the present demographic would be least likely to produce labiodentals. Thus, high labiodental frequency among these individuals could be evidence of contact-induced change.

Language contact [v] appears where Spanish is in contact with other languages that make a phonetic and/or phonological distinction between graphemes v and b, such as English, which is what I predict to be the case for this study. Evidence of Class B has been found by Timm (1976), Merz (1990), Stevens (2000), and Takawaki (2011), predominantly by examining orthography, cognate status, English and Spanish language abilities, and residency. Stevens (2000) interviewed 15 Spanish language instructors from the University of Southern California to analyze the frequency and distribution of labiodentals for /b/. His results found that only grapheme v was ever realized as a labiodental and that they were more frequent in cognates. His participants were all fluent in Spanish, but some were categorized as "near-native" speakers. On average, these speakers were more likely to produce labiodentals than those labeled "native speakers." Additionally, his participants who had resided in English dominant countries such as the United States or Canada for more than ten years produced labiodentals at a higher frequency than those who had residency under ten years in such places. Ultimately, he ruled it as a case of language contact [v]. For the present study, all participants are native Spanish speakers with varying degrees of English language proficiency.

Lastly, hypercorrect [v], or Class C, means labiodentals are either induced by speech formality, or the speaker uses them with the intention or assumption that labiodentals are proper or correct (Lope Blanch, 1988). Hypercorrect uses of [v] have been shown to exist in certain Spanish varieties in Mexico. Blanch (1988) analyzed the speech of politicians, radio talk show hosts, and other public figures in northern Mexico and concluded that labiodentals are often produced in formal or emphatic speech for grapheme v to perhaps show awareness of the orthographic distinction between letter v and b. Takawaki (2011) also concluded a case of hypercorrectness from her data of four speakers of northern Mexican descent who resided in the United States. Her data consisted of audio-recorded speaking tasks and were analyzed based on the educational level of the participants. The educated participants from her study produced labiodentals 17% more on average than those who were non-educated.[4] This means her educated participants are likely placing a value of correctness on

the labiodental pronunciation of grapheme v. The present research will only have participants who are currently receiving an undergraduate education and are residents of Puerto Rico.

3. METHODOLOGY AND EVALUATION
3.1 Participants and Assessments
Speech samples of twelve college students from ages 18-26 were collected from audio-recorded interviews. Additionally, participants completed an online questionnaire regarding demographic information. All participants were current undergraduate students at Universidad del Sagrado Corazón in San Juan, Puerto Rico during the time of the study. Some participants learned English before age ten and others learned at age eleven or later. Consequently, their level of bilingualism and English dominance varied. This allowed an analysis that correlated each student's labiodental production, or lack thereof, with their English language abilities.

The interview consisted of three speaking tasks that required different speech styles,[5] which went from most formal to least formal. The first speaking task required participants to read a list of Spanish words in isolation; the second task required them to read a list of Spanish sentences containing target words; and the last speaking task involved verbally translating a list of English words into Spanish. In each speaking task, the investigator took note of how each targeted grapheme was pronounced by paying visual attention to the speaker's articulation, as done by Cacoullos and Ferreira (2000). In all tasks combined, grapheme v appeared in 66% of all targeted words, which resulted to over 1,300 orthographic tokens for all speakers combined. Of the total targeted words containing grapheme v, 40% were cognates.

3.2 Variables and Predictions
The recorded samples of labiodentals were analyzed independently based on orthography (i.e. if the word contains a v or b) and cognate status (i.e. if the word has phonological, orthographic, and semantic overlap in Spanish and English as in *provocar* 'to provoke'). If labiodentals are a case of language contact, they will only be produced for grapheme v and not b, and their frequency will be substantially higher in cognates. In addition to

the linguistic variables, this research also considered two social variables, including the age at which one learned English and one's English language proficiency.[6] These are analyzed independently because the age at which one learns a language isn't always indicative of their abilities in that language. If labiodentals are conditioned by language contact, their frequency would be higher by those who learned English at a younger age due to early exposure of the English phonological system. Additionally, their frequency would be substantially higher by those who report higher English language abilities.

4. RESULTS
4.1 Linguistic Variables of Labiodental Production

As expected, orthography proved to be the most significant linguistic factor in labiodental production. Without a doubt, [v] was sometimes produced instead of [b] or [β], but it was done so exclusively for grapheme v. On average, grapheme v was pronounced as a labiodental 56% of the time that it appeared and grapheme b was never pronounced as a labiodental. These results are similar to Takawaki (2011), who found a case of Class C. In her study, labiodentals were pronounced on average 58% for grapheme v and about 1% for grapheme b. However, these results significantly

differ from those of Cacoullos and Ferreira (2000), whose participants produced labiodentals for grapheme b 69% of the time on average, reflecting a mix case of Class A and C.

Cognate status, surprisingly, did not prove to induce labiodentals, which weakens the claim of language contact [v]. *Table 1* shows the average frequency of labiodentals for grapheme v and the distribution of the total labiodentals recorded based on cognate status and speaker.[7] On average, grapheme v was pronounced as a labiodental 55% of the time in non-cognates and 59% of the time in cognates, which is a statistically insignificant difference. This means labiodentals appear independently from cognate status, which is contrary to previous expectations and discredits the notion of contact-induced change.

Speech style or speech formality was not an intentional factor in this study, but proved to be significant since the frequency of labiodentals varied substantially among speaking tasks. *Table 2* shows the average distribution of labiodentals for grapheme v based on cognate status and speaking task. The first speaking task yielded the most labiodentals (73%); the third task yielded the fewest (43%), and the second fell in between (51%), which is a notable

Speaker	Average for non-cognates	Distribution in non-cognates	Average for cognates	Distribution in cognates
S1F	40/46 (87%)	40/301 (13%)	26/28 (93%)	26/198 (13%)
S2F	17/46 (37%)	17/301 (5.6%)	7/28 (25%)	7/198 (3.5%)
S3F	26/46 (56%)	39/301 (13%)	13/28 (46%)	13/198 (6.5%)
S4F	31/46 (67%)	31/301 (10%)	15/28 (53%)	15/198 (7.6%)
S5F	2/46 (4%)	2/301 (<1%)	4/28 (14%)	4/198 (2%)
S6F	42/46 (91%)	42/301 (14%)	26/28 (93%)	26/198 (13%)
S7M	24/46 (52%)	24/301 (8%)	20/28 (71%)	20/198 (10%)
S8M	19/46 (41%)	19/301 (6%)	20/28 (71%)	20/198 (10%)
S9M	38/46 (83%)	38/301 (12.6%)	21/28 (75%)	21/198 (10.6%)
S10M	23/46 (50%)	23/301 (7.6%)	20/28 (71%)	20/198 (10%)
S11M	1/46 (2%)	1/301 (<1%)	3/28 (11%)	3/198 (1.5%)
S12M	38/46 (83%)	38/301 (12.6%)	22/28 (78.5%)	22/198 (11%)
Average	301/552 (55%)	x	197/336 (59%)	x

Table 1: Average labiodental frequency and distribution by speaker

Task	Average for non-cognates	Distribution in non-cognates	Average for cognates	Distribution in cognates
Task 1	76%	100/301 (33%)	70%	109/198 (55%)
Task 2	51%	142/301 (47%)	67%	25/198 (12.6%)
Task 3	43%	59/301 (20%)	45%	65/198 (33%)

Table 2: Average labiodental frequency and distribution of labiodentals based on task

and coincidental decline. In other words, labiodentals decreased as the required formality of the speech decreased (i.e. reading words in isolation to reading words in sentence context). Stevens (2000) also found speech style to be statistically significant in terms of labiodental production. He found that labiodentals were less frequent in speaking tasks than conversational tasks, which suggested that labiodentals were preferred in informal speech. This did not appear to be the case in San Juan. Instead, labiodentals appeared in higher rates the more formal the task was, which suggests a case of hypercorrectness

.

4.2 Social Factors of Labiodental Production

Table 3 shows the average frequency and distribution of labiodentals for grapheme v based on cognate status and the age at which participants learned English. Originally, it was predicted that students who learned English earlier would produce more labiodentals. However, those who learned English earlier produced labiodentals significantly less often than those who learned English later. For instance, the six students who learned English at age ten or before produced labiodentals 47% of the time on average and were responsible for producing 57% of the total recorded labiodentals. Yet, the other six students who learned English at age eleven or later produced labiodentals a little over 65% and were responsible for producing only 43% of all recorded labiodentals. If labiodentals were a case of language contact, we would expect the results to

be reversed.

The second social factor, English language abilities also yielded unexpected results. The data was separated into two different groups[8] based on self-reported scores ranging from 1-4 on the questionnaire regarding English language abilities. Group one reported the highest abilities in English and group two reported the lowest. Unsurprisingly, group one pronounced labiodentals 49% of the time on average. Nonetheless, this group made up ¾ of the participants, but were responsible for only 66% of the labiodentals recorded in all speaking tasks. Contrary to expectations, group two, all of whom reported poorer English abilities, produced labiodentals 75% of the time on average. This group only made up ¼ of all participants but were responsible for producing 34% of all labiodentals recorded. Again, we would expect the reverse if labiodental production is induced by language contact.

5. CONCLUSION

This study has shown a high frequency of labiodentals for Spanish phoneme /b/ among bilingual college students in San Juan, Puerto Rico. From the linguistic and social factors tested in this study, the results showed little to no evidence of labiodentals being induced by language contact. Instead, these findings show considerable evidence of a case of hypercorrect [v]. Significantly, labiodentals were highly preferred for orthographic v, which strengthens the claim of language contact [v]; however, grapheme v was not

Age	Average	Average for non-cognates	Average for cognates	Distribution of labiodentals	Distribution in non-cognates	Distribution in cognates
Before 6	51%	47%	58%	150/499 (30%)	87/301 (29%)	63/198 (32.2%)
6-10	43%	43%	43%	63/499 (13%)	39/301 (13%)	24/198 (12.2%)
11-15	61%	62%	61%	182/499 (36.5%)	114/301 (38%)	68/198 (34.4%)
16+	70%	66%	76%	103/499 (20.5%)	61/301 (20%)	42/198 (21.2%)

Table 3: Average labiodental frequency and distribution based on age at which speaker learned English

produced as a labiodental 100% of the time by any speaker. This makes it evident that other linguistic factors condition labiodentals besides orthography. With this information, we can presume that the voiced labiodental does not act as its own phoneme in Spanish, but rather as an unfaithful allophone of the voiced bilabial stop /b/. Additionally, labiodentals appeared independently from cognate status. If labiodentals were a case of language contact, they would be substantially more prevalent in cognates than non-cognates.

Furthermore, after analyzing the data based on the age at which participants learned English and their English language abilities, the results were opposite from previous expectations. These results discredit labiodentals as contact-induced change because they would be used significantly more by those with stronger English language proficiency. Class B in Puerto Rico could be examined further by looking at speakers in other regions where English language contact is less frequent than in San Juan. If labiodentals are produced only for orthographic v by speakers with little to no daily exposure to the English language, there is further reason to eliminate the notion of language contact [v] in Puerto Rico.

Likewise, there is little support for a claim of archaic retention because labiodentals were never pronounced for orthographic b. This is significantly different from Cacoullos and Ferreira (2000), whose results reflect an almost equal labiodental frequency for orthographic v and b. However, they state word frequency is the most significant indicator when classifying labiodental presence. They explain that labiodentals in low-frequency words are evidence of contact induced change because they tend to be affected first.[9] Thus, looking at labiodental production based on word frequency in San Juan could assess more

accurately whether or not there is a case of archaic retention in Puerto Rican varieties.

Correspondingly, the data of this study showed most support of hypercorrect [v]. Primarily, the results suggest a correlation between speech style or formality and labiodental frequency due to each task yielding remarkably different amounts of labiodentals. As previously stated, tasks that required less formal speech resulted in far fewer labiodentals than those that required more formal speech. These results are contrary to those of Stevens (2000) who found that labiodentals were preferred in informal speech. Therefore, my results presume that formal speech (i.e. reading, because it requires visual attention to each phonetic unit) elicits labiodentals. More evidence of Class C could be acquired through further exploration of speech style such as collecting recordings of natural speech in various contexts. Hypercorrectness can also be explored further by considering the speaker's attitudes surrounding the English language and the social implications that may surround the use of labiodentals when speaking Spanish, as this may influence their use of labiodentals.

Nevertheless, future studies should analyze this phenomenon in various regions and varieties of Spanish. Researchers should also ask speakers directly about the v and b distinction and if anything conditions their use of [v] in place of [β] and [b]. These studies should also consider linguistic and social factors that were not included in this study, such as phonetic context, word frequency, residency, and socio-economic status, to identify a more accurate pattern of labiodental distribution. Continuing these studies will allow us to determine the systematic conditions of labiodentals and will raise questions about whether the [v] should be included in the phonetic inventory of modern Spanish as either an allophone of /b/ or as its own phoneme.

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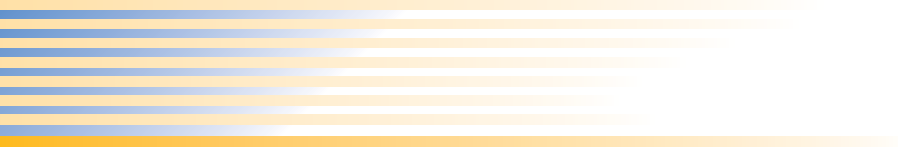
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ENDNOTES

1. These three classes exclude the presence of labiodentals due to rules of assimilation which states that a phoneme or sound will absorb some of the phonetic qualities of the phonemes that surround it. The proper use of [v] in place of [b] or [β] in Spanish exists only in cases of assimilation. For instance, [v] will occur when the voiceless labiodental.

2. Judeo-Spanish is also referred to as Ladino. See Hualde, J. I., & Şaul, M. (2011). p. 89-110, which includes a discussion of the phonological contrast between /b/ and /v/ in Judeo-Spanish.

3. High-frequency words are those that are used more in written or verbal speech. According to Cacoullos and Ferreira (2000), language change happens in low-frequency words first. If labiodentals are appearing in high-frequency words, Cacoullos and Ferreira conclude that this is likely not due to English contact, but to a preservation of archaic features.

4. High-frequency words are those that are used more in written or verbal speech. According to Cacoullos and Ferreira (2000), language change happens in low-frequency words first. If labiodentals are appearing in high-frequency words, Cacoullos and Ferreira conclude that this is likely not due to English contact, but to a preservation of archaic features.

5. Speech style refers to the amount of attention that is applied to speech. For instance, reading elicits more formal and through pronunciation of language versus speaking, which is largely due to the different attention allotted to speech. See (Labov, 1966 & Labov, 1984), who discussed the importance of attention to speech in influencing an interlocutor to make a linguistic style shift.

6. English language proficiency was determined by the self-reported scores the participants gave themselves on the questionnaire. Participants were asked to rate their ability from 1-4 in the four categories: reading ability in English, writing ability in English, oral ability in English as compared to a native speaker, and ability to comprehend English as spoken by native speakers.

7. Data for grapheme b was omitted from Table 1 since it was never pronounced as a labiodental.

8. The first group contained nine of the twelve students (¾), whose average score on a four-point scale was from 3-4. This reflected higher or more "native-like" abilities in English. The second group contained three of the twelve students (¼), whose average score was from 2-2.9. This reflected poorer, or less "native-like" English language abilities.

9. Cacoullos and Ferreira (2000) discuss the likelihood of phonetic change undergoing in low-frequency words as more likely than in high-frequency words. This is due to low-frequency words being separated into phonetic and phonological units, which is almost never necessary for words of high frequency.

Impact of a Western Diet on Lipid Signaling Molecules in the Left Ventricle of Diet-Induced Obese Mice

Kevin Mortazavi and Mellonie Zhang

Departments of Neuroscience and Biochemistry

ABSTRACT

Seventy-one percent of men and sixty-six percent of women in the United States are overweight, and over a third suffer from obesity. This has been causally linked to cardiovascular disease, resulting in 31% of all deaths worldwide. We require a better understanding of the underlying biochemical processes that affect heart health in diet-induced obese individuals to help develop effective therapeutic treatments.

Endocannabinoids are a class of lipid signaling molecules that regulate many physiological processes, including cardiovascular functions and energy balance. However, the effects of Western Diets, containing high carbohydrate and fat contents on the endocannabinoid system and resulting cardiovascular functions remain largely unknown. This project investigates changes in production of endocannabinoids, 2-AG, AEA, and OEA, in the left ventricle of mice. These lipids were extracted from the left ventricle of the heart of both males and females and subsequently analyzed using Ultra-Performance Liquid Chromatography/Tandem Mass Spectrometry. We found significant increase in levels of AEA and OEA in the left ventricle in diet-induced obese mice, which suggests that there is a diet-dependent endocannabinoid response in the hearts of mice. Further exploration is needed to better understand the biochemical processes involved in this endocannabinoid response and its physiological relevance to cardiovascular disease. Better understanding of the role of endocannabinoids in diet-induced obesity can help identify sites for drug intervention to treat obesity and cardiovascular pathology.

Keywords: Endocannabinoid, Obesity, Cardiovascular, Anandamide, 2-Arachidonoyl Glycerol, Oleoylethanolamide

FACULTY MENTOR

Dr. Nicholas DiPatrizio

Department of Biomedical Sciences

Dr. Nicholas DiPatrizio is an Assistant Professor in the Department of Biomedical Sciences. He earned his Ph.D. in Neuroscience from Drexel University College of Medicine. Dr. DiPatrizio joined UC Riverside's School of Medicine after completing his post-doctoral studies at UC Irvine under Dr. Piomelli in 2014. Dr. DiPatrizio's currently focuses on elucidating the integrative neurobiology and physiology that controls food reward and energy balance. Currently, his lab investigates endocannabinoids under wester diet-induced obesity and its effects on the gut-brain axis.

Kevin Mortazavi

Department of Neuroscience

Kevin Mortazavi is a fourth-year Neuroscience major. His research investigates the effects of Western Diet-induced obesity on endocannabinoids in cardiac tissue. He is President of both the CNAS Science Ambassadors and Support and Mentoring for Aspiring Scientists in High School (SMASH). With SMASH, he focuses on inspiring disadvantaged high school students to pursue higher education in STEM. He is also a Tutor and Early Assist Peer Educator at the UCR's Academic Resource Center. Kevin intends to pursue a career in medicine.

Mellonie Zhang

Department of Biochemistry

Mellonie Zhang is a fourth-year Biochemistry major. She is a resident advisor (RA), working to assist and mentor students in their transition into the campus community and help guide other RAs into becoming strong role models. She joined the DiPatrizio Lab in May 2015 and has been working on the effects of Western-style high fat and carbohydrate diets on a class of lipid signaling molecules in the gut.

INTRODUCTION

The discovery of endocannabinoid receptors in the late 1980s opened the floodgates to the study of an entirely new biochemical pathway that affects nearly every cell in the body. Endocannabinoids are a class of lipid signaling molecules involved in energy homeostasis as well as cardiovascular function. The endocannabinoid system was originally classified by studying Δ^9-tetrahydrocannabinol, the psychoactive component in cannabis. Δ^9-tetrahydrocannabinol was identified as an agonist of Cannabinoid receptor type 1 (CB1), a G-protein-coupled receptor. The endogenously produced cannabinoids, 2-arachidonoyl glycerol (2-AG) and anandamide (AEA), are known to have a high-binding affinity for CB1, which has been implicated in homeostasis regulation in multiple tissues [1].

The Western world is currently plagued by obesity, with 71% of men and 66% of women being reported as overweight or obese, which is credited to diets comprised of high fat, high carbs, and high sugar [2]. The recent discoveries implicating the endocannabinoid system in energy regulation suggests this system, if successfully inhibited, can reduce food intake and decrease obesity [3,4]. There is a strong association between obesity and cardiovascular disease, indicating that obesity increases the chances of developing cardiovascular disease [3,5]. Therefore, it is worthwhile to explore the possibility of using the endocannabinoid system to target not only obesity, but cardiovascular pathology as well.

Although the endocannabinoid mechanism in glutamatergic neurons is well described, the mechanisms in which endocannabinoids function in cardiomyocytes remains unknown. *In vitro* studies suggest the involvement of endocannabinoids in the regulation of cardiovascular functions occurs via nitric oxide production due to Adenosine Monophosphate activated Protein Kinase (AMPK), which mediates activation of the Endothelial Nitric Oxide Synthase [6]. *In vivo* studies have indicated that endocannabinoids regulate blood pressure through CB1 in spontaneously hypertensive rats [7]. Similar to the cardioprotective properties of CB1 by regulating hypertension, lipid signaling molecules have also been implicated in cardioprotective properties during cardiovascular infarctions [8]. These studies suggest that under stressful conditions (i.e. hypertension and infarctions) endocannabinoids act to induce cardioprotective effects.

The DiPatrizio lab has found that endocannabinoids have been linked to vagal signaling that regulates food intake in fasting rats; specifically, 2-AG has been shown to increase food intake when 2-AG levels rise in the jejunum of rats [9]. In contrast to AEA and 2-AG, oleoylethanolamide (OEA), an endocannabinoid-like lipid signaling molecule, has been linked to the feeling of satiety, which reduces feeding when active in the jejunum [10]. Due to the endocannabinoids' tissue-specific properties, more research is needed to explore how the stress of diet-induced obesity affects endocannabinoid levels in cardiac tissue. Literature suggests that endocannabinoids in cardiac tissue are linked to cardioprotective properties during hypertension and other cardiac stress [11]. The cardioprotective properties of endocannabinoids make this a promising approach for the treatment of cardiovascular pathology.

The role of endocannabinoids under diet-induced obesity in the heart, however, remains largely unknown. Determining the role of these lipid signaling molecules in respect to cardiovascular health in diet-induced obese conditions will lead to a better understanding of cardiovascular function. This study explores the changes in lipid signaling molecule concentrations in the left ventricle of hearts of Western Diet-induced obese mice. This research will aid in the development of novel treatment of pathologic cardiovascular function associated with metabolic syndrome. We hypothesize Western Diet-induced obesity is sufficient to dysregulate the endocannabinoid system, increasing concentrations in the left ventricle.

MATERIALS AND METHODS

All of the following methods have been previously described by Argueta and DiPatrizio, 2017 [12].

Animals

Eight-week-old mice C57BL/6 mice (Taconic, Oxnard, CA, USA) were group-housed with access to water and food *ad libitum*, unless otherwise noted for food deprivation studies, and maintained on a 12-hour light/dark cycle (lights off at 1800 hours). Test diets consisted of standard lab rodent chow [(SD) Lab Diet 5001, St.

Louis, MO, USA; 13.4% kcal as fat, 56% kcal from carbohydrates, mostly starch] or Western-style Diet [(WD) Research Diets D12709B, New Brunswick, NJ, USA; 40% kcal as fat, 43% kcal from carbohydrates, mostly sucrose]. Mice were maintained on either SD or WD for 60 days immediately prior to tissue harvest. Five days prior to tissue harvest, animals were single-housed in cages with raised wire mesh inserts to prevent coprophagia during 24-hour food deprivation experiments. All procedures met the U.S. National Institutes of Health guidelines for care and use of laboratory animals, and were approved by the Institutional Animal Care and Use Committee of the University of California, Riverside.

Tissue Harvest

Isofluorane was used to anesthetize animals at time of tissue harvest (0900 to 1100 hours) following 24-hour food deprivation or *ad libitum* feeding. The hearts were rapidly collected, washed with phosphate-buffered saline (PBS) on ice, then snap-frozen in liquid nitrogen. All samples were stored at -80°C until processing.

Lipid Extraction

Frozen tissues were weighed and subsequently homogenized in 1.0 mL of methanol solution containing the internal standards, $[^2H_5]$ 2-AG, $[^2H_4]$ AEA, and $[^2H_4]$ OEA (Cayman Chemical, Ann Arbor, MI, USA). All samples were extracted with a negative control to ensure there was no cross-contamination between tissues. Lipids were extracted with chloroform (2 mL) and washed with water (1 mL). Organic phases were collected and separated by open-bed silica gel column chromatography as previously described [13]. Eluate was gently dried under N_2 stream (99.998% pure) and resuspended in 0.2 mL of methanol:chloroform (9:1) for Ultra-Performance Liquid Chromatography/Tandem Mass Spectrometry (UPLC/MS/MS) analysis.

Statistical Analysis

Data was analyzed using Graphpad Prism7 software. Results are expressed as the mean ± S.E.M. Significant differences among groups were assessed using Student's two-tailed *t*-test. Differences were considered significant if $p < 0.05$.

RESULTS

Impact of Western Diet with Males

Only free feeding male mice did not experience significant changes in 2-AG (p=0.3049). In male mice maintained on either Standard Diet or Western Diet *ad libitum*, AEA increased from an average of 1.333 ± 0.2508 pmol/g in SD to 5.075 ± 0.2307 pmol/g in WD (p<0.0001). Under *ad libitum* conditions, OEA increased from an average of 95.97 ± 6.525 pmol/g in SD to 117.6 ± 5.09 pmol/g (p=0.0202).

Under 24-hour food deprivation conditions, male mice experienced an increase in 2-AG by 0.4424 ± 0.1108 nmol/g (p=0.0015). Similarly, AEA in male mice increased from 4.26 ± 0.1426 pmol/g in SD to 10.74 ± 0.3961 pmol/g in WD under 24-hour food deprivation conditions (p<0.0001). OEA of male mice also increased under food deprivation by 53.97 ± 5.518 pmol/g (p<0.0001) *[Figure 1]*.

Impact of Western Diet with Females

Female mice did not experience significant changes in 2-AG regardless of free feeding or food deprivation conditions. In free feeding female mice maintained on either Standard Diet or Western Diet *ad libitum* AEA increased from an average of 0.9166 ± 0.1391 pmol/g
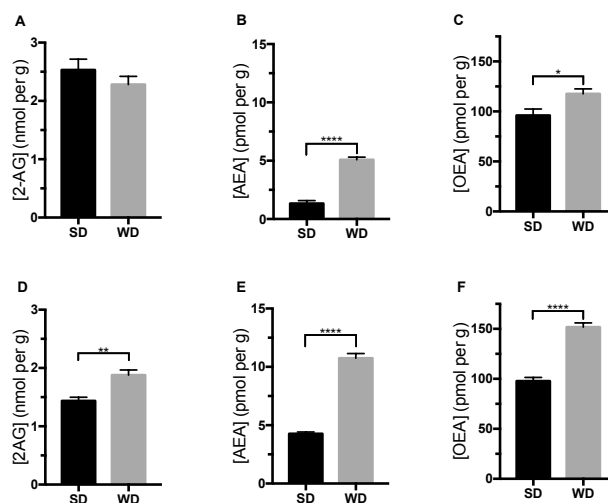
Figure 1: *Increase in lipid-signaling molecules. Samples collected from male mice after 60-days of Western Diet or standard chow administration. Subjects were either free feeding (A-C) or food deprived 24 hours prior to organ collection (D-F). Data points analyzed using Student's two-tailed* t-*test. n = 7-8, ns = p≥0.05, *=p<0.05, **=p<0.01, ****=p<0.0001*

Figure 2: Increase in AEA after 60 Days of Western Diet. Samples collected from female after 60-days of Western Diet or standard chow administration. Subjects were either free feeding (A-C) or food deprived 24 hours prior to organ collection (D-F). Data points analyzed using Student's two-tailed t*-test. n = 8, ns = p≥0.05, *=p<0.05, ***=p<0.001, ****=p<0.0001*
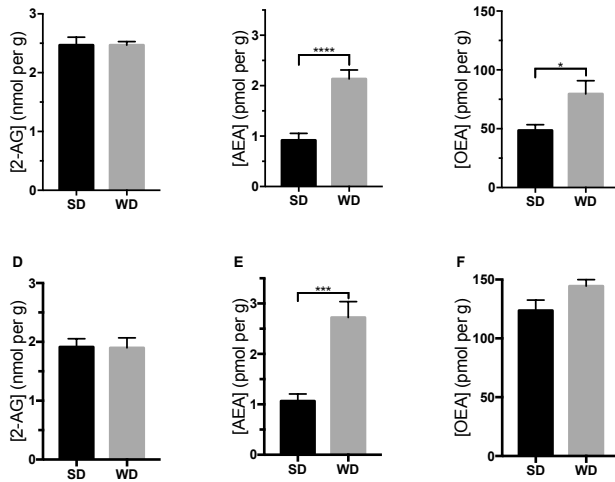
in SD to 2.134 ± 0.1783 pmol/g in WD (p<0.0001). An increase in OEA also occurred from an average of 48.58 ± 4.868 pmol/g in SD to 79.55 ± 11.28 pmol/g in WD under *ad libitum* conditions (p=0.0245).

Under 24-hour food deprivation conditions, female mice experienced an increase in AEA by 1.657 ± 0.3456 (p=0.0003). OEA in female mice increased from 123.7 ± 8.789 pmol/g in SD to 144.4 ± 5.444 pmol/g in WD under 24-hour food deprivation conditions (p<0.0648) *[Figure 2].*

DISCUSSION

The results of this experiment suggest that diet-induced obesity alters endocannabinoid levels in cardiovascular tissue. The increase in AEA for all conditions suggest that, regardless of the sex of the mouse, Western Diet-induced obesity is sufficient to elicit an endocannabinoid response. This response is likely due to hypertensive stress on the cardiovascular system as a result of the Western Diet-induced obesity [14]. This is consistent with literature that suggests AEA activation of CB1 results in vasodilation and nitric oxide production [6]. The results of this study suggest that diet-induced obesity may have been sufficient to cause changes in AEA and OEA which have been linked to hypertension and heart failure, respectively [7,13].

Like humans, male and female mice physiologically differ on a biochemical level, as well as on an anatomical level. A similar increase in AEA suggests that females, like males, may be responding to hypertension as a result of their exposure to WD for 60 days. In response to WD, however, females did not experience significant changes under food-deprived conditions compared to their male counterparts, who exhibited a significant change. Although the role of OEA is not clearly understood in the heart, some findings suggest it may be involved during heart failure and in preventing apoptosis of cardiomyocytes [14,15]. The less dramatic changes in OEA in females *[Figure 2]* observed in this study may be indicative of sex-specific physiological differences in response to cardiac stress. Further research, however, is required to assess the role of OEA in diet-induced obesity and cardiovascular stress.

Although this study successfully investigated the influence of diet, sex, and food deprivation, it is difficult to identify if these changes are occurring in the cardiac tissue itself or the blood it pumps. Therefore, it remains a possibility that levels of lipid signaling molecules are increasing in other organs are then being transported to the heart via blood. To help account for this possibility, blood plasma was also collected from the mice, which underwent LCMS analysis [12]. In comparison to blood plasma, cardiac endocannabinoids were nearly tenfold greater for most analytes. Therefore, although levels of lipid signaling molecules in the blood did contribute to the quantified data, our findings represent changes in the cardiac tissue itself. The presented data suggest that the cardiac tissue is altering either the rate of endocannabinoid production or degradation. Future studies should perform cardiac perfusions with PBS during tissue collection to minimize blood contamination of tissues and provide more accurate findings.

Despite the sex of the mice, the increased levels of lipid signaling molecules, which have been linked to cardioprotective effects, suggest that Western Diet-induced obesity is sufficient to elicit cardioprotective responses in mice. Unfortunately, this study was unable to explore markers for cardiovascular stress or measure signs of pathology such as heart rate, blood pressure, and ejection fraction. Therefore, future research should test for

cardiovascular health in diet-induced obesity in addition to changes in endocannabinoid levels in cardiac tissue. Further exploring endocannabinoids during cardiovascular pathology can lead to the development of new drugs or better use of current therapeutics, such as marijuana.

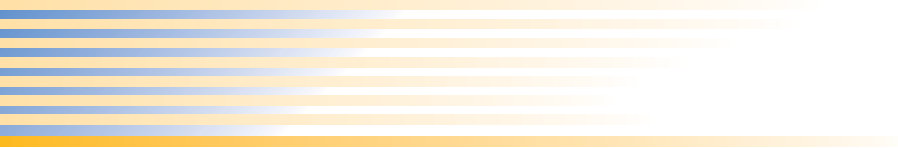This investigation concludes that diet-induced obesity is sufficient to induce changes in endocannabinoid levels in cardiac tissue. We propose that in response to this added stress, the cardiomyocytes produce excess endocannabinoids and OEA to restore cardiovascular homeostasis. This response is suggestive of the cardioprotective properties of the endocannabinoid system in cardiovascular tissue.

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The Containing Spaces of Experiments: US Cold War Influence in Guatemala through Medical Research

Celeste Navas

Department of History

Celeste Navas

Department of History

Celeste Navas is a fourth-year History major. Her academic interests include science and technology studies, inequality in health systems, and feminist theory. With a focus on U.S.-Central American history, her research interests include medical intervention and alleviation in the region. She has received the Chancellor's Research Fellowship, with which she has engaged in archival research at the Centro de Investiagaciones Regionales de Mesoamérica (CIRMA) in Guatemala. She intends to continue her studies in graduate school where she will study the ways historical actors have used public health services to research and experiment with disease and vulnerable communities.

ABSTRACT

This historical research paper examines the complex medical and political roles that the U.S. Health Services played in Guatemala during the early Cold War period. At the same time, the United States was implementing the policy of containment, a policy to contain communism from spreading in the Western Hemisphere, the Public Health Services was conducting medical experimentation to contain venereal disease. It was against this background that containment transformed medicine in a radical way. To construct this argument, I draw upon the Dr. John C. Cutler records that include unpublished reports, journals, surveys, and photographs. Some view doctors, public health services, or government elites as the agents driving medical change, but typically these groups use vulnerable people as leverage to benefit a privileged population. In addition, I use a Science and Technology Studies (STS) approach by casting the venereal disease and nonhuman subjects within Guatemala through the provocative nonhuman analysis. STS is used to explain the intersections of science and society that is evident in the Guatemalan Syphilis Experiment. The Guatemalan Syphilis Experiment attempted to use penicillin as the solution to the pressing problem of U.S. military medicine. However, these experiments resulted in violent and dehumanizing procedures of coerced sexual intercourse and direct inoculation of venereal disease that led to syphilis-infected bodies and the death of many Guatemalans.

Keywords: Containment, Space, Human Experimentation, Cold War, Central America

FACULTY MENTOR

Dr. Dana Simmons

Department of History

Dana Simmons is a historian of science and technology. Her research interests include hunger, nutrition, soil and plant science, political economy, the human sciences, feminist theory, architecture, Modern Europe, technopolitics and technoscientific utopias.

INTRODUCTION

The Guatemalan Syphilis Experiment, conducted from 1946-1948, revolved around finding a way to prevent syphilis and gonorrhea, particularly for military men. This study, with the permission of the Guatemalan government, involved the sexual coercion of prisoners by infected prostitutes and the deliberate inoculation of syphilis into the bodies of psychiatric patients by American doctors. Through animal experimentation, particularly rabbits, American doctors discovered that penicillin could stop the spread of syphilis and gonorrhea. In addition, to ensure reliable syphilis diagnoses, American doctors in Guatemala conducted serological tests on children at an orphanage in the Guatemalan highlands. Although during the Cold War standards of experimental research were ambiguous, the experiment occurred concurrently with the Nuremberg trial in Germany. This article analyzes the Guatemalan Syphilis Experiment and its implications for science, politics, and society.

Until 2003, historians were unaware of the Guatemalan Syphilis Experiment. It's existence was hidden within the personal papers of U.S. Public Health Service (USPHS) doctor John Cutler at the University of Pittsburgh. While researching Cutler for his involvement with the Tuskegee Syphilis Study, historian Susan Reverby discovered his unpublished reports, correspondence, and data in investigating penicillin as preventative care for syphilis from Guatemala. Astonished by this discovery, Reverby thoroughly researched the event and published an article in 2011. In "'Normal Exposure' and Inoculation Syphilis: A PHS 'Tuskegee' Doctor in Guatemala, 1946-1948," she comparatively analyzes the myths and realities between the Tuskegee Syphilis Study and the Guatemalan Syphilis Experiment. Most significantly, a myth persists that the Tuskegee Syphilis Study involved direct injection of syphilis into the bodies of black men in Alabama. Although a myth in the Tuskegee case, this was reality in Guatemala. Even though Reverby's contribution is important for understanding the topic of nonconsensual use of human subjects, this is not the approach I use in this article. A Science and Technology Studies approach expands Reverby's perspective: I focus here on the ways science is shaped by society and the ways society shapes science.

Science and Technology Studies, a field with roots in the interwar period and through the Cold War, is a product of debates among historians and sociologists of science and scientists who became interested in the intersections of science, technology, and society. STS also explores how human societies are collectively producers and users of science and technology. I use STS as a framework for my article. I do not attempt to analyze the medical validity of biomedical research, but rather use this method to examine the political and cultural implications that led to the direct inoculation of syphilis into human bodies in Guatemala. STS allows us to understand the nexus between Cold War ideology in the biomedical research conducted in Guatemala, the clinical gaze of the human subjects, and the lack of separation between human and nonhuman subjects.

In mid-twentieth century Guatemala, the science of human experimentation morphed into a Cold War exercise of spatial power. During the Cold War, lasting between 1945-1990, the United States introduced a policy of containment, declaring that communism could stay where it was, but would not be allowed to spread. It was against this background that containment transformed medicine during the Cold War era in a radical way. Containment is not only an action of keeping something threatening under control, as it is defined in the dictionary. In this article, I define it as the ideological practice that shaped the clinical gaze of the venereal disease researchers, that affecting the way they perceived space, race, and the nonhuman and human subjects, specifically during the inoculation of the psychiatric patients. Containment is evident in the Guatemalan Syphilis Experiment, as the venereal disease researchers control of the space in which they conduct experiments, the types of people, and how they treat the nonhuman and human subjects. What forces of Cold War society allowed Guatemala to become complicit the medical experimentation?

This framework can be used to understand that containment is a form of spatial power, particularly in the spaces of hospitals, prisons, and asylums. Although the nonhuman and human subjects are not directly threatening, they are susceptible to containment due to their inability to resist against the venereal disease researchers. This article focuses on the ways containment is linked within the spaces of rabbits (nonhuman) and human bodies.

Based on archival research conducted using the John C. Cutler papers from the National Archives, this article engages with containment at the three levels: the role of Guatemala as a laboratory, the methods designed to inoculate venereal disease from nonhuman subjects into the human subjects, the consideration of movement in space. To do this, I first conceive of Guatemala as a space for experimental studies, as it was not bound by laws to protect its human subjects and its pre-existing relationship with the United States. Second, I use a Science and Technology Studies (STS) approach to understand the methods designed to inoculate human subjects with syphilis created and contained within the space of rabbit bodies, and to do so from the perspective of the rabbits themselves. Last, I examine the movement of American doctors to contain Guatemala's vulnerable human subjects in hospitals, orphanages, and asylums. In the minds of American venereal disease researchers, the human subjects from Guatemala are analogous to the rabbits from previous medical experimentation and could be used as such. The medical experimentation would not be contained only in these rabbit-analogues, but also contained in the brown bodies in Guatemala. This leads one to ask why public health researchers juxtaposed rabbits and brown bodies in this experiment for the benefit of male bodies in the military.

I argue that containment functions as spatial power in this experimental research come affording specific modes of inequality, and that by engaging in neocolonialism during the early Cold War, the issue of who can be counts as human and whose lives count as lives played a large part in selecting the experiment's contained populations. As rabbits offered the model for humans and a scientific solution to the plagues of venereal disease at the Venereal Disease Research Laboratory in Staten Island (VDRL), New York, the American doctors viewed vulnerable people as analogs for military men and Guatemala as its own "venereal disease research laboratory." Therefore, by examining the containment of space, both in the literal sense of Guatemala and in the scientific sense, with the bodies of nonhuman and human subjects, does the use of Guatemala as a semi-colonial laboratory becomes clear.

AN INOCULUM OF RABBIT MATERIAL

With the introduction of penicillin as a cure for syphilis

in rabbits in 1943, many public health researchers wondered if a more effective penicillin treatment could replace the then painful calomel-sulpha-thiazole ointment provided to American military men during World War II. Since penicillin had become effective through animal experimentation, venereal disease researchers conceded that human experimentation would be the next step. Animals such as rabbits have provided medical researchers one of the earliest models of the ways gonorrhea and syphilis spread, which led to the discovery of a penicillin cure by doctors John Mahoney, Richard Arnold and A.D. Harris. This answered one of the many complex parts of the "pressing problem of military medicine." But who in 1946 America was using rabbit material to be injected in humans?

In May 1947, the American doctors began "initial work with rabbit material" on the human subjects at the insane asylum and penitentiary only a day apart from the other. The "rabbit material" of were differing strains of bacteria animal and human donors. These bacteria strains would eventually be the material injected in both rabbits and into the bodies of the mentally ill. While the human subjects in Guatemala were inoculated at hospitals, prisons, and insane asylums, the rabbits were infected with the bacteria strains back at the headquarters in New York. The rabbits would then be flown to the venereal disease laboratories in Guatemala City. This procedure originated from controversial inoculation studies earlier in the century that proceeded on animals, not humans. At the time of the experiment leading scientists were optimistic that this procedure would work. In October 1946, Mahoney told Cutler "your show is already attracting rather wide and favorable attention up here. We are frequently asked as to the progress of the work. Doctor T. B. Turner at Johns Hopkins wants us to check on the pathogenicity in man of the rabbit spirochetes." The nonhuman subjects—rabbits and bacteria strains—involved in the experiment were essential in understanding how syphilis might spread in human bodies thus, public health researchers would treat and respect them seemingly differently than they would their human subjects.

In fact, anytime there was mention of movement from inoculating prisoners or the mentally ill, the importing of rabbits to either location was crucial for public health researchers. In a letter on January 23, 1947, after notice of

a quarantine of passengers and shipments due to hoof and mouth disease in cattle in Mexico, Cutler anxiously writes to Mahoney, "while we know that the likelihood of rabbits acquiring infection…is slight we feel that the rabbits should be shipped in such a fashion that they do not pass through Mexico." This insight is crucial for understanding Cutler as he functions as venereal disease researcher. Such an analysis focuses on the fact that without his rabbits that contained the syphilitic inoculum from the VDRL, he could not inject syphilis into the bodies of his human subjects, undermining the purpose of his project in Guatemala. The import of these rabbits in mid-twentieth Guatemala was both practical and ideological. Without the import of the several cages of rabbits from the Venereal Disease Research Laboratory in Staten Island, Cutler's experiment would collapse. Without the rabbits, there would be no strains for human passage. The human passage of strains was as follows: "patients originally inoculated with animal passage material served as donors of chancre material for further experiments…treatment was delayed to study the healing of operative wounds in syphilitic patients." The inoculum that was used was created with heat-killed bacteria and living spirochetes and would be introduced in the bodies of the subjects at Guatemala's only asylum, into, described by Cutler as, "desperately and pathetically poor, both financially and in terms of personnel and medical attention."

RABBIT- HUMAN NEXUS: GUATEMALA AS A LABORATORY

For their human subjects, American researchers chose people who were both available and contained: prisoners in a national penitentiary, inmates in Guatemala's only mental institution, children in the national orphanage, and soldiers in the capital. They carried out two types of procedure: prostitute transmission taking place in the prison and inoculation studies taking place in the asylum. This article is particularly concerned with the inoculation procedures, as they were applied to both animals and people.

The second of the two procedures became central to the experiment, as Cutler was not able to provide the necessary data from prostitute transmission and serology (blood) tests. As Cutler reported, "the inmates were for the most part uneducated and superstitious. Most of them believed they were being weakened" by the frequent blood withdrawals. Serology tests were done on the

inmates before and after sexual transmission and after to see if infection had occurred. If positive, the men would be provided with penicillin as a cure. With the men, the inoculation was often much more direct. They chose men with "at least moderately long foreskins [to keep the mucus membranes moist]" and who could "sit or stand calmly in one spot for several hours." In the experiments, a doctor held the subject's penis, pulled back the foreskin, abraded the penis slightly just short of drawing blood by scraping the skin with a needle, introduced a cotton pledget (or small dressing), and dripped drops of the syphilitic emulsion onto the pad and through it with the roughened skin on the man's penis for at least an hour. On the women, because of what was called "local prejudices against male viewing of the body, even by physicians," the inoculum was inserted after needles were used to abrade the women's forearms, face, or mouth. A medically engineered inoculum became a tool of power that conflated brown bodies and animals to during experimentation.

RACIAL HIERARCHIES THAT SHAPED SCIENCE

The public health researchers encountered of too many positives even before sexual intercourse with inoculated prostitutes occurred, leaving them, with insignificant data. Instead of abandoning the research they began to question the serological tests. With permission from the Guatemalan government, the researchers turned to the children at the National Orphanage to study blood tests. The researchers were in need of a "pure" population with specific kinds of blood to rule out confounding factors they could not identify. In other words, to answer the question of the positive and negative serology tests, the researchers sought children between the ages of 6 and 16 as a contained population of syphilis-free-blood. This was the moment where the nexus between race and the Guatemalan study became most explicit.

Studying race in the United States, one can become accustomed to viewing racism as a literal black and white binary. However, racism, much like race, changes from place to place. In Guatemala, racism can be traced back to Spanish colonialism, which left a legacy of racist social from the American south to South America. The issue of race in Guatemalan society is best described by words of Guatemalan sociologist, Egla Martinez Salazar. "[The Spanish conquest] created two kinds of Guatemalans: those

who feel they descended from Europeans—even though they are brown-skinned and are actually indigenous or mestizos, but are being taught to be ashamed of their ancestry—and those who are descendants of original peoples."

Its society consists of two categories with complicated overlaps that intersect with race and social class: Ladinos and Indios. Over time, "Ladino" has changed its meaning; during the experiment it defined a group of people who spoke Spanish and were part of the land-owning minority. It included but was not limited to government officials, physicians, and clergy. On the other hand, are the Indios that are ascribed to the indigenous populations of Guatemala; they did not speak Spanish or belong to the working class. Indios were denied legal recognition and were expected to assimilate, making them invisible citizens and strangers to their land. As the only great power left in the Western Hemisphere, the United States often wielded enormous authority in its ability to aid Central American economies and institutionalize political and medical inequality. Thus, Guatemala, with its pre-existing relationship with the United States by way of the Office of Inter-American Affairs, became a "laboratory for colonialism, liberalism, and the modern nation state" that American doctors benefited from during the Cold War. Although as one of the five Central American states that achieved independence from the Spanish in the nineteenth century Guatemala in the twentieth century, it was still a nation-state dependent on foreign trade, investment, technology, and aid. This would be the society that American venereal disease researchers would encounter and take advantage of in 1946.

Cutler based most of his research off the work American professor of tropical medicine, George Cheever Shattuck, who conducted his own syphilis research in the 1930s. In Shattuck's research he states, "[Syphilis] is even milder and more difficult to recognize among the Indians. There is good reason to believe that these Indians have an unusual degree either of inherent racial or of acquired and inherited resistance to syphilis." This research was the foundation which Cutler would build his own research from, reinforcing racial assumptions from the past into his work. Furthermore, Shattuck claimed, that syphilis in "mountain villages may be explained by the fact that we were dealing with Indians and with Latins having a high proportion of

Indian blood whereas in Guatemala City the proportion of Indian blood is very much less."

Cutler, too, believed that syphilis occurred differently between the Indians in Guatemala City and those in the highlands. This assumption led him to seek a space for "clean bodies." Cutler tested this theory with serological tests on rural children. To determine whether penicillin was not a problem but rather the type of "Indian" was the problem. However, 89 of the 438 children tested gave positive results on their tests display showing signs of clinical syphilis. The child experiments failed to confirm the validity of the serological tests, and Cutler turned to yet another type of experimental subject.

Since the question of penicillin as prophylaxis was not answered, researchers turned to experiments with the country's only asylum. The researchers planned an inoculation study within the asylum's contained space. USPHS doctor John Mahoney would later contest this choice politically and morally: "I am a bit, in fact more than a bit, leery on the experiment with the insane people. They cannot give consent, do not know what is going on, and if some good organization got wind of the work, they would raise a lot of smoke."

The interconnection between the rabbits and human subjects exists in the ways the public health doctors respected their vulnerabilities. They are woven together, at least in the eyes of the sanctimonious doctors, as analogues that will solve the problem of the spread of venereal disease, although never treated with the same regard as those who would benefit from this experiment. Both rabbits and human subjects were viewed as powerless and weak and thus contained within controlled spaces such as hospitals, clinics, and asylums. This is not to say that the humans were being treated as animals, but rather their personhood was not regarded. In other words, the rabbits were seen as both precarious and vulnerable subjects by the doctors, however, because of the doctor's medical gaze the doctors failed to treat the human patients as humans and viewed their bodies as separate from their identity; never treating the humans differently from the rabbits. Thus, the neocolonial laboratory became a distinct and contained locus of cold war science that intersected with race.

CONCLUSION

Ultimately, both the American and Guatemalan doctors failed in their ambitious experiment. Nearly from the onset of the experiment, the nonhuman subjects refused to cooperate with the procedure standards. That is to say that the syphilis contained in the bodies of rabbits did not transmit itself into the bodies of humans, nor did it find a cure for venereal disease infections. The directors of the venereal disease research back in New York also eventually left the campaign. By the close of the experiment, the PHS doctors repudiated the experiment as "ethically impossible." Where they once spoke greatly of the experiment because of its implications to military medicine, the pages of the New York Times now carried opposition:

Drs. Harry Eagle, Harold J. Magnuson, and Ralph Fleischmann of the United States Public Health Service, the John Hopkins School of Hygiene... have discovered that small doses of penicillin injected within a few days after exposure, prevent syphilis from developing. This case holds good for rabbits, but no tests on human beings have yet been made. To settle the human issue quickly it would be necessary to shoot living syphilis germs into human bodies, just as Dr. Eagle shot them into rabbits. Since this is ethically impossible, it may take years to gather the information needed.

Cutler complained bitterly that he and his colleagues, "[had] so much more at stake and we have highly suggestive evidence to make us believe that we are on the right track with respect to prophylaxis." International health organizations such as the National Institute of Health and the Pan American Sanitary Bureau, by way of Public Health services in Guatemala and the U.S., attempted to contain venereal disease by medical experimentation on humans, but a penicillin cure never materialized from this experiment. Ultimately, the medical forces—the venereal disease research directors, public health physicians (particularly Cutler), and syphilis at itself—remained complicit to an experimentation that unethical, though the legal at the time.

Although the call for experimental research in venereal disease research went through the Pan American Sanitary Bureau, a U.S.-Latin American health institution, Guatemala was chosen as the site for venereal disease research in large part because of Juan Funes, an Inter...doctor and the director of the Guatemalan Venereal Disease Section. Juan Funes, an Inter-American Affairs medically trained doctor. The USPHS campaign for containing venereal disease offers an exemplary moment of Cold War medical containment society. First, it enacted a political and ideological contest between the US and Soviet Union as the last two superpowers mediated by neocolonial states, specifically in Latin America. Second, as it called upon power over the USPHS participation in the emergence of medical research. Third the USPHS work reflected doctors racial and social assumptions of humans, particularly Guatemalans.

After a little over two years of failed attempts to manifest syphilis in the bodies of the human subjects, let alone find a penicillin cure for syphilis, the VDRL in Staten Island imposed that the experiment be terminated. The USPHS physicians in the U.S. and Guatemala would then take up the research. The data was never published in any academic journals; the science of animal strains transmitted into human bodies could not provide a stable ground for medical experimentation.

The nonhuman subject was seen as analogous to the contained human subjects, and their animalization was ongoing. This offers a crucial insight into this experimental research as it functions as it functions in a neocolonial power context. First, the bodies of both animals and humans became spaces of containment, a spatial metaphor of the impossibility of escaping from the condition of the environment—the asylum—which turned the human subjects into victims. Second, the use of psychiatric patients for inoculation of syphilis, although known to be unethical by Cutler's colleagues, continued to be done, but kept as a secret amongst the venereal disease researchers.

Last, the rabbit and human bodies blurred into a space that contained and kept syphilis alive in hopes of finding a cure. The psychiatric patients who were inoculated with syphilis, at least to Cutler, were no longer a people with identity, but a brown bodies only seen for its use, much like the rabbits used to contain the man-made inoculums.

I argue in this article, that venereal disease researchers juxtaposed rabbits with human subjects because of the parallels drawn from the advantages of using rabbits as analogues to humans: docile and non-aggressive, easy to handle and observe, widely bred and very cheap to work with compared to population who would have benefited from the experiments. In biomedical research, rabbits are used for the production of antibodies, to detect the presence or absence of disease, and for research into infectious diseases. In the Guatemalan experiment, rabbits and the human subjects were used for the production of syphilis, and their blood was used to detect the presence or absence of disease in order to determine whether or not they were useful models for inoculation. With this analysis, I offer a discursive tie between the brown-bodied human and the animal that maps more fully on to the function of nonhuman and human subjects in experimental research and the expressed realities of the venereal disease researchers' contained spaces.
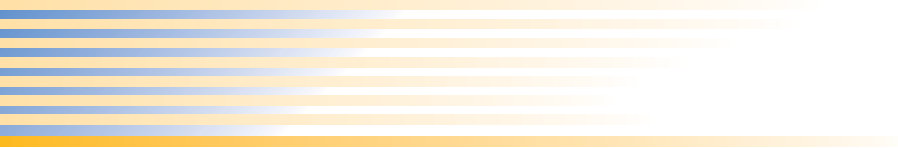
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The Role of Behavioral Activation when Navigating Uncertainty

Danielle Oleskiewicz

Department of Psychology

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Department of Psychology

Danielle Oleskiewicz is a fourth-year Psychology major. She studies uncertain waiting periods in a Social and Health psychological context under Dr. Kate Sweeny. Danielle is a Phi Beta Kappa inductee, is involved in other research pursuits on campus, and is currently a member of the Student Editorial Board for the University of California, Riverside Undergraduate Research Journal. In the future, she plans to pursue a PhD in Social/Health Psychology.

ABSTRACT

Waiting periods are uncertain moments in life when a personal outcome could result in a positive development or a negative setback. Potentially relevant to such experiences, the behavioral activation and the behavioral inhibition systems are sensitive to possible rewards and punishments. The behavioral activation system's (BAS) sensitivity to reward cues prompts behaviors that furthers an individual's goals. The behavioral inhibition system (BIS) motivates an avoidance of punishment and pain. The present study examines whether behavioral activation and inhibition are associated with waiting experiences such as negative emotions, outcome predictions, and expectation management strategies. Specifically, we sought to explore whether people who are high in BAS sensitivity experience an easier waiting period in comparison to people who are BIS sensitive. Participants believed their attractiveness and allure as a dating partner would be rated by other ostensible participants in the study. After completing baseline measures and a photo-rating task, participants endured a brief waiting period while their photo ratings were supposedly downloaded. During this time, participants completed self-report measures of negative emotions, worry, bracing for the worst, positive expectation management, and made predictions of their photo ratings. Correlational analyses revealed that trait behavioral activation is related to a more optimistic outlook and less bracing, and the behavioral inhibition system is associated with negative emotions, pessimistic outcome predictions, and more bracing. This study reveals that both the behavioral activation and behavioral inhibition systems have a role in the experience of a waiting period.

Keywords: Behavioral Activation, Behavioral Inhibition, Waiting, Bracing, Positive Expectation Management, Worry

FACULTY MENTOR

Dr. Kate Sweeny

Department of Psychology

Dr. Kate Sweeny's research examines two broad questions. First, how do people cope with uncertain waiting periods? Second, how should doctors talk to their patients? She has studied law graduates awaiting news about the bar exam, patients awaiting biopsy results, researchers awaiting manuscript decisions, surgeons talking to their adult patients, and asthma specialists talking to pediatric patients, among many other topics and studies.

THE ROLE OF BEHAVIORAL ACTIVATION WHEN NAVIGATING UNCERTAINTY

People encounter numerous periods in their lives when they are forced to wait for uncertain news, such as a medical test, exam results, or waiting to hear back about potential career opportunities. Waiting periods vary in severity and some may result in very dire news or incredible progress. Waiting periods are moments in life marked by uncertainty (Cavanaugh & Sweeny, 2012); the outcome could be negative like a punishment, such as a failed exam, or the result of a waiting period could be positive like a reward, such as receiving an "A" on an exam. Going about daily life while anticipating uncertain news is difficult (Sweeny & Cavanaugh, 2012; Sweeny & Andrews, 2014), especially when the result has crucial implications on life domains like work and health. The current research aims to identify individual differences that may be associated with an easier or more difficult time waiting for such news.

People experience heightened levels of distress while waiting for important news, which stems from the uncertainty of the situation and the potential for a negative outcome (Sweeny & Cavanaugh, 2012). Similar to waiting for important news, the behavioral inhibition system (BIS) and the behavioral activation or approach system (BAS) are sensitive to the possibility of rewards and punishments (Carver & White, 1994). Furthermore, when people high in BIS sensitivity perceive a potential punishment, their emotional experience is similar to the distress and anxiety experienced during an uncertain waiting period when the outcome is possibly negative. The behavioral inhibition system or BIS is an aversive motivational system marked by the avoidance of a potential punishment. The BIS is activated when an individual inhibits progress towards a goal to avoid punishment or a negative result (Carver & White, 1994; Gray, 1978, 1981, 1987b, 1990). That is, if an individual fails to inhibit certain behaviors, he or she will experience a negative event or punishment, and activating the BIS provides motivation to end those behaviors. BIS sensitivity is associated with more negative emotions like anxiety, fear, frustration, and sadness when a potential punishment is perceived (Carver & White 1994; Gray, 1987, 1990). Conversely, the behavioral activation or approach system (BAS) is more sensitive to possible reward and eliminating punishment and provides motivation to engage in certain behaviors that progresses

an individual toward a goal (Carver & White, 1994). BAS sensitivity is associated with positive emotions such as hope, elation, and happiness when a potential reward is perceived (Carver & White, 1994; Gray 1977, 1981, 1990).

People high in BIS sensitivity are more prone to anxiety due to their sensitivity to cues of punishment (Carver & White 1994; Gray, 1987, 1990; Gomez et al. 2002). When people high in BIS sensitivity perceive a potential punishment, anxiety may emerge from fear of impending pain or other negative outcomes associated with the punishment (Carver & White, 1994). In the context of waiting periods, sensitivity to punishment cues and proneness to anxiety could compound the distress that people typically experience as they anticipate uncertain news. Additional research also reveals a bias towards processing unpleasant or negative information when people high in BIS sensitivity are in fear of a potential punishment (Gomez & Gomez, 2002). Thus, when people high in BIS sensitivity are enduring a period during which punishment is considered imminent, they may focus on more negative information that ultimately could influence their expectations, namely by bracing for the worst rather than attempting to be optimistic about their future. Bracing is defined as a predictable pattern of expectations wherein people become more pessimistic about their outcomes as the end of a waiting period nears (Sweeny, Carroll, & Shepperd, 2006). People may also use bracing as a coping strategy to lower anxiety by anticipating the worst and preparing for the consequences that may follow (Cavanaugh & Sweeny, 2002). Not everyone succumbs to pessimism, though, as some people maintain optimism and expect good news to come (Sweeny & Cavanaugh, 2012).

Opposite of people high in BIS sensitivity, individuals high in BAS sensitivity are more attentive to cues of reward and opportunity (Carver & White 1994). Individuals high in BAS tend to experience more positive affect when they interpret a potential reward (Carver & White, 1994). In the opposite fashion of the BIS, people high in BAS sensitivity have a tendency to gravitate towards positive information processing (Gomez & Gomez, 2002). As people high in BAS sensitivity have a tendency to feel positive emotions and fixate on positive information, they may be more likely to view a waiting period as a potentially rewarding situation. By focusing on positive information, they may also have more optimism when anticipating the future.

Research has yet to explore trait levels of BAS and BIS sensitivities in the context of a waiting period. Examining these individual differences makes a novel contribution to a growing body of literature investigating waiting periods and could help researchers understand what makes waiting for news so difficult. As uncertain waiting periods are anxiety provoking and are characterized by distress and negative emotions (Sweeny & Cavanaugh, 2012), focusing on the trait-level processes at play when an individual is expecting important news can provide further insight into the nature of waiting periods and may even inform interventions aimed at easing the negative emotions and anxiety associated with waiting periods.

Considering the conceptual connections between waiting periods and the behavioral approach and inhibition systems, the current study sought to explore whether trait-level BIS or BAS sensitivities relate to people's cognitive and emotional experiences as they await uncertain news. In light of previous research linking the behavioral approach system to positive affect and the processing of pleasant information, we hypothesized that people high in BAS sensitivity would have an easier time waiting, perhaps marked by less worry and more optimistic outcome predictions. Accordingly, because previous research relates the behavioral inhibition system to negative affect and the processing of negative information, we hypothesized that people high in BIS sensitivity would experience relatively more distress while waiting in the form of worry and more pessimistic outcome predictions.

METHOD
Participants

Participants (N = 170; 61.18% women) in the present study were undergraduate students taking an introductory psychology course at the University of California, Riverside. Students volunteered to participate in exchange for research credit required by the course. Participants identified as Asian (42.94%), Hispanic (35.88%), Caucasian (5.88%), African American (4.71%), Middle Eastern (3.53%), mixed/other ethnicity (6.47%), and Pacific Islander (0.59%).

Procedure

Undergraduate students arrived at the lab to take part in a study they believed was investigating perceptions of attractiveness. At the beginning of the session, each participant posed for a photo that he or she thought would be rated by other concurrent participants on dimensions of physical appeal and allure as a dating partner. Under the guise that their photo was being uploaded to a central server, participants were then asked to fill out baseline measures of individual differences and emotions. When finished with the baseline survey, participants proceeded to rate the photos of the other ostensible participants on the attractiveness dimensions, and thought their own photos were being simultaneously rated on the same dimensions. Contrary to participants' beliefs, the photos that participants viewed were of previous research assistants, and the experimenter deleted participants' own photos immediately after the beginning of the study. Once participants finished with the photo-rating task, the experimenter explained that they would receive their photo ratings before leaving the session. However, because it would ostensibly take time for the ratings to come in, participants were instructed to wait quietly, and then were asked to fill out a short survey regarding their emotions and expectations before being thoroughly debriefed. An additional manipulation was part of the present study, the results of which are not reported here.

The experimental procedures implemented in the present study were employed primarily due to the exploratory nature of our research questions. When investigating new relationships among variables, high experimental control is necessary. (Furthermore, laboratory studies in the psychology department have access to the psychology subject pool, which made it easier for us to recruit participants for the study.)

Measures

Behavioral Activation. The baseline questionnaire included a 24-item measure of trait behavioral approach and avoidance to assess participants' characteristic sensitivities of the behavioral approach and inhibition systems (BIS/BAS scales; Carver & White, 1994). We utilized three subscales from the BAS scale: which were the behavioral activation "drive" subscale, the behavioral activation "fun-seeking" subscale, and the behavioral activation "reward responsiveness" subscale. The behavioral activation "drive" subscale measures the persistent pursuit of desired goals (e.g., "I go out of my way to get things I want;" 1 = very false of me, 4 = very true of me; M = 19.15, SD = 2.27, Cronbach's α = .71). The behavioral activation "fun seeking" subscale detects a desire for novel rewards and

spontaneity when it comes to reward activities or events (e.g. "I'm always willing to try something new if I think it will be fun"; 1 = very false of me, 4 = very true of me; M = 3.09, SD = .50, Cronbach's α = .60) Finally, the behavioral "reward responsiveness" subscale assesses positive responses when a reward is available or anticipated (e.g. "When I'm doing well at something I love to keep at it"; 1 = very false of me, 4 = very true of me; M = 3.47, SD = .39, Cronbach's α = .65).

Participants responded to seven items assessing BIS sensitivity (e.g., "Criticism or scolding hurts me quite a bit"; 1 = very false of me, 4 = very true of me; M = 3.04, SD = .58, Cronbach's α = .76). Two of the behavioral inhibition items were reverse-coded or phrased in a way that represented low levels of inhibition (e.g. "Even if something bad is about to happen to me, I rarely experience fear or nervousness").

Emotion Measures. The baseline questionnaire also included an 8-item scale designed to measure current negative emotions such as anxiety and nervousness (e.g. "I feel anxious" and "I feel distressed"; 1 = strongly disagree, 7 = strongly agree; M = 2.81, SD = 1.40, Cronbach's α = .90). This scale was also completed during the waiting phase, when participants were anticipating their results (M = 3.01, SD = 1.48, Cronbach's α = .92). In both phases, two of the items were reverse-coded (e.g. "I feel calm").

Worry & Expectations. Additionally, participants completed measures of worry and expectations while waiting for their photo ratings. Participants reported their worry with three items (e.g., "I am worried about how people rated me"; 1 = strongly disagree, 7 = strongly agree; M = 3.62, SD = 1.72, Cronbach's α = .89). Participants then reported whether they were bracing for the worst-case scenario before receiving their ratings with two items ("I'm bracing for the worst when it comes to my photo ratings" and "I'm trying to keep my expectations low when it comes to my photo ratings"; 1 = strongly disagree, 7 = strongly agree; M = 4.42, SD = 1.78, Cronbach's α = .86). Hopeful and optimistic expectations were assessed with two items ("I'm hoping for the best when it comes to my photo ratings" and "I'm trying to be optimistic when it comes to my photo ratings"; 1 = strongly disagree, 7 = strongly agree; M = 4.3, SD = 1.31, Cronbach's α = .78). Additionally, in the beginning of the second questionnaire, participants estimated the sum of their ratings from the other pseudo-participants on a scale of 0-100.

RESULTS
Behavioral Approach System

In order to look at possible relationships between behavioral activation and the dependent measures related to waiting periods, we ran multiple Pearson product-moment correlations. Correlations provide information regarding the magnitude of relationship between two variables. A significant positive correlation indicates that as one variable increases so does the other, and a negative correlation signifies that as one variable increases, the other variable decreases.

Correlation analyses revealed a negative association between BAS "drive" and bracing (r = -.15, p < .05) and positive associations between the BAS "drive," positive expectation management (r = .17, p < .05), and photo rating estimates (r = .19, p < .01). Thus, participants who scored higher on the BAS "drive subscale" reported less bracing and engaged in a more optimistic outlook when it came to their potential ratings. The participants who were higher in BAS "fun seeking" reported trying to be more hopeful and optimistic while waiting for their ratings (r = .16, p < .05), indicating a positive relationship between BAS fun seeking and positive expectation management. Participants high in the "reward response" also reported higher levels of positive expectation management (r = .26, p < .001), meaning that participants who expressed high trait BAS "reward responsiveness" scores also reported greater efforts toward optimism when it came to their ratings.

Behavioral Inhibition System

BIS sensitivity is associated with more worry (r = .53, p < .001), higher levels of negative emotions (r = .43, p < .001), and efforts to brace for the worst (r = .45, p < .001). BIS sensitivity is also associated with lower rating estimates (r = -.17, p < .02). Together, these findings reveal that participants high in BIS sensitivity reported more distress in the form of worry, negative emotions, and bracing for the worst. Additionally, participants who were high on the BIS scale also made more pessimistic predictions when it came to the ratings they anticipated receiving.

DISCUSSION
We hypothesized that people high in BAS sensitivity

would have an easier time navigating a waiting period. More specifically, we anticipated they would experience less worry, would brace less, would be more hopeful and optimistic, and would make more optimistic predictions while waiting for their photo ratings. Although none of the BAS subscales related to worry, all of the behavioral activation subscales related positively and significantly with positive expectation management. Additionally, BAS drive was associated with higher photo-rating estimates and correlated negatively with bracing, promoting the idea that people high in BAS have a smoother experience and adopt a more optimistic mindset when undergoing a waiting period. A possible explanation for the non-significant correlations between any of the BAS subscales and worry may be the associations BAS has with positive affect and positive information processing along with the lack of associations to negative affect (Carver & White, 1994; Gomez & Gomez, 2002; Gray 1977, 1981, 1990). Perhaps a propensity to focus on positive information, as well as experiencing positive emotions, may be unrelated to the experience of anxiety or the proclivity to ruminate. In addition, the buffer created from positive affect, as well as positive information processing, may have not been enough to influence the level of worry experienced while undergoing a waiting period.

We also predicted that people high in BIS would experience a troublesome waiting period accompanied with more worry and pessimism about the potential outcome. Contrary to BAS sensitivity, individuals with higher BIS sensitivity endured more worry, negative emotions, braced more, and made more pessimistic outcome predictions. To this extent, those high in BIS sensitivity may experience a more difficult waiting period plagued with negative emotions, pessimism about the potential outcome, and may brace more in order to cope with the perceived punishment than people lower in BIS sensitivity.

The results presented here replicate and extend patterns of findings from the behavioral activation and behavioral inhibition literature. For instance, previous research demonstrated that BAS sensitivity relates to positive emotions, but not negative emotions. Our findings replicate the independence of BAS sensitivity and negative emotions. Our findings also replicate the strong relationship between BIS sensitivity and positive emotions

(Carver & White, 1994; Gray 1977, 1981, 1987, 1990). Extending beyond previous findings, results from our study relate BAS sensitivity to a hopeful and optimistic outlook and BIS sensitivity to more bracing while waiting and lower outcome predictions. The current study is the first exploration of BIS/BAS theory and concepts in the domain of expectation management and future forecasting.

These findings confirm that behavioral activation and inhibition are relevant to how people experience waiting periods. During a waiting period, such as a medical test, one with sensitivity to either BIS or BAS may deploy these systems when the outcome is uncertain. The consequences of activating either system differs based on an individual's trait sensitivity to rewards versus punishments. Previous research has found that people higher in BAS sensitivity may have a tendency to focus on positive information (Gomez & Gomez, 2002), and when anticipating an outcome this could influence expectations and emotions by reinforcing positive perceptions of the situation. Individuals that are BIS sensitive may seek out negative information while waiting for important news and thus potentiate the negative experiences like the worry that waiting evokes. On the other hand, if the individual was BAS sensitive they might look at more positive information that supports the idea of a positive outcome, thus bolstering the positive emotions and coping strategies associated with behavioral activation (Carver & White, 1994; Gray 1977, 1981, 1987, 1990).

CONCLUSIONS & FURTHER RESEARCH

Overall, findings from the current study could have implications when it comes to sensitive groups, for instance, potentially ill patients who are experiencing an incredibly stressful waiting period. Ultimately, our results confirm that behavioral activation systems relate to cognitive and emotional experiences during a waiting period. A person who is BIS sensitive may experience greater negative emotions, engage in more bracing, and have a more pessimistic outlook in comparison to someone who is BAS sensitive. Someone who is more BAS sensitive may also adopt a more optimistic perspective instead of the pessimism displayed by a high BIS individual.

Waiting periods extend into many avenues of life and by exploring this topic of behavioral activation we have added to the growing body of research exploring how people navigate periods of uncertainty surrounding important

outcomes. Our results point toward the cognitive framing of an uncertain outcome as an important topic of study. Activation of the BIS/BAS systems depends on how people interpret cues of reward and punishment, and research investigating prolonged uncertainty could benefit from further exploration of these motivational systems. It would be valuable to explore just how the BIS and BAS may differ in their influence on information processing and emotions throughout waiting periods by measuring cognitive framing, information processing, and positive affect in future studies. Also, further research should look at how these processes vary throughout a prolonged period of time. By conducting longitudinal research aimed at discovering when activation of the BIS/BAS systems are most prevalent and when they are of little influence throughout a specified time frame would add to the understanding of behavioral activation and inhibition in a waiting period. In addition, looking at the behavioral activation/inhibition systems in a waiting period can aid those who are waiting for news by looking at trait BAS and BIS sensitivities and the framing of information before and after a medical test. By doing so, interventions may be helpful in aiding physicians on how to communicate with patients to help reduce stress and promote an easier, less anxiety-provoking waiting period.

However, the present study was entirely correlational, meaning no causation can be inferred based off the results presented in this article. Additionally, our sample included exclusively undergraduate students who were participating for credit required for their course. Undergraduate students only represent a small proportion of people who experience waiting periods, and our sample is not representative of the general population in terms of age and occupation, among other important demographic characteristics. Thus, the findings from the current endeavor can only be generalized to undergraduate students and groups of similar characteristics. Including more representative samples in future research would be beneficial in determining links between behavioral activation and uncertain waiting periods.

The present research sought to answer the question of whether behavioral activation and behavioral inhibition are involved in waiting periods. In conclusion, this study reveals novel findings that the behavioral activation and behavioral inhibition systems are related to several key waiting period experiences. These are important associations that should

be further explored in future research and utilized to expand the knowledge of waiting periods.

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Embodied Identities: The Experience of Coming Out as UndocuQueer

Maria Liliana Ramirez

Departments of Anthropology and Hispanic Studies

Maria Liliana Ramirez

*Departments of Anthropology
and Hispanic Studies*

Maria Liliana Ramirez is a fourth year Anthropology and Spanish major. She has been awarded the Mellon Mays Undergraduate Fellowship and the UCR Quarterly Mini-Grant. Liliana is engaged in research with the support of her faculty mentor, Dr. Nájera, and the University Honors Program. As a queer undocumented student herself, her research focuses on the coming out experiences of undocumented queer students in Southern California. She plans to pursue a PhD in Anthropology, and become a professor, and mentor other underrepresented students.

A B S T R A C T

Queer undocumented students face obstacles stemming from both their legal status and their sexual orientation. They also experience a double coming out; that is, a coming out as undocumented and as queer, giving them a different experience than other undocumented students identifying as straight. The lack of research on queer undocumented students has contributed to reinforcing a homogenous conceptualization of identity formation for undocumented students. What has been written about queer undocumented students has been through the frame of the UndocuQueer movement and therefore has focused on its Development and progress as a political entity. Based on preliminary findings, this paper looks at the process of coming out as queer and undocumented, and at the rejection of the term "UndocuQueer" as an embodied identity.♦

Keywords: Undocumented Migration, Queer Studies, UndocuQueer, Coming Out, Identity Formation, Globalization

F A C U L T Y   M E N T O R

Jennifer R. Nájera

Associate Professor of Ethnic Studies

Jennifer R. Nájera is Associate Professor of Ethnic Studies at the University of California, Riverside. An anthropologist by training, she is the author of The Borderlands of Race: Mexican *Segregation in a South Texas Town* (University of Texas Press, 2015). She is currently researching the intersections between immigration, education, and activism in the experiences of undocumented college students. Nájera has mentored several undergraduate students through the process of original research.

♦ The term "UndocuQueer" stems from the recent UndocuQueer movement and is commonly used among undocumented immigrant-rights activists who identify as queer. "UndocuQueer" literally merges the word "undocumented" and the word "queer" into a single word.

I don't know what was harder—to say that I was gay or to say I was undocumented...
I have a hard time knowing where people stand. Even, I've met other gay friends that are
actually out, men and women, and then all of a sudden I come to find out
that they are extremely anti-immigrant. I have to be very careful.
Just because a person is gay doesn't mean that they're going to accept the other.
–KASSANDRA†, AGE 36

INTRODUCTION

Undocumented migration in the United States has become a heated political topic in which undocumented individuals are increasingly dehumanized and criminalized. Due to the increasingly xenophobic political climate in the United States, interdisciplinary scholars have attempted to provide a more humanized narrative of being undocumented. However, even scholarship that claims to provide a humanized narrative of undocumented immigrants often becomes contradictory, since it can reinforce narratives of good versus bad immigrants. Given that the scholarship on undocumented migration is dominated by a heterosexual focus, it automatically positions queer migrants in the category of a bad immigrant. Most significantly, the existing literature actively erases the experience and existence of queer undocumented individuals. It has become important to explicitly discuss the resistance of undocumented communities and of the various otherwise excluded groups within the undocumented community, such as queer undocumented individuals.

Through concepts such as a globalized identity and the rhizome, it is possible to expose resistance among undocumented queer individuals. The experiences of undocumented communities inhabit the global through their resistance of "official classification" (Kearney 1995, 555). Such resistance to official classification blurs geographical lines of national borders and challenges structured identity formation. While an individual's undocumented status generates obstacles in accessing education and employment, it also generates a double burden of a "coming out" experience during dating and friendships. When coming out as undocumented and as queer, an individual embodies blurred borders as well as displacement. To reveal the complexities of a globalized identity and to further explicate the experience of being undocumented and queer, I make use of Deleuze and Guattari's rhizome. In their introduction to A Thousand Plateaus: Capitalism and

Schizophrenia, Deleuze and Guattari describe the rhizome as a subterranean assemblage varying in form where any of its parts can connect to another (Deleuze, 1987). The rhizome does not rely on any one part of the assemblage for its existence or for self-definition. Instead, the rhizome is composed of multiplicities which do not dominate each other. All multiplicities are connected and coexist along with each other. The rhizome opens an abstract space in which the embodiment of identity is mapped and more specifically, it provides a space to further think about the possible embodiment of a queer identity along with an undocumented status.

LITERATURE REVIEW

Early scholarship on undocumented students heavily focused on the obstacle of obtaining a higher education (Garcia Pena, 2012; Lopez, 2010; Patel, 2013; Perez, 2009; Soltis, 2015). The earliest research took place prior to "undocumented friendly" policies and examined experiences before the passage of AB 540 or the CA DREAM Act, and before the signing of the executive order authorizing Deferred Action for Childhood Arrivals (DACA). Since then, scholars have been following the development of such policies to discover their effects on the lives and self-understandings of undocumented youth. The earliest undocumented friendly policy in the state of California was AB 540, which not only opened educational opportunities, but also destigmatized the identities of undocumented students (Abrego, 2008; Negron, 2014). With this early piece of policy, undocumented students began to use shorthand terms such as AB 540 instead of bluntly stating their undocumented status. This strategy of using a shorthand to express an undocumented identity has continued to evolve along with policy changes and along the development of the undocumented youth social movement. This trend can be seen with the early use of the term "DREAMers" after the push for a federal DREAM Act, and currently with some undocumented youth calling

themselves "DACAmented" after the executive order authorizing the Deferred Action for Childhood Arrivals (DACA) program. Although research on "DREAMers" or on "DACAmented" individuals has served to highlight the connection between policy and identity formation among undocumented youth, it also creates a dangerous idea of a homogenous identity and recreates supposed divisions between deserving and undeserving immigrants. Further, it actively erases the existence of other identities experienced by undocumented youth, such as being queer.

With the recent emergence of activism strategies such as "undocumented and unafraid" and "coming out of the shadows," researchers began to look at the coming out aspect of the undocumented experience (Negron-Gonzales, 2014). This body of literature connects the strategies used in the LGBT movement with strategies adapted by the undocumented youth movement, including the UndocuQueer movement (Terriquez, 2015; and White, 2014). It is here where undocumented queer individuals are finally acknowledged by discussing the concept of a "double coming out." A double coming out is unique to the undocumented-queer experience since individuals must navigate coming out not only as queer but also as undocumented. This attempt to break the heterosexual narrative of undocumented youth or their activism continues to be one dimensional. It demonstrates the structural intersectionality of the UndocuQueer movement, but does not go further than to show its contribution or cost to the overall undocumented youth movement. It does not fully discuss the experience of being undocumented and queer.

METHODOLOGY

With IRB approval, I conducted ten in depth interviews with undocumented students in Southern California who identified as queer between June 20 and September 28, 2016. The interviews touched on topics about the individuals' undocumented status, queer identity, as well as their coming out stories with family, friends, and co-workers. All interviews were audio recorded and transcribed verbatim. The recruiting process was based on a snowball sample method to expand the diversity in educational background of my participant pool. I reached out to old high school classmates, current college peers, and then to individual people of color and LGBTQ+ organizers

at the school and community levels. Individuals agreed to participate with the acknowledgement that the study was not paid and were given the option to be represented by a pseudonym or their real names.

The criteria for participant selection required that students: 1. were undocumented—DACA or non-DACA; 2. self-identified as non-heterosexual and; 3. were current students, on a break, or had graduated from an institution of higher education. Individuals were at different levels of their education: One had just finished a master's degree, another was taking a break before transferring to a four-year institution, and the rest were between their third and fourth year of their bachelor's degree. The individuals I interviewed were between the ages of 20 and 36 and identified as gay, lesbian, bisexual, pansexual, queer, or did not identify with any label that would signal a sexual orientation. Seven women and three men were interviewed, and all immigrated from Mexico. Not all participants benefited from DACA, AB 540, or the CA DREAM Act. I include the experiences of those who do not qualify for any undocumented friendly policies because they are still relevant and important to discuss.

The fact that I am an undocumented queer student worked in favor of my recruitment of participants and gave participants a comfort level to express concerns that they may not freely have expressed to a non-undocumented, or non-queer, researcher. My undocumented status and queer identity placed me as an insider of this community instead of an outsider. Indeed, one participant before and after the recording continuously expressed his concern and discomfort with what he called the "fetishizing" of non-undocumented people doing research on undocumented individuals. He felt as if his story had been abused by past researchers, and said he allowed me to interview him because of my undocumented status. I must, therefore, address how I navigated disclosing both my legal status and queer identity to my participants.

Although a few had knowledge of my undocumented status before the interview, most did not know either my undocumented status or that I identify as queer. Even those who knew I am undocumented did not know I am queer. Without exception, all participants asked me with curiosity

about my status or sexual orientation at some point in the interview. Given that for most participants, our interview session was our first meeting, we built rapport during the minutes prior to and throughout the interview. Coming out to them as queer and undocumented became a crucial opportunity to build trust, since at that moment I stopped being treated as a distant researcher.

FINDINGS:
Coming Out as Undocumented

Coming out stories have been mostly dominated by experiences of disclosing a queer identity to others. However, there is a similar process which undocumented individuals are forced to navigate. The experiences of coming out as undocumented heavily overlaps with coming out as queer in that stigma plays a major role. Although undocumented individuals do not have to come out to their family, due to the increasing xenophobia in the United States, they do have to overcome the stigma of not having a legal immigration status before coming out to others.

My conversation with Christian†, age 20, revealed that an influential factor in navigating coming out as undocumented is the individual's comfort level with both identities. For example, it was more difficult to disclose an undocumented status when there was a higher comfort level with a queer sexual orientation. In Christian's first romantic relationship, he did not disclose his undocumented status due to his partner's conservative political views on immigration, but now— two years later—he tries to disclose his status sooner rather than later. Christian explained,

I just let them know in casual conversations rather than sit them down and be like I'm undocumented. I think I've gotten more comfortable with my undocumentedness in the last two years. It's not a big deal; it doesn't make me less than anything ... it literally means nothing. Like it does in certain contexts in ways. But like does it define, is it my full identity? Not really. Like yes and no. So if somebody doesn't want to date me because I'm undocumented or whatever it's dumb yeah... So I feel more comfortable letting people know, whoever I'm talking to, like yeah I'm undocumented. It's just a part of my identity. I'm in this type of situation.

The experience of trauma and love are merged by the fear of rejection when imagining coming out as undocumented in a romantic context. Experiencing pain along with romance consequently spurs an acceptance of an undocumented status. Pandolfo has written about a version of this pain in "The Burning," where she describes how "the person in despair comes to inhabit a border, a region of normative instability..." (Pandolfo, 349). Although she speaks of "kufr" or disbelief experienced specifically through the migration from Morocco to Europe, I found that the concept of inhabiting a border conveys a similar experience in the context of coming out as undocumented. In the moment of the imagined and the possibly lived rejection, a queer undocumented individual inhabits a border of uncertainty, despair, and transgression. An undocumented status is thus inhabited in the form of a fragment in which it is credited as being only part of the complete identity. These identity fragments undo the binaries in identity formation to fully inhabit a globalized identity.

Similarly, Kassandra expressed having a harder time disclosing her undocumented status than her sexual orientation. Kassandra explains the following as her process of coming out as undocumented to her friends:

I'm very out as a lesbian to my closest friends. Not all of them know [I am undocumented], still up to now, even after knowing me for years a lot of them don't know... I think sometimes I keep that out on purpose because sometimes I just want to talk about normal things and not feel so... vulnerable. Because then there's the chance they might pity me and that's something I hate, that I absolutely hate. I have different things that I say, for example when they would say why don't you know how to drive? I would say, I bike instead. I love biking because I don't want to be an extra car on the streets. Things like that ... I find ways to delude that conversation. And they end up thinking I'm an interesting person, very eccentric. So I just keep it out because I don't want to feel different from them.

Sometimes not coming out as undocumented is not only about safety concerns, but also about creating distance from the emotional baggage an undocumented status carries. The distressing effect of an undocumented status is reminiscent

of what Pandolfo describes as an intimate wound in which trauma and vulnerability are embodied. Kassandra does not come out as undocumented to some of her friends, not because she feels shame about her legal status or feels unsafe, but because it gives her a space where she doesn't feel the traumatic weight of being undocumented. For that moment, she does not have to explain the legal implications of her status and thus does not relive some of the traumatic aspects of being undocumented. Both Kassandra and Christian regain their agency in balancing how much power and control they consciously give their undocumented status.

Embodiment of "UndocuQueer"

The concept of "UndocuQueer" attempts to fuse two fragmented identities to create a whole, but falls short in creating a complete identity. While categories such as UndocuQueer fail to convey the entire experience in being, I borrow Deleuze and Guattari's image of the rhizome to liberate the infinite ways in which identity can be expressed through the queer undocumented individual. It is through the unstructured rhizome that queer undocumented individuals embody a globalized identity. The lack of structure embodies an identity through an ever-expanding process that allows for infinite multiplicities.

Most, but not all, of the individuals I interviewed were familiar with the UndocuQueer movement. Monica[†], for example, explained that her appreciation for the UndocuQueer movement was more about the visibility it creates. She explained,

I think there's some that I do identify with, I think I really appreciate the work that shows the diversity even in being UndocuQueer. I think that's why I like it, not exactly because I identify with everything but it shows visibility.... I don't think I say it but if I post something on social media I'll tag it like UndocuQueer, or like UndocuQueer woman of color, but I think when I am speaking to someone often as an undocumented queer woman of color, I'll say it. UndocuQueer looks cooler as a hashtag.

While Monica values the work done by the UndocuQueer movement because of the space it creates, for her, using the term is mostly relevant only through social media.

"UndocuQueer" is not a term that she uses to introduce her identity to someone to whom she is speaking in person; instead, when the opportunity comes to disclose both identities, she prefers to state both "undocumented" and "queer" as two separate words. In this instance, Monica states both identities to introduce herself as an undocumented queer woman of color instead of using the term "UndocuQueer," which she uses on social media. The inability to reduce her identities to one, or even two, reflects the complexities of globalized identities, which are constructed not by an "either/or" labelling, but by a "both/ and" (Kearning, 1995). Similarly, Christian also said he did not use the word UndocuQueer and instead introduced himself as both undocumented and queer because it feels more natural. However, his justifications for why he did that are slightly different than Monica's. He explained,

UndocuQueer still sounds weird for me to say just because it sounds like alphabet soup, it sounds like too much to say. For me I'm just like oh I'm undocumented and I'm queer, which is the same thing. But there is power in that word when you say it out loud and people listen to you when you say it. I've never used that word. It almost sounds like something that the DREAMers or older activists were using when they first were trying to get AB 540 or the DREAM Act out. I have a friend, she did all that activism work and she has friends from that circle who identify as UndocuQueer, so by the time I got to college they already did all that work for me you know? They set up the DREAM Act they set up AB 540. So for me I had a cushiony spot—I didn't need to have such a political word attached to my identity because that work was already done. I was given that space to be undocumented and queer.

Although "UndocuQueer" may be a shorthand expression, it does not work that way in the daily lives of these individuals at a personal level, since it feels unnaturally constraining. For Christian, the term is too politically charged to be used as representation of his identity. It is not relevant for him to use it, as the term has connotations of activism in which he did not participate. He is grateful for that work because it has given him the option to not have his personal identity politicized, and it has allowed him to shape his sense of self beyond a list of policies. Although social movements and policies regarding undocumented

people are connected to his identity, it is not the sole origin of his identity. To more effectively think about both the connection and the rejection of "UndocuQueer" as an identity based on political associations, I turn to Deleuze's concept of "transformational multiplicities" characterizing the rhizome. "Transformational multiplicities" expand the spatial dimension in which identity is formed by its countless connections without depending on one main link.

Like Monica, Christian, and all the other people I have interviewed, Karla* does not think of the term UndocuQueer as reflective of her identity. In the following she reflects on the function of UndocuQueer:

I don't like the use of it just because of the fact that it's not something people should think of you as. Oh not only are you undocumented but you're queer. Well you're whatever you are, you're documented or came here or queer or straight. I don't personally like labels. That's one of the main reasons why I don't like some people knowing I'm bi because it's like you're this or you're that. One of each, and you can never be whatever you think yourself as. I don't always see myself undocumented and yet I am ... Growing up it was never a priority for me. Now, yeah I see the difference in it. In either one I never put much importance to it because I never like thinking of myself that I'm just this label that they put on me and being UndocuQueer it's nothing more than a label.

Karla's rejection of UndocuQueer is based on its working as an imposed category. Even though the term was created by undocumented queer activists, it still holds the potential to be perceived as an imposed identity, which is constraining of a full identity expression. She rejects labels that indicate that she is undocumented and queer because it is more liberating for her identity. The experience in being undocumented and queer lay in what Deleuze and Guattari call a "plane of consistency" of multiplicities in which various identities are mapped in the same dimension. It alludes to the coexistence of various identities in which there is no constraint to the number or the specific identities to be embodied. By undoing the polarized structure of identity formation, the rhizome also undoes the totalization of imposed categories.

CONCLUSION

My interviews have suggested that "UndocuQueer" as a form of identification is not embodied at the individual level. Instead, the participants' coming out stories suggest that being undocumented and queer are manifested as two fragmented, separate-yet-connected identities. For these individuals, although their undocumented status and queer identity are influential factors in their lives, they reject the term "UndocuQueer" because, to them, that term is restrictive and does not fully express their identities. This points to the complexity and partiality of a globalized identity where neither an undocumented status nor a queer sexual orientation alone accurately reflects an individual's identity. The depolarized nature of the rhizome shows how identity is not a binary notion in which an individual embodies one single way of being. Instead it demonstrates the existence of various multiplicities and plateaus in which identity actively reconstructs and expands itself in the form of lines connected to each other but not solely to each other. An undocumented status and a queer identity then take the form of a line connected to each other, but also connected to various other lines. Through this perspective, it is impossible to shape identity formation as rooted in either simply an undocumented status or simply a queer identity.

Similarly to the rhizome, a globalized identity lacks a traceable structure. The rhizome provides a space in which the embodiment of identity can be drawn as some phenomena that are unstructured, depolarized, and in constant movement. It is through the rhizome that an undocumented-queer experience is inhabited as a globalized identity. As a globalized identity, the experience of being undocumented and queer both blurs geographical borders and inhabits borders. The rhizomatic nature of a globalized identity resists the constraining and divisive purposes of national borders by creating a space that expands beyond the limits of borders. While national and geographical borders are imposed on the land, the rhizomatic globalized identity challenges the validity of those borders. Those who embody a rhizomatic globalized identity, such as undocumented-queer individuals, resist the impositions of borders.

The rhizome and the globalized identity show the messiness

of constructing identity and of being undocumented. The rhizomatic globalized identity of being undocumented and queer speaks against the linear way in which academics have written about the experience of being undocumented. Being undocumented alone is not as structured as academics make it seem. Instead, being undocumented is a very complex and diverse experience. Including the experiences of undocumented queer youth will disrupt and inform the current heterosexual scholarship on undocumented youth. Given the lack of research focused on queer undocumented individuals, I argue that further research is needed across disciplines to reshape the current body of literature on undocumented youth to be more representative of the undocumented experience.

ENDNOTES

† Pseudonym

* Real name

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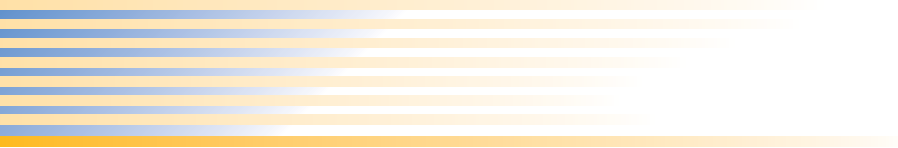
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In Silico Physicochemical Analysis of Helical Interactions in Resistin

Siddharth Sai, Rohith R Mohan, Meera G Nair, Dimitrios Morikis
Department of Bioengineering and Division of Biomedical Sciences, School of Medicine

Siddharth Sai

Department of Bioengineering

Siddharth Sai is a second-year Bioengineering major. Siddharth has been doing research in Biomolecular Modeling and Design Lab since his sophomore year. He has developed a strong interest in the mechanisms of the endocrine and immune system and aims to study this in a computational approach. In the future, he plans to pursue a PhD in the field of bioengineering.

ABSTRACT

Resistin is a protein that is involved in the function of the endocrine system and in unregulated immune response. Resistin functions as a trimer, with each monomer containing an N-terminal alpha-helical tail and a C-terminal beta-sandwich head. The N-terminal helices may be important for resistin's endocrine and immune function and for its functional interaction with its putative receptors. In this study, we use computational methods to evaluate the molecular mechanism of stability of the resistin helical tail in its monomer and trimer forms. Our analysis is performed using the crystal structure of resistin, and is based on the evaluation of polar and nonpolar intra-helical and inter-helical interactions, such as hydrogen bonds, ionic interactions (salt bridges and weak Coulombic interactions), and hydrophobic contacts. In addition, we demonstrate that charge plays a significant role in the stability of the alpha-helices of resistin, based on a computational alanine scan and calculation of electrostatic potentials. A comprehensive understanding of the structural properties of resistin may serve as a basis for the development of a potential biotherapeutic for inflammatory diseases and diseases of the endocrine system.

Keywords: Resistin, Endocrine, Metabolic Disorders, Inflammatory Response, Helices, Electrostatic Interactions, Monomer, Trimer

FACULTY MENTOR

Dimitrios Morikis

Professor of Bioengineering

Professor Morikis' work focuses on immune system function and regulation, structure-dynamics-activity/function relations, design of peptides and proteins with tailored properties, drug discovery, and development of structural and translational bioinformatics methods. His research is predominantly computational, with emphasis on molecular dynamics simulations, electrostatic calculations, free energy calculations, pharmacophore modeling, virtual screening, and protein-ligand docking, and has an experimental component, with emphasis on binding, biochemical, and functional assays and NMR spectroscopy. Siddharth's work includes graduate student Rohith Mohan, and is part of a collaborative project with Professor Meera Nair of UCR's School of Medicine.

INTRODUCTION

The endocrine system is composed of a wide range of hormones, and serves its main purpose of regulating the functions of a human body working in conjunction with the immune system.[1] Sometimes, dysregulation in these systems can contribute to the development of endocrine metabolic disorders. Resistin, a hormone known for its role in increased resistance to insulin,[2] has been linked to imbalances in endocrine response and implicated in chronic conditions such as Type 2 diabetes, obesity, and even atherosclerosis.[3,4] In addition, resistin is found to be induced through inflammatory response in conditions such as parasitic infections,[5] cancer,[6] and other metabolic disorders.[7] In terms of structural components, resistin has a main scaffold consisting of three chains that is connected to three helices, which therefore defines its trimer form.[8] The overarching goal of this study is to evaluate resistin, specifically its helices, to see if it retains structural stability and potential binding interactions in its monomer form. If it could be shown that resistin is stable in its monomer form, then it would be a positive step towards developing a folded, stand-alone scaffold for reducing the initial barrier to biotherapeutic design since the computational analysis can be done more rapidly and cost less than performing similar analysis experimentally. Here, we studied the physicochemical properties of resistin, primarily focusing on the N-terminal alpha helices that may be important in functional interaction with putative resistin receptors. We examined the structural stability of the alpha-helices in their trimer and monomer states, using physicochemical property analysis originating from hydrophobicity, polarity, and charge. We also performed a computational alanine scan to delineate the role of each ionizable amino acid in the stability of the N-terminal helical monomer and trimer.

METHODS

We implemented three primary methods, which include structural, physicochemical, and electrostatic analysis, to shed light into the stability of individual helices and the helical trimer of resistin. Analysis of the local structure and physicochemical properties provide insight into the intramolecular and intermolecular interactions that contribute to the stability of resistin. Additional electrostatic analysis of the resistin trimer, through a computational alanine scan, elucidates significant contributions to stability by ionizable amino acids. The computational alanine scan provides a rapid alternative to an experimental alanine scan.

Structural Analysis: The crystallographic structure of resistin (PDB code: 1RFX)[8] was visualized and analyzed using the software UCSF Chimera.[9] The initial structure contained missing hydrogen and heavy atoms, so these were filled in through the tool PDBFixer, part of the OpenMM software suite,[10] according to standard atom specification of amino acids. Selecting a specific helix from Chains A, B, and C was arbitrary as all three helices are structurally equivalent, so Chain B was selected for general analysis. Many structural components were examined and include the following: the primary, secondary, tertiary, and quaternary structure, disulfide bridges, hydrogen bonds, salt bridges, and weaker-charged residue interactions. The structure of the standalone helix and its amino acid sequence was visualized to show certain properties of the helix, such as its polarity and hydrophobicity. Also, the number of hydrogen bonds in the helix was closely evaluated using Chimera because these bonds are prime examples of stabilizing interactions within the helix that give it its helical shape. To ensure uniformity, all helices were truncated to 24-amino acid residues using Chimera so that the number of hydrogen bond donors and acceptors would be identical for an accurate comparative analysis. Furthermore, analyzing the salt bridges was crucial because the interactions of amino acids with opposite charges typically add to the local stability. Salt bridges are formed by strong/medium charge-charge interactions within 5 Å, whereas weak charge-charge interactions in the range of 5-8 Å are referred to as weak Coulombic interactions. In combination, hydrogen bonds and Coulombic interactions (salt bridges or weak) are referred to as electrostatic interactions. Coulombic interactions between opposite-charge residues are more favorable, whereas those between like-charge residues are less favorable. Disulfide bridges produce long-range contacts through covalent bonds between thiol groups and typically contribute to tertiary packing of the protein.

Physicochemical Analysis: The following steps of analysis primarily focused on the intermolecular interactions between the helices of resistin. First, the interactive webserver PDBePISA[11] was used to detail the stabilizing

interactions between the amino acids from all helices of the trimer. This analysis generated a detailed database of all intermolecular interactions between each monomer with corresponding distances (in Å).

Furthermore, the ability to predict the pKa values of each ionizable amino acid in its respective environment within the protein is a strong indicator of its interaction with another ionizable amino acid, with the latter being identifiable through structural visualization and distance analysis. Calculation of apparent pKa values of each ionizable amino acid within resistin was performed through a webserver known as PROPKA,[12] and they were compared to model pKa values of free amino acids in solution. Deviations of the apparent pKa values from the model pKa values are indicators of participation of the ionizable amino acid in salt bridges or other favorable or unfavorable Coulombic interactions. Apparent pKa values were calculated for the helix trimer and stand-alone helices.

Electrostatic Analysis. The computational framework AESOP (Analysis of Electrostatic Structures of Proteins)[13–16] was used for a more detailed study of the electrostatic interactions that occurred between the amino

acids of the helix trimer and monomer forms. Specifically, the alanine scan class of the AESOP library implemented as a webserver was used. In the alanine scan, each ionizable amino acid of the helix is replaced with the neutral amino acid of alanine, one at a time, to generate a family of computational mutants for comparison to the parent (un-mutated) protein. Subsequently, electrostatic energies of association are calculated to evaluate the strength of the electrostatic interactions between the helices of the helix trimer. This type of analysis provides a measure for the importance of the original (replaced) amino acid in the formation of helical dimers and the trimer.

RESULTS

As shown in **Figure 1**, the N-terminal alpha-helix of the crystal structure of resistin consists of 24 amino acids and 6.7 turns (3.6 amino acids per turn), and has the sequence C[6]PIDEAIDKKIKQDFNSLFPNAIK[29] spanning amino acids 6-29. The alpha-helix appears to be amphipathic in its central region due to the presence of opposite hydrophobic and polar surfaces. The helix demonstrates the classic bend of amphipathicity, owed to the clustering of hydrophobic side chains (not shown) against each other to minimize contact with the polar solvent.

Structural Stability of Resistin Helices:
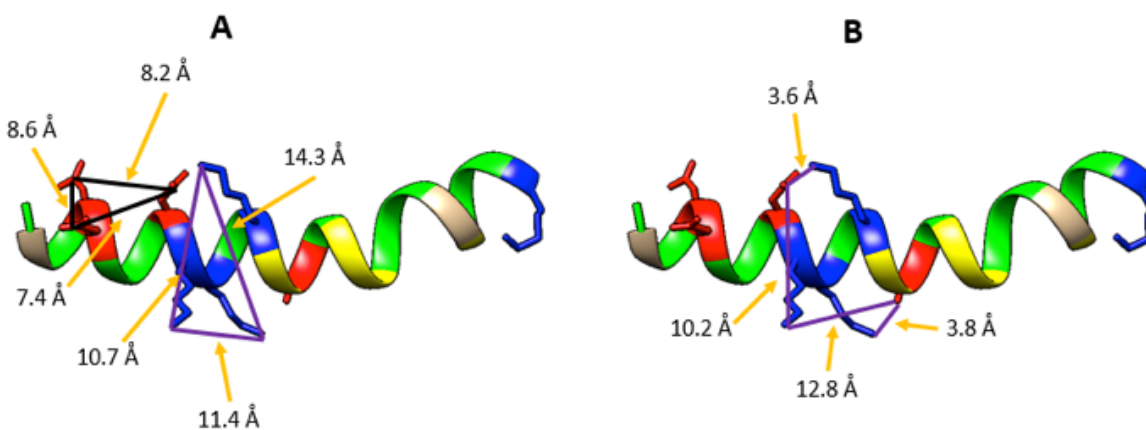
Figure 1: N-terminal helix of resistin. Images A and B depict a standalone helix of resistin that is colored by its respective properties: bright green is hydrophobic, red is polar negative, blue is polar positive, and yellow is polar neutral. Panel A shows the possible destabilizing interactions occurring within the helix and their respective distances in angstroms (Å). The black lines indicate the like-charge interactions between the side-chains of the negatively charged amino acids while the purple lines indicate the like-charge interactions between the positively charged amino acids. The purple lines in Panel B demonstrate the side chain interactions of the opposite-charge amino acids along with their distances.

Table 1 details the intramolecular hydrogen bond interactions between two amino acids (donor and acceptor) specifically from Chain B. Between 24 amino acids, there is a total of 18 hydrogen bonds. Moreover, the relative distances of the hydrogen bonds between any two amino acids are within the typical 3.5 Å range.

Donor	Distance (Å)	Acceptor
GLU 10-N	2.67	CYS 6-O
ALA 11-N	3.11	PRO 7-O
ILE 12-N	2.95	ILE 8-O
ASP 13-N	2.74	ASP 9-O
LYS 14-N	3.00	GLU 10-O
LYS 15-N	3.17	ALA 11-O
LYS 15-NZ	2.89	ASP 19-OD1
ILE 16-N	2.90	ILE 12-O
LYS 17-N	3.07	ASP 13-O
LYS 17-NZ	3.52	ASP 13-OD1
LYS 17-NZ	2.73	ASP 13-OD2
GLN 18-N	2.98	LYS 14-O
ASP 19-N	2.90	LYS 15-O
PHE 20-N	2.82	ILE 16-O
ASN 21-N	2.98	LYS 17-O
SER 22-N	3.07	ASP 19-O
SER 23-OG	2.76	ASP 19-O
LEU 24-N	2.93	ASP 19-O
PHE 25-N	2.92	PHE 20-O
ASN 26-ND2	2.71	SER 22-O
ALA 27-N	3.23	LEU 23-O
ILE 28-N	2.88	PHE 24-O
LYS 29-N	3.02	PRO 25-O
LYS 29-NZ	3.20	PRO 25-O
ASN 30-N	3.17	ALA 27-O
ILE 31-N	3.18	ILE 28-O

Table 1: *Intramolecular Hydrogen Bonds in Chain B. The three-letter amino acid code, sequence number, and atom type used to calculate distances are shown.*

Figure 2 shows the helices of the trimer that belong to the three chains, as shown in their respective colors, and their intramolecular hydrogen bonds. The 24 amino acid helix in Chain A, shown with the helix labeled in blue, has a total of 17 intramolecular hydrogen bonds. Chain B, shown in red, has a total of 18 intramolecular hydrogen bonds. Chain C, as shown in green, has a total of 13 intramolecular hydrogen bonds from 24 amino acids. The discrepancy in the number of hydrogen bonds can be attributed to the conformational differences in the crystallographic structure and the rigid hydrogen bond criteria applied.

Importance of Intermonomer Interactions in Resistin. Through PDBePISA, helical intermonomer interactions occurring in resistin were identified. The amino acids shown under Structure 1 and Structure 2 indicate the amino acid residue along with the corresponding chain (A, B, or C) and its atom type (O, NZ, OD1, or OD2). As seen in *Tables 2 and 3,* there are a total of 27 intermolecular interactions that play a crucial role in stabilizing structure
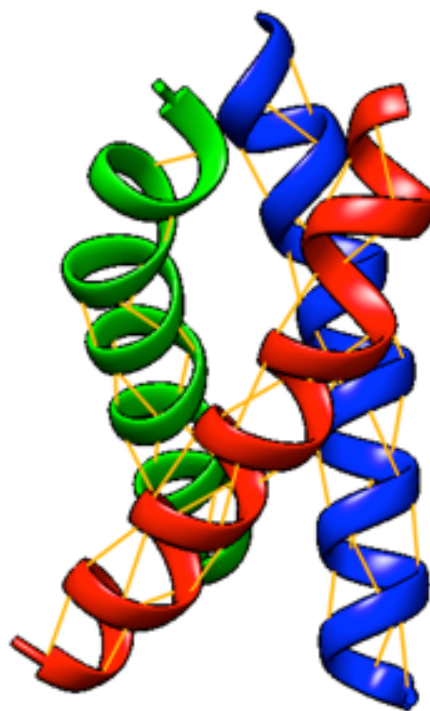
Figure 2: *N-terminal helical trimer of resistin. A detailed image of the hydrogen bonds within each helix of the trimer, depicted in orange lines, for all three chains ranging from the 6th to the 29th residues. The helices of the chain are colored as follows: Chain A-blue, Chain B-red, and Chain C-bright green.*

of the trimer.

Tables 4 and 5 show the difference in apparent and model pKa values for selected amino acids. The differences were only noted if they were greater than 0.5 units. The apparent pKa values differ from model pKa values as they are influenced by the surrounding amino acids and participation in salt bridges or Coulombic interactions.

The results obtained from the AESOP analysis are shown in the **Figure 3**. The areas of amino acids with the largest magnitude in electrostatic energies of association range from the 6th residue to the 29th residue, which correspond to the regions of the helices of the trimer from all three chains. A positive change in electrostatic energy signifies a predicted loss in stability of the trimer as result of the mutation of the ionizable amino acid to alanine with regard

Structure 1	Distance (Å)	Structure 2
ASP 9.B-O	3.46	LYS 15.C-NZ
ASP 13.A-OD1	2.88	LYS 15.B-NZ
LYS 15.A-NZ	2.94	ASP 9.C-OD2

Table 2: *Helical Intermolecular Hydrogen Bonds. The three-letter amino acid code, sequence number, and atom type used to calculate distances are shown.*

Structure 1	Distance (Å)	Structure 2
ASP 13.B-OD1	3.81	LYS 15.C-NZ
ASP 13.A-OD1	2.88	LYS 15.B-NZ
LYS 15.A-NZ	2.94	ASP 9.C-OD2

Table 3: *Helical Intermolecular Salt Bridges. The three-letter amino acid code, sequence number, and atom type used to calculate distances are shown.*

Residue	Apparent pKa	Model pKa
ASP 13.B	3.31	3.80
ASP 19.B	3.32	3.80
CYS 6.B	8.26	9.00
LYS 17.B	11.11	10.50

Table 4: *Differences between Apparent and Model pKa Values (> 0.5 units) for Standalone Helix*

to the stability of the parent (WT) trimer, while a negative change in electrostatic energy signifies a predicted gain in stability. Throughout the trimer, there was a higher number of positive electrostatic energies of association than negative electrostatic energies of association.

DISCUSSION
Structural Stability of Resistin Helices:

As seen in **Figure 1A**, like-charge interactions between residues (polar-positive and polar-negative) were prevalent in the helix. These unfavorable interactions have the potential to destabilize the helix. Typically, these interactions are considered significant if within the range of 5 Å. In this case, all the like-charge interactions involving the side chains are well out of the range. Therefore, it can be inferred that these interactions do not contribute to the destabilization of the overall structure of the helix. In **Figure 1B**, there are 4 side-chain interactions that could be considered possible salt bridges, but there are only 2 interactions that could be very strong as their distances are

Residue	Apparent pKa	Model pKa
ASP 13.A	1.05	3.80
ASP 19.A	6.17	3.80
CYS 6.A	8.59	9.00
LYS 15.A	11.92	10.50
LYS 17.A	11.60	10.50
ASP 13.B	1.83	3.80
ASP 19.B	5.26	3.80
CYS 6.B	8.46	9.00
LYS 15.B	12.57	10.50
LYS 17.B	11.68	10.50
ASP 9.C	2.72	3.80
ASP 19.C	6.28	3.80
GLU 10.C	3.85	4.50
CYS 6.C	8.45	9.00
LYS 14.C	11.14	10.50
LYS 17.C	9.59	10.50

Table 5: *Differences between Apparent and Model pKa Values (> 0.5 units) for Trimer*
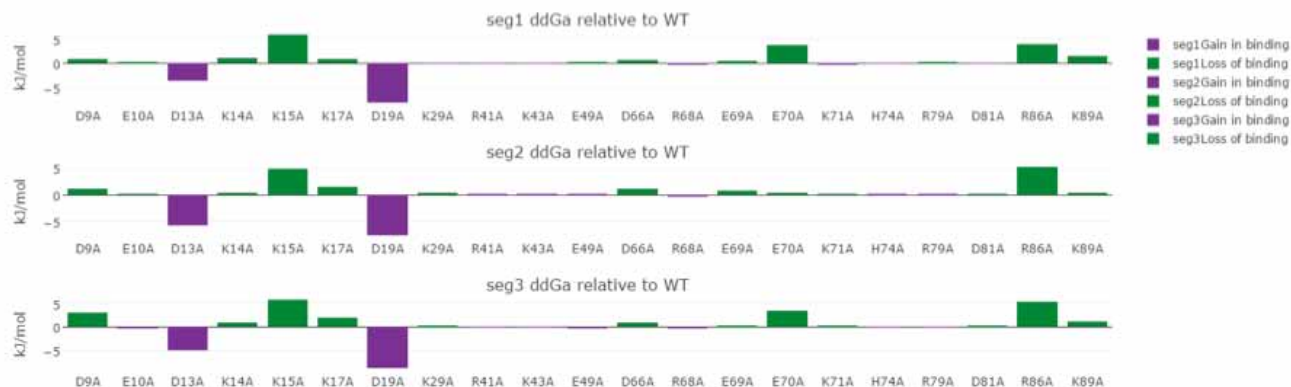
Figure 3: *AESOP analysis of resistin trimer. Electrostatic energies of association for each ionizable amino acid in their specific residue position along a chain of the protein are displayed. The rectangular regions encoded in green detail a positive electrostatic energy, while the purple regions show a negative electrostatic energy. Segments 1, 2, and 3 refer to Chains A, B, and C of the resistin trimer, respectively. The one-letter amino acid code is: D for aspartic acid (Asp), E for glutamic acid (Glu), K for lysine (Lys), and R for arginine (Arg). AESOP analysis is performed on the full-length resistin protein. The N-terminal helical portion includes the mutation segment of D9A to K29A.*

within the range of 5 Å. The ones that are over 5 Å may still be possible salt bridges but are not likely to be very strong ones. Salt bridges aid the helix in retaining its shape.

Based on the data from ***Table 1 and Figure 2***, there is a considerable amount of hydrogen bonds for a limited number of amino acids which suggests that the structure of a single helix is likely to be stable. This data shows that the hydrogen bonding network of individual helices is well-established and contributes to the stabilities of their individual secondary structures.

Importance of Intermonomer Interactions in Resistin. All the helical intermolecular hydrogen bonds and salt bridges observed from ***Tables 2 and 3*** are within the typical 3.5 Å and 5 Å range, respectively, which suggests that these interactions are strong.

Distinct differences are observed in the comparison of apparent and model pKa values between the standalone helix and the trimer from the data in ***Table 4***. For example, the apparent pKa values for ASP 13.B and ASP 19.B were 3.31 and 3.32, respectively, in the monomer. In terms of the trimer form, however, these values now correspond to 1.83 and 5.26. This difference can be attributed to the increased number of intermolecular interactions with amino acids from other chains.

Role of Electrostatics in Helical Trimer Stability. The data produced from the AESOP analysis indicate that there are more predicted losses in stability as a result of individual amino acid mutations owing to the loss of favorable electrostatic contributions from these amino acids. For the helical portion of resistin, the data from AESOP showed that the amino acids with a positive electrostatic energy from all three chains, corresponding to a predicted loss of stability after mutation, were Asp 9, Glu 10, Lys 14, Lys 15, and Lys 17. Likewise, the amino acids with a negative electrostatic energy, corresponding to predicted gain of stability, were Asp 13 and Asp 19. The AESOP analysis demonstrated the electrostatic contributions of specific amino acids to the structural stability of the helices and the trimer itself. Furthermore, the electrostatic contributions of amino acids in the helix are more numerous and larger in magnitude than that of the scaffold.

Conclusions and Perspective. Through the computational analysis of the helical inter- and intramolecular interactions of resistin, we have evaluated the structural stability of both the trimer and monomer forms. Through physicochemical property evaluation and analysis of intramolecular interactions such as hydrogen bonds and favorable or unfavorable Coulombic interactions, it was shown that resistin is likely to be stable in its monomer form. In addition to the interactions stabilizing the

monomer, intermolecular interactions between the three helices further contribute to the structural stability to the trimer form. Electrostatic analysis and pKa analysis further demonstrates the overall stability of the trimer. Based on these results, it is likely that the trimer form is more stable than the monomer form. However, the monomer can still be a subject of future investigation for regulation of inflammatory and endocrine diseases if it can be shown wheth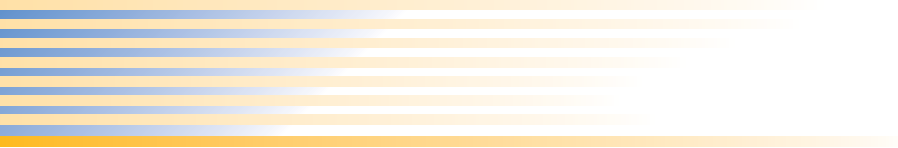er the functional properties of resistin are similar between the monomer and trimer forms of the protein. This is of interest as the monomer form, specifically the helix, is only 24 amino acids long, which would address concerns in scalability and production that other biopharmaceutical industries encounter. This would have to be further evaluated through other methods such as molecular or Brownian dynamics simulations and Circular Dichroism techniques to test this plausible hypothesis.

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Predicting Political Engagement from Moral Values during the 2016 U.S. Presidential Election

Kaitlyn Spillane

Department of Psychology

Kaitlyn Spillane

Department of Psychology

Kaitlyn Spillane is a fourth-year Psychology major. She currently works as a research assistant in Dr. Kate Sweeny's Life Events Lab and Dr. Tuppett Yates' Adversity and Adaptation Lab. She also holds an officer position as Treasurer for the Psi Chi National Honors Society at University of California, Riverside. After graduation, she plans to pursue a PhD in Clinical Psychology. In her studies, she hopes to train as a child psychologist and study the consequences of childhood adversity.

ABSTRACT

According to Moral Foundations Theory, five foundations underlie morality: care/harm, fairness/cheating, sanctity/degradation, authority/subversion, and loyalty/betrayal. Considerable evidence suggests that Americans' values align with their political orientation and party preference; however, little is known about how moral values are related to political behaviors such as political engagement. Our study examined this potential link in the context of the 2016 presidential election. We surveyed potential Donald Trump and Hillary Clinton voters via Amazon's Mechanical Turk survey service using a cross-sectional panel design. We assessed the moral values of Donald Trump and Hillary Clinton supporters each week over a seven-week period prior to the election, as well as their self-reported political engagement and objective markers of political engagement. As hypothesized, Clinton voters reported a stronger commitment to traditionally liberal values (care/harm, fairness/cheating), whereas Trump supporters reported a stronger commitment to traditionally conservative values (sanctity/degradation, authority/subversion, and loyalty/betrayal). Turning to our novel question regarding values and political engagement, four of the five moral values significantly predicted objective political engagement, although not all in the predicted direction. In contrast, none of the moral values predicted self-reported political engagement. Understanding the link between moral values and political engagement can identify why people engage in politically-relevant social acts and how to possibly maintain engagement throughout the political season.

Keywords: Moral Values, Political Engagement, Presidential Election, Liberal, Conservative

FACULTY MENTOR

Dr. Kate Sweeny

Department of Psychology

Dr. Kate Sweeny's research examines two broad questions. First, how do people cope with uncertain waiting periods? Second, how should doctors talk to their patients? She has studied law graduates awaiting news about the bar exam, patients awaiting biopsy results, researchers awaiting manuscript decisions, surgeons talking to their adult patients, and asthma specialists talking to pediatric patients, among many other topics and studies.

INTRODUCTION

The 2016 U.S. presidential election was an unusual historical event in many ways. It was the first to have a female candidate representing a major party, and it was the first in recent history to have a major party candidate with little to no political experience. Given these unusual features of the Democratic and Republican candidates, as well as an outcome that defied even the most reliable polling data, the 2016 election provided an opportunity to test and extend the generalizability of political theories. The goal of this study was to compare supporters of Hillary Clinton and Donald Trump in terms of their moral values, as delineated in Haidt's (2007) Moral Foundations Theory, and examine whether these values predicted political engagement during the months leading up to Election Day.

Moral Foundations Theory was developed in an effort to explain both differences and similarities in moral values across cultures (Haidt, 2007; Graham, Nosek, Haidt, Iyer, Koleva, & Ditto, 2011). According to the theory, five foundations underlie morality: care/harm, fairness/cheating, sanctity/degradation, authority/subversion, and loyalty/betrayal. The care/harm value focuses on noticing and preventing the suffering of others. The fairness/cheating value focuses on pursuing basic rights and justice. The sanctity/degradation value focuses on standards of decency and living a clean and noble life. The authority/subversion value focuses on respect for tradition and hierarchy. Lastly, the loyalty/betrayal value focuses on prioritizing one's group and love for one's country.

Although Moral Foundations Theory originally addressed cultural differences, it is also commonly used to guide investigations into variability within one culture's political system. Consistent with this application of the theory, research has shown that in previous U.S. presidential elections, variability in moral values predicted the presidential candidate voters supported. In general, this line of research has shown that people who more strongly value care/harm and fairness/cheating typically vote for more liberal candidates who are more progressive, whereas those who more strongly value sanctity/degradation, authority/subversion, and loyalty/betrayal typically vote for more conservative candidates, who tend to be more traditional (Franks & Scherr, 2015; Graham, Haidt & Nosek, 2009; Jost, Nosek, & Gosling, 2008).

In addition to predicting the candidate for whom people ultimately vote, moral values may also affect how engaged people are during political campaigns leading up to an election. In general, many studies have investigated how different types of values are related to different forms of engagement, including public engagement with climate change (Corner, Markowitz, & Pidgeon, 2014), cultural values with academic engagement (Gonzales et al., 2008), and career values with work engagement (Sortheix, Dietrich, Chow, & Salmela-Aro, 2013). Most relevant to the current investigation, one study found that those who had stronger moral convictions (i.e., a strong belief that something is either right or wrong) were more likely to vote (Skikta & Bauman, 2008). Another study found that moral identity (the importance one places on being a moral person) predicted different forms of political involvement (e.g., contacting a political representative about an issue or expressing views on political issues; Porter, 2013). Although these definitions of moral values and political engagement differ from the ones considered in the present study (see below), these findings point to a potential link between moral values and political engagement.

Although limited research has examined the link between morals and political engagement in general, we know of no research that has tested this relationship using the five values of Moral Foundations Theory, a theory that has previously been used in political contexts (e.g., Graham, Haidt, & Nosek, 2009). In the present study, we focus on the moral values laid out in Moral Foundations Theory and target a more general form of engagement rather than voting behavior, namely the degree to which voters are actively involved with their candidate's political campaign. This investigation may reveal why some people are more politically engaged than others, which can inform political campaign coordinators about how to target and increase political engagement of potential voters.

In the present study, we assessed moral values and political engagement in the months prior to the 2016 U.S. presidential election. We hypothesized that, consistent with previous findings, people who supported Hillary Clinton (the candidate for the Democratic party; identified as liberal) would more strongly value care/harm and fairness/cheating. In contrast, but consistent with previous research, we hypothesized that people who supported Donald

Trump (the candidate for the Republican party; identified as conservative) would more strongly value sanctity/degradation, authority/subversion, and loyalty/betrayal. We did not anticipate a difference between Clinton and Trump voters in their degree of political engagement; however, we anticipated that holding any value more strongly would predict greater political engagement.

METHOD
Participants
Participants (N = 800) were recruited from Amazon's Mechanical Turk (MTurk, a crowdsourcing site where participants can be recruited to complete quick research surveys), and received US$1 for their participation. We recruited participants from MTurk because it allowed us to reach Trump and Clinton supporters across the country rather than only locally. The surveys from 131 participants were removed due to multiple submitted responses, inconsistency in their supposed candidate support (e.g., reportedly supported Hillary Clinton prior to the election, then voted for Donald Trump), or incomplete survey responses. A final total of 669 participants (55.59% male; Mage = 34.56 years, SDage = 10.29; race and ethnicity data were not collected) were included in the final analyses. In order to be considered for participation, participants had to be U.S. citizens over the age of 18.

Procedure
A total of eight surveys were administered online over the seven weeks leading up to the 2016 US Presidential Election. Each week a new set of fifty Hillary Clinton supporters and fifty Donald Trump supporters were recruited to complete a survey. The eighth and final pre-election survey was administered one day prior to Election Day.

Measures
Moral Values. Participants responded to a 30-item moral foundations questionnaire measuring five moral values (Graham, Haidt, & Nosek, 2009), with the prompt, "When you decide whether something is right or wrong, to what extent are the following considerations relevant to your thinking?": care/harm (e.g., "Whether or not someone was cruel"; 0 = not at all relevant , 5 = extremely relevant; M = 4.46, SD = .97, α = .77), sanctity/degradation (e.g., "Whether or not someone did something to betray his or her group"; M = 3.50, SD = .97, α = .72), fairness/cheating (e.g., "Whether or not some people were treated differently

than others"; M = 4.44, SD = .87, α = .71), authority/subversion (e.g., "Whether or not someone showed a lack of respect for authority"; M = 3.72, SD = 1.01, α = .75), and purity (e.g., "Whether or not someone acted in a way that God would approve of"; M = 3.31, SD = 1.32, α = .87).

Political Engagement. Participants completed two measures regarding their political engagement during the current political campaign season. The first was self-reported political engagement and was assessed with a single item ("How politically engaged do you consider yourself to be?"; 1 = *not at all*, 7 = *extremely; M* = 4.97, SD = 1.41). Participants additionally responded to a 6-item measure assessing objective political engagement, adapted from a previous study (Krizan & Sweeny, 2013; "I actively share my views about my preferred candidate," "I encourage others to vote for my preferred candidate," "I try to persuade others to share my views for my preferred candidate," "I actively campaign to influence the vote for my preferred candidate," "I have attended political rallies," "I'm involved with an organization that is attempting to influence the vote for my preferred candidate"; 1 = *strongly disagree*, 7 = *strongly agree; M* = 3.56, SD = 1.28, α = .84).

RESULTS
Differences Between Supporters
Table 1 presents independent-sample t-tests comparing Trump and Clinton supporters on each of the five moral values and the two measures of political engagement. As hypothesized, Clinton supporters had stronger values of fairness/cheating and care/harm compared to Trump supporters, whereas Trump supporters had stronger values of authority/subversion, sanctity/degradation, and loyalty/betrayal compared to Clinton supporters.

We also examined differences in political engagement between supporters. Clinton and Trump supporters did not differ on the measure of self-reported political engagement. However, Trump supporters had higher objective political engagement scores compared to Clinton supporters, suggesting that Trump supporters were more politically active prior to the election.

Relationship Between Self-Reported and Objective Engagement
Next, we examined the relationship between the measures of political engagement. Findings indicate that self-reported

	MDT	SDDT	MHC	SDHC	t	d
Moral values						
Authority/Subversion	4.07	.91	3.37	.99	9.48**	.73
Fairness/Cheating	4.23	.87	4.64	.83	6.23**	.48
Care/Harm	4.28	1.00	4.63	.91	4.68**	.36
Loyalty/Betrayal	3.81	.91	3.20	.34	8.56**	.66
Sanctity/Degradation	3.75	1.25	2.88	1.25	8.92**	.69
Political engagement						
Self-reported engagement	5.06	1.41	4.89	1.41	1.58	.12
Objective engagement	3.68	1.28	3.45	1.26	2.28*	.18

Note: *$p < .05$; **$p < .01$. M_{DT} and SD_{DT} are the means are standard deviations and Donald Trump supporters. M_{HC} and SD_{HC} are the means and standard deviations for Hillary Clinton supporters. ds are Cohen's d effect sizes.

Table 1: *Comparing Moral Values and Political Engagement of Trump and Clinton Supporters*

and objective political engagement were correlated, albeit not so strongly as to suggest that they measured the same construct, $r(669) = .27$, $p < .0001$. Additionally, people perceived themselves to be more politically engaged than they objectively were, $t(668) = 22.40$, $p < .0001$, d = 1.73.

Predicting Political Engagement from Moral Values

Table 2 presents the results of multiple regression analyses in which the five moral values were simultaneously entered in the model as predictors, along with candidate support (Trump vs. Clinton), to predict self-reported and objective political engagement. Controlling for all other moral values and candidate support, no moral value significantly predicted self-reported political engagement. In contrast, values of loyalty/betrayal and sanctity/degradation positively predicted objective political engagement, and values of authority/subversion and fairness/cheating negatively predicted objective political engagement.

DISCUSSION

The goals of the present study were to assess the moral values of Trump and Clinton supporters prior to the 2016 U.S. presidential election and examine the association between these values and political engagement. Our results replicated previous findings on political patterns in moral values (Haidt, 2007): Clinton supporters had stronger moral values of care/harm and fairness/cheating, and those who supported Trump had stronger moral values of sanctity/degradation, authority/subversion, and loyalty/betrayal. Regarding political engagement, our findings

only partially supported our hypothesis that moral values would positively predict engagement. Although the values of loyalty/betrayal and sanctity/degradation positively predicted objective political engagement, consistent with our hypothesis, the values of authority/subversion and fairness/cheating negatively predicted objective political engagement. Surprisingly, none of the five moral values predicted self-reported political engagement.

	Self-Reported Engagement	Objective Engagement
Authority/Subversion	-.004	-.13*
	[-.13, .12]	[-.26, -.02]
Fairness/Cheating	.06	-.12*
	[-.05, .16]	[-.22, -.18]
Care/Harm	.06	.03
	[-.04, .17]	[-.07, .14]
Loyalty/Betrayal	.03	.23**
	[-.08, .15]	[.11, .33]
Sanctity/Degradation	.02	.12*
	[-.09, .13]	[-.02, .23]

Table 2: *Predicting Self-Reported and Objective Political Engagement from Moral Values*

Note: †$p < .10$; *$p < .05$; **$p < .01$. Standardized betas are provided with 95% confidence intervals in brackets below each. All regression analyses control for candidate support (Trump vs. Clinton).

Differences in Moral Values

Neither Donald Trump nor Hillary Clinton were typical presidential candidates. Donald Trump had little to no political background, nor clear ties to the party that nominated him. Although Hillary Clinton had close ties to the Democratic Party throughout her political career, she was the first woman to be nominated by a major party. Given these unusual features of the candidates, it was plausible that their voters may have been unusual as well—perhaps crossing party lines, or supporting a major party candidate when they would not have done so otherwise. Nonetheless, our results were consistent with previous findings on differences in moral values between conservatives/Republicans and liberals/Democrats. Although Donald Trump and Hillary Clinton were atypical candidates, Trump supporters were still significantly more conservative than Clinton supporters, suggesting that voting patterns fell along typical political lines.

Political Engagement

Novel to this study was our investigation of the links between moral values and political engagement, which extends previous research focusing on other values and other methods of political engagement (Skikta & Bauman, 2008; Porter 2013). Loyalty/betrayal and sanctity/degradation positively predicted objective political engagement, such that voters who held these values more strongly reported engaging in clear and specific acts of support for their preferred candidate. Individuals who have stronger values of loyalty/betrayal may be more politically engaged because this value underlies patriotism, which may be related to the tendency to more strongly support one's own preferred candidate and encourage others to support him or her as well. Similarly, the value of sanctity/degradation entails striving to live in an elevated way, typically consistent with religious beliefs. To the extent that individuals are committed to living within the bounds of a specific lifestyle, they may be more likely to encourage others to follow in their footsteps.

In contrast, authority/subversion and fairness/cheating negatively predicted objective political engagement, such that voters who held these values more strongly reported engaging in fewer acts of support for their preferred candidate. Fairness/cheating may have negatively predicted objective political engagement because of its strong ties to autonomy and individual rights. If people believe that all individuals have a right to their own opinion, they may be hesitant to impose on their right to vote for whichever candidate they support. In addition, authority/subversion may have negatively predicted objective political engagement because this value is associated with respect of traditions. For over 200 years, the United States has elected officials using democratic voting methods. People who respect these traditions may be less likely to interfere, not because they respect others' preferred candidate, but because they respect the process.

Surprisingly, none of the five moral values significantly predicted self-reported political engagement. We suspect that two forces may be at work in this (non)finding. First, voters reported themselves to be significantly more politically engaged than they appeared to objectively be. This inconsistency suggests that people may not be accurate when reporting how politically engaged they are, either because they are unaware of their true level of engagement or because they wish to seem more engaged than they truly are. This bias leads to our second consideration. Although objective political engagement and self-reported political engagement were significantly correlated, an association of .27 suggests that these two measures are not tapping exactly the same construct. Future research in this area should carefully consider how political engagement is measured. Allowing people to self-define their engagement versus measuring actual examples of engagement (e.g., attending political campaigns) can lead to drastically different conclusions.

Conclusion and Future Directions

A clear next step in this line of research is to replicate the findings in future elections. Although this election was unusual in many ways, the fact that we found the typical pattern of moral values across party lines may speak to the generalizability of our findings. Nonetheless, future studies should examine dynamics of values and engagement in other presidential and non-presidential elections, as well as other politically-related events (e.g., support for a public ballot initiative; community elections). Additionally, the present study could not look at within-person fluctuations in political engagement. Future studies should determine if and how moral values are linked to changes political engagement as information regarding the likely election

outcome emerges. If a voter's preferred candidate is in the lead or behind in the race, do people who subscribe to particular morals become more or less politically involved?

Across domains, studies have shown that being actively engaged can be beneficial. For example, greater engagement in a classroom setting is related to academic achievement (Bundick, Quaglia, Corso, and Haywood, 2014), and engagement in the workplace predicts job satisfaction (Schaufeli, Taris, & Van Rhenen, 2007). However, we know far less about the consequences of political engagement. To identify the positive outcomes, and perhaps some negative ones, associated with political engagement is an important next step toward determining how this form of engagement can lead to beneficial outcomes for the individual.

Finally, the results from this study can inform campaigns about which values to emphasize when communicating with potential voters, assuming the candidates want to increase political engagement. Campaigns on both sides of the political spectrum may benefit from emphasizing loyalty/betrayal and sanctity/degradation, and deemphasizing authority/subversion and fairness/cheating, although the flexibility of these values should be assessed before further considering this possibility Additionally, previous studies have suggested that engagement with a political endeavor may lead to more disappointment if the outcome is not one that a voter desires (Krizan & Sweeny, 2013). Thus, although campaigns may benefit from their supporters being politically engaged, for example by increasing voter turnout (Skitka, & Bauman, 2008; Boeckmann & Tyler, 2002; Britt, 2003), engaged supporters may become more vulnerable if things do not go their way. In sum, although these issues are complex and many questions remain, this novel approach to understanding political engagement reveals that morals and values play a clear role in people's likelihood of engaging in politically-relevant acts.

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Leadership Behaviors across Contexts

Dulce E. Wilkinson, Kyle S. Sauerberger, and David C. Funder

Department of Psychology

ABSTRACT

Leadership behaviors can be broadly categorized as having the ability to inspire others to work toward a common goal. Literature suggests that leadership is not unidimensional, and may manifest as several distinct patterns of behavior that are differentially expressed depending upon the behavioral demands of one's situation. The current study divides leadership behaviors into three distinct styles —domineering, task-oriented, and social emotional—and examines the degree to which behaviors representative of each style are expressed across different situations. Participants engaged in three social interactions—an informal chat, a cooperative task, and a competitive task—in unacquainted triads. These three situations elicited distinct leadership behaviors, showing that situational demands influence leadership behavior. Trained research assistants assessed behavior by rating video recordings of the interactions using the Riverside Behavioral Q-Sort. Results confirmed that each leadership style was expressed differently based on the demands of the situation. Specifically, social emotional leadership was expressed most in Visit 1 wherein the inherent aim was social cohesion, whereas task-oriented leadership was most commonly expressed during Visits 2 and 3, which involved the pursuit of a specified goal. These findings hold important implications for determining how leaders ought to behave to enhance positive outcomes in real-world domains.

Keywords: Leadership, Behavioral Change, Behavioral Consistency, Social Emotional, Dominance, Domineering, Task-Oriented

FACULTY MENTOR

David C. Funder

Professor of Psychology

David C. Funder is a Distinguished Professor of Psychology at the University of Calfiornia, Riverside. Dr. Funder's research focuses on personality judgement, personality development, and the psychological assessment of situations. Before coming to UC Riverside, he taught at Harvey Mudd College, Harvard University, and the University of Illinois, Urbana-Champaign.

Dulce Wilkinson

Department of Psychology

Dulce Wilkinson is a third-year psychology major at UC, Riverside. A recipient of the Mini-grant as well as the Highlander Excellence scholarship, she studies behavioral consistency in the context of leadership under the guidance of Dr. David Funder. An active member of University Honors and several research labs on campus, Dulce's passion lies in theory-driven research of psychology. She plans to pursue a Ph.D. in Social Psychology to fulfill her goal of teaching and conducting research at a research university.

INTRODUCTION

A leader is an individual who has a disproportionate amount of influence on a group activity (Van Vugt & Grabo, 2015). Leaders are ubiquitous; people have a natural tendency to form hierarchical social structures, and these hierarchies enhance group performance, motivation, and success (Halevy, Chou, & Galinsky, 2011). However, an understanding of the factors that distinguish leaders from non-leaders, and the qualities that differentiate effective leaders, are not well understood (Vroom & Jago, 2007). Despite a lack of consensus, leadership is thought to function via the process of social influence (i.e., the attainment of followers) and motivation of group behavior. The present study examines the emergence of leadership behaviors across a variety of contexts. We propose two research questions to address the aims of the present study. Research Question 1 asks if the three leadership styles are displayed to a different degree within three laboratory situations. Research Question 2 asks in which of the three visits each leadership style is the most prevalent. The purpose of this study is to support and extend findings of previous research on behavioral consistency and leadership by assessing the natural expression of three leadership styles (i.e., social emotional, domineering, and task-oriented) across three laboratory visits.

A wide spectrum of leadership behaviors exist, ranging from those considered intimidating or aggressive, to more task-oriented and social emotional. The present study specifically examines the natural emergence of three styles of leadership – social emotional, domineering, and task-oriented. Firstly, social emotional intelligence represents "people skills" that effective leaders often possess (Riggio et al., 2003). Followers tend to view social emotional leaders as more effective, but less able to produce group productivity (Riggio et al., 2003). When examining social emotional leadership, prior studies have tended to focus on its actual or perceived effectiveness (Riggio et al., 2003). While the current study does not aim to assess how effective certain leadership styles are, it contributes to existing literature by identifying the situational variables associated with the expression of leadership behaviors.

Secondly, according to Leary and colleagues (2001), leadership captures a central feature of dominance, for dominant individuals are generally influential and tend to prompt submission from others. In one study, participants who received high leadership feedback reported greater feelings of dominance when compared to those who received low leadership feedback (Leary et al., 2001). While dominance is often considered an integral aspect of leadership (Maner & Case, 2016), not all leadership is expressed via domineering tactics. Rather than being infallibly present, the current study posits that domineering leadership may manifest differentially depending on the demands of a given situation.

Lastly, previous study suggests that task-oriented leaders are preoccupied more with task performance relative to cooperating with others (Tabernero, Chambel, Curral, & Arana, 2009). When trained to use either task-oriented or social emotional leadership tactics, task-oriented leaders stimulate higher group efficacy, whereas social emotional leaders achieve greater group cohesion (Taberbnero et al., 2009). In essence, leadership tactics produce different outcomes based on the goals of a task or context. Therefore, delineating the situations associated with the expression of certain leadership styles may aid in producing beneficial outcomes in real-world domains.

Past research supports that psychological properties of situations produce different behavioral outcomes (Funder & Colvin, 1991). In a review by Vroom and Jago (2007), the researchers argued that the sort of leader people desire varies based on task. For instance, leaders who manage ineffective teams behave in a less considerate and supportive manner than those managing effective teams. Thus, the situation may be a key component in shaping leadership behaviors. Although prior research has focused on the relationships between single situations and leadership behavior, the current study has a novel focus on the natural emergence of leadership behaviors across a variety of contexts.

An individual's social environment, along with the nature of a goal implicit in a task, influences emerging patterns of leadership. In a study by Burke (1971), participants engaged in a "creative discussion" in which an elected or emergent leader moderated a group debate. Participants rated themselves and other group members on task-oriented and

social emotional dimensions. Results showed that as task leaders' preoccupation with performance increases, they become less concerned with maintaining group relations and behaving in a social emotional fashion (Burke, 1971). These findings not only illustrate that task-oriented and social emotional leadership emerge independently, but that they are largely contingent upon context. Though this study examines the natural use of social emotional and task-oriented leadership, our study extends beyond this by also assessing domineering leadership, across three separate time points.

METHOD
Participants

The study consisted of 256 (130 F, 126 M) undergraduate students from the University of California, Riverside. On average, participants were 19.83 years old (*SD* = 1.25). Participants were recruited using an online research participation system and asked to engage in three laboratory visits. Compensation included both research credit and a monetary payment that, with the completion of all visits and applicable bonuses, was up to $115. The sample was 48.8% Asian, 23% Hispanic/Latino, 8.2% Caucasian, 4.3% Middle Eastern, 3.1% African American and 12.5% other.

Measures

The Riverside Behavioral Q-Sort (RBQ; Funder, Furr, & Colvin, 2000) was used to assess behavior in each situation. The RBQ is a 68-item measure used to describe behavior in a situation (e.g., "seems detached from the situation"). Q-sort measures are forced-choice instruments that produce a quasi-normal distribution of ratings (1 = *not at all characteristic,* 9 = *extremely characteristic*). Raters are only able to place a limited number of items in the more extreme categories. Research assistants rated the extent to which each behavior in the RBQ was characteristic of the participant they rated in a given visit. While the RBQ is not regularly used to assess leadership, it is a valid and appropriate measure for quantifying a wide range of observable behavior. We were able to derive specific leadership styles from the behaviors included in the RBQ, making it a suitable method of measurement for assessing leadership behavior.

Procedure

Prior to the laboratory visits, participants gave informed consent and provided demographic information. Subsequently, participants engaged in three laboratory visits that took place about 1 week apart. Participants interacted in previously unacquainted groups of three; we ensured there were unique triads during each visit. It was necessary to assess leadership at three time points to determine if the emergence of leadership behavior changed or remained consistent depending on the situation and people present. Assessing behavior at multiple time points also increases the validity of behavioral observations (Kenrick & Funder, 1988).

Visit 1 was an unstructured interaction in which participants were instructed to speak freely for 5 minutes. Visit 2 was a cooperative task in which participants were asked to work together to build a pre-specified model out of tinker-toys. If they succeeded in building the tinker-toy model within 5 minutes, a $5.00 bonus was awarded. Visit 3 was a competitive task wherein participants played a sound repetition game, Simon. After several games, the participant who won the most rounds was awarded a $5.00 bonus.

Each visit was video recorded, and research assistants rated participant behavior using the RBQ after watching the full 5-minute visit. Research assistants were arranged such that they did not rate the same participant's behavior more than once, nor did they rate the behavior of a participant with whom they were acquainted outside of the lab. A different group of four raters was assigned to assess participant behavior in each visit.

RESULTS

The first step in the analyses was to operationalize the three leadership styles by forming three behavioral composites. Research assistants demonstrated good interrater reliability in their judgements of participant behavior (mean α = .80). If the reliability of the four raters assigned to a certain video was below α = .70, the coder whose ratings matched others' the least was asked to re-watch the video and recode for the participant's behavior.

Factor 1: Social Emotional	Factor 2: Domineering	Factor 3: Task-Oriented
Tries to control the situation	Tries to control the situation	Expresses hostility (R)
Seems interested in what someone had to say	Seems likable (R)	Others seek advice from P
Seems to like other(s) present	Behaves in a competitive manner	Concentrates on or works
Exhibits social skills	Exhibits condescending behavior	hard at a task
Is expressive in face, voice, or gestures	Speaks in a loud voice	
Keeps others at a distance; avoids development of any sort of interpersonal relationship (R)		
Is reserved and unexpressive (R)		
Talks at rather than with others (R)		

Table 1: *Final List of RBQ Items consistent in the Three Leadership Styles*

Note: Table displays the final list of RBQ items that make up each factor developed from the communalities present in the exploratory factor analyses.

Forming Behavioral Composites

Initially, we selected behaviors we regarded as prototypical of leadership from the RBQ. RBQ items were considered characteristic of leadership based on the face validity of each item. With these RBQ items, we conducted a series of exploratory factor analyses on behaviors at each of the three visits to see whether factors that emerged conveyed a meaningful leadership style. We then examined the resultant factors to determine if a consistent pattern was emerging across the three visits.

Three factors emerged consistently across the three visits. We named these factors: social emotional leadership, domineering leadership, and task-oriented leadership. Three coherent factors of leadership emerged from our statistical analysis, thus only three leadership styles were assessed in the present study. After identifying these three distinct leadership styles, we constructed a final list of RBQ items for each leadership style from the commonalities present in the previous factor analyses *(Table 1)*. The three leadership behavior factors are composed of RBQ items that represent the core features of each leadership style as assessed via reliability analyses. For example, social emotional leadership was best represented by items such as "exhibits social skills" and "seems interested in what someone had to say" (mean $\alpha = .89$) *(see Table 1)*.

Research Question 1 (RQ1): Which leadership style is most common within each visit?

To address Research Question 1, we examined the presence of the three leadership styles in each visit respectively. Three repeated measures ANOVAs were conducted to determine if there was an overall difference in how often each leadership style was expressed in each situation *(Table 2)*.

Visit	F	Social Emotional	Domineering	Task-Oriented
Unstructured	707.35**	6.58_1	4.46_1	6.44_1
Cooperative	611.74**	6.00_1	4.71_1	7.23_1
Competitive	518.69**	5.99_1	4.50_1	6.90_1

Table 2: *Research Question 1: Mean expression of each leadership style within each visit*

Note: Unstructured $N = 194$, Cooperative $N = 209$, Competitive $N = 216$. Leadership means that share a subscript are significantly different from each other at $p < 0.05$. **$p < 0.01$.

Unstructured Visit (RQ1). A repeated measures ANOVA indicated that the three leadership styles were expressed to a varying degree within the unstructured interaction $F(2, 386) = 707.35$, $p < .01$. We then conducted three paired sample t-tests to determine which leadership style was expressed most commonly in Visit 1. The first paired samples t-test indicated that social emotional leadership ($M = 6.58$) was expressed more than domineering ($M = 4.46$), $t(193) = 33.33$, $p < .01$. The second paired samples t-test showed that social emotional leadership was also expressed more than task-oriented ($M = 6.44$), $t(193) = 2.12$, $p = .036$. The third paired samples t-test indicated that domineering leadership was expressed less than task-oriented, $t(193) = -31.43$, $p < .01$ *(Table 2)*. These findings indicate that social emotional leadership was most commonly expressed in Visit 1, followed by task-oriented and domineering.

Cooperative Visit (RQ1). The second repeated measures ANOVA conducted for Visit 2 indicated that the three leadership styles varied in their expression within the cooperative situation $F(2, 416) = 611.74$, $p < .01$ (see Table 2). Three paired samples t-tests were again conducted and showed that task-oriented leadership ($M = 7.23$) was expressed significantly more than both social emotional ($M = 6.00$), $t(208) = -18.33$, $p < .01$ and domineering ($M = 4.71$), $t(208) = 15.40$, $p < .01$ *(Table 2)*. Task-oriented leadership was expressed most commonly in Visit 2, followed by social emotional and domineering.

Competitive Visit (RQ1). The third repeated measures ANOVA conducted for Visit 3 demonstrated that the three leadership styles also varied in their expression within the competitive situation $F(2, 430) = 518.69$, $p < .01$ *(Table 2)*. Three paired samples t-tests were conducted to determine which leadership style was most commonly expressed. As with Visit 2, results show that task-oriented leadership

($M = 6.90$) was expressed significantly more than social emotional ($M = 5.99$), $t(215) = -12.21$, $p < .01$ and domineering ($M = 4.50$), $t(215) = -37.84$, $p < .01$ in Visit 3. These findings demonstrate that task-oriented leadership was expressed most commonly in Visit 3, followed once again by social emotional and domineering.

Research Question 2 (RQ2): In which visit is each leadership style most prevalent?

The next set of three repeated measures ANOVAs were conducted to address how commonly each leadership style was expressed in each visit. To do this, we looked at each leadership style across all three visits for a total of three repeated measures ANOVAs.

Social Emotional Leadership (RQ2). The first repeated measures ANOVA showed that social emotional was indeed expressed differently across the three visits $F(2, 310) = 37.05$, $p < .01$ *(Table 3)*. Three paired samples t-tests were then used to determine in which visit social emotional leadership was most commonly expressed. Results of the first paired samples t-test indicated that social emotional leadership was expressed more in Visit 1 ($M = 6.58$) than in Visit 2 ($M = 5.96$), $t(167) = 9.14$, $p < .01$. The second paired samples t-test demonstrated that social emotional leadership was displayed significantly more in Visit 1 than in Visit 3 ($M = 5.99$), $t(174) = 6.65$, $p < .01$. The third paired sample t-test did not provide significant findings, such that the expression of social emotional leadership was not significantly different in Visit 2 and Visit 3, $t(192) = 0.12$, $p = .91$ *(Table 3)*.

Domineering Leadership (RQ2). The second repeated measures ANOVA showed that domineering leadership emerged differently across the three visits $F(2, 310) = 3.63$,

Leadership Style	F	Unstructured	Cooperative	Competitive
Social Emotional	37.05**	$6.58_{1,2}$	5.96_1	5.99_2
Domineering	3.63*	4.49_1	4.69_1	4.53
Task-Oriented	105.05**	6.46_1	7.21_1	6.93_1

Table 3: Research Question 2: Overall mean level change for each leadership style across each visit

Note: $N = 156$. N represents participants that took part in all three visits. Visit means that share a subscript are significantly different from each other at $p < 0.05$. *$p < 0.05$, **$p < 0.01$.

p = .028 *(see Table 3)*. A paired samples t-test showed that domineering behaviors were observed less in Visit 1 (M = 4.49) than in Visit 2 (M = 4.69), $t(167)$ = -2.72, $p < .01$. A second paired samples t-test indicated that there was no significant difference in the expression of domineering leadership between Visit 1 and Visit 3 (M = 4.53), $t(174)$ = -1.11, p = .27. A third paired sample t-test showed that domineering leadership was expressed more in Visit 2 than in Visit 3, $t(192)$ = 2.98, $p < .01$.

Task-Oriented Leadership (RQ2). The third and final repeated measures ANOVA demonstrated that task-oriented leadership differed in its expression across the three situations $F(2, 310)$ = 105.05, $p < .01$ (Table 3). A series of paired samples t-tests indicated that task-oriented leadership was less prevalent in Visit 1 (M = 6.46) than in Visit 2 (M = 7.21), $t(167)$ = -17.37, $p < .01$. Task-oriented leadership was also expressed less in Visit 1 than in Visit 3 (M = 6.93), $t(174)$ = -9.33, $p < .01$. The third paired samples t-test showed that task-oriented leadership was expressed more in Visit 2 than in Visit 3, $t(192)$ = 6.32, $p < .01$.

DISCUSSION

The present study evaluated the emergence of leadership behaviors across three visits with differing situational demands. A cross-situational examination of behavior is necessary to comprehend the natural expression of leadership and determine how leaders ought to behave (Vroom & Jago, 2007). Prior studies focused on elucidating the qualities of mainly social emotional and task-oriented leaders (Burke, 1971; Tabernero et al., 2009). However, the present study sought to understand how behaviors that constitute social emotional, domineering, and task-oriented leadership emerge naturally across situations. We formulated two research questions to address the consistency of leader behavior.

In regards to Research Question 1, the three leadership styles were found to be displayed to a different degree within the three situations. Task-oriented leadership was displayed to a higher degree in Visits 2 and 3, whereas social emotional was displayed most in Visit 1. One possible explanation for the difference between the assessed leadership styles is that Visits 2 and 3 are task-oriented in nature, requiring that participants perform specific actions to win additional compensation. By contrast, in the unstructured visit, participants acted freely, which prompted them to foster social bonds via social emotional behaviors. Thus, it may have been the lack of demands present in the unstructured situation that engendered the use of social emotional behaviors (Funder & Colvin, 1991; Sauerberger & Funder, 2016).

Another explanation is that the expression of social emotional leadership is, to some extent, incompatible with that of task-oriented leadership (Burke, 1971). As participants become more preoccupied with task-performance, social emotional behaviors may be viewed as less important. For this reason, task-oriented leadership emerged more often in Visits 2 and 3 and social emotional in Visit 1. Lastly, while domineering leadership was displayed differently within each visit, domineering behaviors were not as commonly displayed as were social emotional and task-oriented behaviors. This may be indicative of a decline in the popularity, and perhaps efficacy, of domineering tactics. Further research is necessary to reveal whether domineering leadership is truly as common or effective as is commonly believed (Maner & Case, 2016).

In assessing Research Question 2, each leadership style was found to be displayed to a different degree across each visit. Social emotional leadership was expressed most commonly in Visit 1, domineering in Visit 2, and task-oriented in Visit 3. Specifically, participants talked and shared more about themselves in Visit 1, presumably in order to form social relations. For this reason, social emotional was most commonly used to preserve this semblance of group cohesion. Though Visit 2 was a cooperative task, domineering was expressed most commonly. We suspect that participants may have become frustrated with task progress and attempted to take charge, leading to the expression of domineering leadership. Lastly, task-oriented emerged most within the competitive task. Since the competitive task yielded additional cash bonuses, participants may have been focused on the task at hand (i.e., performing well at the sound repetition game) rather than on cooperating with or dominating others.

Conclusion & Future Directions. The present study confirmed patterns of findings from the behavioral consistency literature. For instance, previous research

demonstrated that people alter their behavior in important ways as situations change (Funder & Colvin, 1991; Sauerberger & Funder, 2016). Our findings confirm that these changes in behavior occur specifically in the context of leadership. Although this study did not assess which leadership strategies people prefer, it does contribute to existing research regarding how leaders typically behave in different situations and the consistency of that behavior.

Overall, findings from the current study could have implications in the organizational realm and aid researchers in understanding the core features of leadership. By identifying some of the behavioral and contextual factors that distinguish leaders, this study may help bring about a more appropriate measure of leadership behavior. Additionally, this study specifies leadership techniques that are employed in certain situations, potentially enabling leadership positions to be filled with increased proficiency and designate how leaders should behave. Future research should focus on obtaining more detailed accounts of leadership from direct leadership measures in the form of self- and peer-report. Along with a more accurate measure of leadership, future studies could examine which leadership styles participants prefer depending on their situation.

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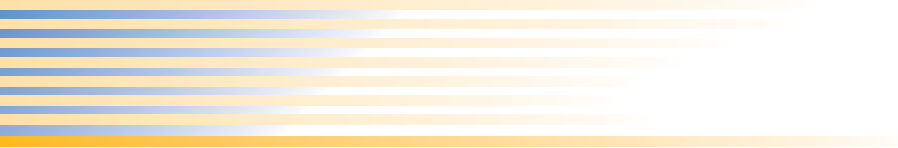
The International Happiness Project: National Averages of Happiness Are Related to Aspects of the World Development Index

Zizhong Xiao

Department of Psychology

Zizhong Xiao

Department of Psychology

Zizhong (David) Xiao is a fourth-year Psychology major. His research emphasizes on social, personality, and positive psychology. His projects have received funding from the UC President and the UCR Chancellor. Additionally, he has won travel sponsorships from the Society of Personality and Social Psychologists as well as the Association of Psychological Sciences to present his research at conventions in Chicago, San Antonio, and Boston. Concurrently, David is currently completing a research project at UC Irvine.

ABSTRACT

Behavior consists of two factors: the person and the situation (Funder, 2016). Recent well-being research has focused much more on the former rather than the latter, with numerous studies showing that certain personality traits (i.e., extraversion) are associated with individual levels of happiness (Fernham & Cheng, 1997). However, these studies are typically limited to the personality domain and within a single culture. Thus, fewer studies have examined the relationship between the situational domain (e.g., Gross Domestic Product (GDP)) and national averages of happiness cross-culturally (Hagerty & Veehoven, 2003). To further investigate the associations between countries' relevant situational factors and their national averages of happiness, this study expands upon previous studies by examining the possible relationships between the world development indicators and national averages of happiness across 158 countries. By using the Pearson Bivariate Correlation (r), a quantitative measurement of linear relationships between two variables1, this study linked the national averages of happiness, derived from the Gallup's 2016 World Happiness Report, and other aspects of the World Development Indicators (e.g., Gross National Income, Adult Literacy rate, etc.), derived from the 2016 World Data Bank. Results show that happier countries, on average, tend to have positive linear relationships with factors such as Gross Domestic Product, Internet Access Rate, higher Adult Literacy Rate, and higher Gross National Income rate. However, no significant relationship was detected between National Averages of happiness and the GDP growth rate. These results, in turn, stress the complexity of both situational attributes and happiness when examined cross-culturally.

Keywords: Happiness, International, World Development, Cross-Culture, Development

FACULTY MENTOR

Rebekah Richert

Associate Professor of Psychology

Dr. Rebekah Richert is an Associate Professor of Psychology. She received her Ph.D. from the University of Virginia and completed her Post-Doctoral research at Harvard University. She currently runs the Childhood Cognition Lab, which focuses on examining how cultural factors and children's developing social cognition influence their understanding of religion, fantasy, and media. Under a NSF Grant, her research team is examining the role of parasocial relationships with screen characters (televised, avatars) for young children's learning of STEM concepts.

INTRODUCTION
The Science of Well-Being

At the turn of the 21st century, there were significant breakthroughs within the science of well-being: the study of happiness and optimal human functioning (Compton & Hoffman, 2012). Researchers have shown through empirical evidence that the engagement in simple positive activities such as expressing gratitude, performing acts of kindness, and counting blessings can increase people's psychological well-being (Lopez, 2015). Results have also shown that psychological well-being is the source of many benefits. For example, Fredrickson (2004) has developed the broaden and build theory of positivity, which indicates that having high levels of positive emotions (e.g., happiness, fulfillment, serenity. etc.) is related to an increase in people's mental strength and resources (i.e., knowledge, creativity, and resilience). Other correlational studies support that on average, happier people are more likely to be physically healthier, more likely to live longer, and are more successful in terms of career development and relationship satisfaction (Seligman, 2013). Clearly, the results of this line of research can have positive effects on people's lives.

Human behavior, which includes happiness, is generally characterized by two domains: the person (personality identifications such as extraversion, openness to experience, neuroticism, etc.) and the situation (contextual factors such as the environment, setting, and location) (Funder, 2016). Previous research has demonstrated a significant relationship between the personality domain and happiness. For example, Diener, Sandvk, Pavot, and Fujita (1992) documented a positive correlation between extraversion and happiness. Nonetheless, there is minimal research on the relationship between the situational domain and happiness. As previously stated, happiness is an important psychological variable to examine because of its potential benefits to human lives. Therefore, to gain a more in-depth understanding of happiness, it is vital to research happiness not only from the personality domain, but also from the situational domain because early research demonstrates that situational contexts (i.e., economic indicators and political freedom) serve as a predictor for a country's happiness and well-being (Veehoven, 1999). This study addresses this gap by examining the possible relationship between the situational domain and happiness because the results can offer noteworthy insights on the factors that might be related to happiness.

Assessing the Situational Domain and Happiness

Previous research has indicated that there is indeed, a significant relationship between the situational domain and happiness. For example, Diener et al. (1992) observed a positive relationship between one's income (money) and the individual level of happiness. However, Diener et al.'s (1992) study utilized participants from only one country and therefore lacks application to other countries and their cultures. To address these limitations, other researchers attempted to establish relationships between national averages of happiness and economic indicators cross-culturally. For example, Hagerty and Veehoven (2003) studied approximately $N = 24$ and found a positive linear relationship between countries' overall GDP and their national average of happiness. Other research supports this finding by showing that on an individual level, someone who earns approximately $50,000 per year is significantly happier than someone who only earns approximately $10,000 per year (Lopez, Teramoto, & Snyder, 2015). Also, on a national level, people who live in developing countries are unhappier than people who live in relatively developed countries (Compton & Hoffman, 2012). Despite the robust relationship between happiness and the GDP, there are many other relevant economic indicators other than the GDP (e.g., Gross National Income, GDP Growth Rate, and Literacy Rate). Thus, future studies need to locate possible relationships between happiness and other economic indicators. Once relationships between a particular set of economic indicators and happiness are established, economists and psychologists can aim to increase the specific economic indicators that have a strong relationship with happiness. As a result, the potential of this research can increase the happiness level globally.

Gaps in Previous Research

Although previous research efforts indicated that situational attributes such as economic status (GDP) play a significant role in happiness, there are several apparent limitations. For example, previous studies only calculated the relationship between countries' overall GDP and the national averages of happiness but not with other relevant

World Development indicators such as Gross National Income or Literacy rate that may have a relationship with global happiness. Thus, this study attempts to address this limitation by testing the relationship between happiness and other World Development Indicators. Furthermore, studies are typically done with limited participating countries. For example, Hagerty and Veehoven (2003) only utilized a small sample of countries (N = 24), which is not an adequate representation of the 150+ countries in the world, thus the previous studies lack applicability. To solve this issue, we utilized two credible data-oriented organizations for this study, the Gallup and the World Data Bank, that have collected a broad amount of open and downloadable data from 180+ countries recognized by the United Nations.

Purpose of the Study

We hope to accomplish two main goals for this study: 1) to replicate the findings of whether the overall GDP is positively related to national averages of happiness by utilizing more data-available participating countries; and 2) to identify new relationships between national averages of happiness with other economic indicators. Based on previous research, we hypothesize the following:

- The study may not be able to replicate the robust relationship between a country's overall GDP and national averages of happiness since this research utilizes different data sources and more participating countries than many of previous findings such as Hagerty & Veehoven (2003).
- National averages of happiness will also have significant relationships with the overall GDP growth

rate because previous findings show that higher levels of national income predict higher levels of happiness (Diener et al, 1997).

- National averages of happiness will have significant relationships with the Gross National Income (GNI) since GNI is simply the overall GDP plus the values generated by residents abroad.
- Since the level of adult education and the access to the World Wide Web is strongly correlated with GDP and GNI, we also hypothesize that national averages of happiness are also significantly related to the adult education and web access.

Following the completion of this study, if those factors are related to national averages of happiness, researchers can aim to increase the level of those economic indicators in all countries to promote happiness internationally, thus further promote world peace.

METHOD
Participants

There are a total of (N = 158) participating countries within this study. We obtained this study's data through two open-source data sets on the World Wide Web, the Gallup and the World Data Bank. *Table 1* provides the details of a sample of the countries studied with their continent affiliation (not all 158 countries were included due to space limitation).

Assessment of the National Averages of Happiness

The national average of happiness for the 158 countries was obtained from the 2016 World Happiness Report. The Gallup Organization surveyed randomly selected participants from 150+ countries by either telephone or

Continent	(Sample) Participating Countries
Africa	Algeria, Nigeria, Namibia, Ethiopia, South Africa, Egypt, Kenya
Asia & Eurasia	Mongolia, Laos, Pakistan, United Arab Emirates, Morocco, China, Nepal
Europe	Belgium Spain, Slovakia, Belarus, Luxembourg, United Kingdom, Denmark
North America	Canada, United Sates, Mexico
South America	Chile, Panama, Argentina, Uruguay, Trinidad and Tobago, Belize, Peru
Oceania	Indonesia, Australia, New Zealand, Malaysia

Table 1: Sample of Participating Countries

face interviews regarding their subjective well-being (e.g., self-reported happiness and self-reported life satisfaction (The World Happiness Report, 2016). Samples of the questions within the survey are:

- Did you experience (anger, depression, enjoyment, happiness, sadness, stress, and worry) during a lot of the day yesterday?
- All things considered, how satisfied are you with your life as a whole these days? Use a 0 to 10 scale, where 0 is dissatisfied and 10 is satisfied.

Following the data-collection, the Gallup scientists analyzed and combined all the responses into a single number (ranges from 1, the least happy – 10, the happiest) that indicates the national averages of happiness for each respective country. Their purpose is to identify which countries are happier on a ranked system. For example, Denmark scored 7.526, which is happier than Thailand, which scored a 6.747. Thailand, in turn, is happier than Zimbabwe which scored 3.193 (The World Happiness Report, 2016).

Identifications of the World Development Indicators

The World Data Bank communicated with approximately 160+ countries recognized by their supervisory organization, the United Nations. The comprehensive data publications contain figures and information that drew from each country's official data reporting resources. For the purpose of this study, we utilized five measures of the World Development Index. They are: 1) Overall Gross Domestic Product, 2) Growth Domestic Product Growth, 3) Gross National Income, 4) Adult Literacy Rate, and 5) Internet Access Rate. The definition of those five variables are (Stock, 2013):

- Gross Domestic Product (GDP): the monetary value of all produced services and goods within a governed state's national border in a specific time frame.
- Gross Domestic Product Growth Rate (GDP-G): the percentages of increased monetary value of all produced services and goods of a nation from the previous year.
- Growth National Income (GNI): the total domestic plus foreign output claimed by residents of a certain country. It consists of the GDP and incomes earned by foreign residents, but without the income earned by nonresidents.

- Adult Literacy Rate: the percentage of people ages 15 and above who can read, understand, and write simple statements.
- Internet Access Rate: the percentage of people (within a 100 random sample size) who have readily World Wide Web access.

Since most of the countries have different currency scales than others, all measures related to money (GDP, GDP-G, and GNI) have been converted to the International Dollar. The International Dollar is a hypothetical unit that contains the same purchasing power as the U.S dollar (World Data Bank, 2015). Since the Gallup's World Happiness Report only contained 158 countries (less than the countries reported by the World Data Bank), we were only able to conduct correlational analysis for linear relationships on the 158 countries that were included in both open-data sources.

Data-Analysis Procedure & Reasoning for Chosen Methodology

All data sets were entered into a statistical programming software, SPSS. The national averages of happiness served as the first variable. The world development indicators (GDP, GDP-G, GNI, Gross National Income, Adult Literacy, and Internet Access) tested in this study were a part of a set of the second variable. As per industry standard, we utilized Pearson Bivariate Correlations that ran a linear relationship analysis between two variables were computed between the first variable, along with each of the second variables. The degree of the linear relationship between the variables were calculated as the Pearson r. In addition, the probability value, p, was determined – the likelihood that the obtained Pearson r is due to mere chance. Since the data were drawn from pre-existing sources, the principal investigator did not have to collect participants nor undergo the Institutional Review Process for human participants.[1] For the purpose of this question, it is impractical and expensive for the principal investigator to travel to 150+ country to collect data. Therefore, drawing from pre-existing data is the ideal method to answer this research question.

RESULTS

We used Pearson's Bivariate Correlations to examine the relationship between national averages of happiness and various factors of the World Development Index. The

r value, the Pearson's Correlation Coefficient, reports the level of linear relationship between the two measured variables.[2] The p-value, the level to which the finding could be mere chance, was also reported. Since a majority of the obtained p-values were $p<0.01$, the likelihood of all the findings being due to mere chance was less than or equal to 1%.[1] First, there is a robust positive correlation between National Averages of Happiness and GDP, $r = 0.679$, $p < 0.01$. Similar to previous findings, happier countries tend to have higher GDP. Second, there is also a significant positive correlation between National Averages of Happiness and GNI, $r = 0.680$, $p = <0.01$. Happier countries tend to have higher GNI. Third, this data shows a robust relationship between happiness and countries' access to the internet, $r = 0.792$, $p < 0.01$. In addition, happier countries tend to have a higher adult literacy rate, $r = 0.650$, $p < 0.05$. Lastly, the data did not show any significant relationship between National Averages of Happiness and increase in GDP. For a graphical presentation of the obtained results, please refer to *Table 2.*

DISCUSSION

Our data supports the majority of our original hypotheses. First, our results replicated the initial finding that happier countries on average have a higher overall GDP. Second, we located new relationships between happiness and other World Development Indicators – happier countries tend to have 1) higher GNA, 2) higher Internet access rate, and 3) higher adult literacy rate than less happy countries. However, our hypothesis that the national averages of happiness is associated with economic growth (tested with the variable GDP increase rate) was not supported.

There are several probable explanations as to why a majority of the hypotheses was well-supported. Since GDP measures a nation's overall level of economic growth,
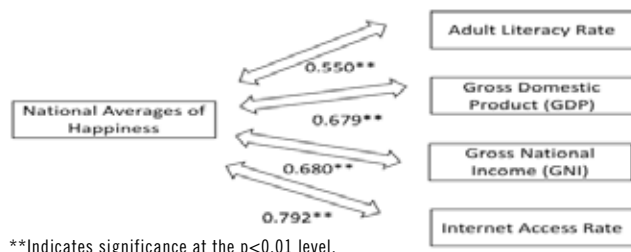
**Indicates significance at the p<0.01 level.

Table 2: Cross-Over Pearson's Correlations Among the Significantly Related Variables

citizens of countries with higher economic status are more likely to be happier because the government is able to provide its citizens more basic needs. This aligns with previous well-being science research results that indicate people who have their basic needs met are happier than people who do not (Compton & Hoffman, 2012). Other variables tested, (i.e., GNI, adult literacy rate, and internet access rate), are all significantly related to the overall GDP rate *(see Table B).* Thus, it is empirically probable that they are also related to the national average of happiness, which is closely related to the overall GDP rate. This is especially the case with GNI since GNI is simply GDP plus the revenues earned by domestic residents who work in a foreign country. Another explanation is that previous research has shown that people with higher levels of education tend to be happier than those with lower levels of education, thus explains the relationship between National Averages of Happiness and Adult Literacy Rate. Finally, the Internet provides the opportunity for intellectual growth. Thus, citizens of countries with a higher level of Internet access are more easily able to learn about current events, research historical records, and absorb other information valuable for learning. This aligns with previous research that has found people with opportunities to seek knowledge are relatively happier than those who lack the opportunity (Fredrickson, 2003).

Our hypothesis that national averages of happiness would be associated with GDP growth was not supported. We find this result contrary to previous findings that GDP growth would promote happiness, especially in developing countries (Hagerty & Veehoven, 2003). Some well-being studies have found that happier people are more successful in terms of employment stability and moving up the career ladder (Fredrickson, 2003). Perhaps, the presence of happier people within a country (e.g., Denmark and Sweden) are contributing to the success factors measured by the World Development Index. Conversely, there are also studies that indicate countries with higher levels of World Development Index measurement (e.g., GDP and GNI) are more likely to be happier. It is important to note is that people's happiness level decreases dramatically if their basic level of needs are not met. For example, in the United States, the lowest income bracket is around $32,500 to $50,000 – not having all basic needs met per

household (i.e., shelter, clothing, and food). Studies have shown that an increase in income brought people out of a lower income class into the middle class ($60,000 - $80,000), their long-term happiness increased due to no longer having to worry about basic needs (Seligman, 2013). However, previous research also shows that as people move out of the poverty line and have their basic needs met, more money will not necessarily increase their subjective happiness – the positive correlation between money and happiness nearly plateaus following a certain amount of income. Furthermore, empirical data has shown that a person making half a million dollars a year is not significantly happier than someone making $100,000 a year (Seligman, 2013). Thus, GDP growth may contribute to national averages of happiness as more money comes into the economy; however, we were not able to detect this phenomenon through this data set.

Additionally, for this study we only evaluated the relationship between GDP growth and national averages of happiness with a mixture of developed and developing countries. Therefore, the relationship may have disappeared since GDP growth may not increase happiness within developed countries as much as within developing countries (Diener et al. 1992). A possible future direction for research is to clearly distinguish between developed and developing countries to detect whether there is a relationship between GDP growth and national averages of happiness.

Limitations

This study has several limitations. First, all the analysis conducted within this study consists of Pearson Correlation r, which means that we cannot indicate which variable (e.g., national averages of happiness or the world development index) caused another. Therefore, we cannot infer the directionality of the variables: whether it is happiness that caused the increased in the higher GDP, GNI and other relevant World Development Index or is the World Development Index variables caused the higher levels of happiness. The only firm conclusion this study can make is that the two variables are interrelated. Additionally, a majority of the data-sources came from participants' self-reported measures, which could run into limitations such as data falsification (Sanford, Theommes, & Rosenthal, 2014).

Furthermore, since the data for happiness and the World Development Index come from two different data collecting organizations (the Gallup Organization and the World Data bank), inconsistencies will exist in terms of how the two sources obtained the data. Thus, the internal reliability may suffer due to inconsistency in data collection methods between the two sources. Second, not all countries indicated on the World Development Index are available on the World Happiness Report, causing the analysis to leave out some of the countries. We predict that the Pearson Correlation r could have been different if the two sources had contained the same number of countries. Lastly, correlation does not imply causation. As aforementioned, we cannot infer whether happiness is the mechanism that caused the developed countries to be happy, or if it is happiness that provided the high levels of economic growth. Lastly, we failed to locate any significant relationships between national averages of happiness and GDP growth. Although previous research has stated that increasing developing countries' GDP will simultaneously positively affect their happiness levels, this study's data cannot confirm that those two variables have causal relationships.

Future Implications & Significance

Clearly, more research is needed to locate the relationship between happiness and various development indicators. This data suggest that happiness plays an integral role in the development of all countries, not just the Western hemisphere where most of the well-being science research takes place. Therefore, it is essential that happiness research be conducted in a cross-cultural context. Furthermore, the variables tested in the World Development Index can expand further. For example, we can test the relationship between national averages of happiness and percent of agricultural production or amount of electricity used in future studies. This research serves as one of the initial findings for the International Happiness Project – in which the first author plans to conduct a longitudinal study of cross-cultural happiness research for the next thirty years. Similar studies can indicate other economic indicators that are highly related to national averages of happiness. Behavioral scientists, global economists, and non-governmental organization activists can then use the collected results to

design programs or initiatives to increase the economic indicators that are related to happiness, especially within developing countries. This line of research has the potential to increase global happiness.

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ENDNOTES

1. The principal investigators of this project did not collect any participants, as all the data were drawn from open data sources. The sources of the data (e.g., the World Happiness Report and the World Data Bank) has already underwent through the human participant safety measures before collecting and publishing their data.

2. As per industry standards, describing the Pearson Correlation method are usually not included in standard psychology papers. However, it is included here for the non-industry experts.