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The Interplay Between Oxidation, Phosphorylation, and Regulation of RitR in *Streptococcus pneumoniae*

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ABSTRACT

Streptococcus pneumoniae functions as a two-component system (TCS), one of the most widespread regulatory systems identified in bacteria. TCS are recognized by a kinase and a response regulator (RR); these two components rely on specific domains that signal inputs and outputs. Kinase are proteins capable of sensing signals/stimuli and autophosphorylating themselves as a response. The RR on the other hand undergoes phosphorylation and then a regulation process for DNA, RNA, or other proteins. When *Streptococcus pneumonia* senses extracellular iron by its kinase/enzyme (Stkp), the intracellular domain is activated. The kinase then catalyzes the transfer of a phosphate from ATP (Adenosine triphosphate) on to the cell's important regulatory protein (RitR) involved in iron homeostasis and when bound to DNA prevents iron uptake proteins from being expressed. The phosphorylation by the kinase causes RitR to dissociate from the DNA, allowing for the production of iron uptake machinery and an excess amount of iron to enter the cell at dangerous amounts. These amounts can lead to oxidative stress through the production of reactive oxygen species (ROS) and the production of hydroxyl radicals that attack cellular macromolecules and promote cell death and tissue injury. Along with RitR's phosphorylation mechanism, RitR has also been shown to respond to oxidative stress through a monomer to dimer transition facilitated by oxidants that cause the formation of a disulfide bond. This project aims to further characterize the interplay between oxidation, phosphorylation, and the DNA binding properties of RitR.

LITERATURE REVIEW

Bourret, R. B. *Current Opinion in Microbiology* **2010**, *13* (2), 142-149. Response regulators consist of receiver domains and output domains that play key roles in its function. Most receiver domains act as phosphorylation switches, but others are responsible for transferring phosphate groups. This article specifically focused on the characterization of receiver domains and their functions. The functions that were studied include catalyzed phosphorylation and dephosphorylation, and phosphorylation -mediated conformational change. This article also researched atypical receiver domains and pseudo-receiver domains that do not use phosphorylation. Overall, the researchers concluded that while there are many known aspects of receiver domains, there are still many things to be studied like the functioning of the pseudo-receiver domains and determination of the specificity of metal ions and their affinity for receiver domains.

Galperin, M. Y. *Current Opinion in Microbiology* **2010**, 13, 150-159. Many response regulators have output domains that control different processes within the cell. The article wanted to get an understanding of the different known output domains as well as the unknown ones. They did a classification of the known response regulator output domains including DNA-binding, enzymatic, ligand-binding, and protein-binding. They were also able to find an unknown that appeared to be used for membrane transport for nitrate, sulfate, and dicarboxylates. With this analysis of

the different output domains, they were able to find that there are no restrictions as to what these domains are capable of doing within the cell. They also found that response regulators with very specific roles have the ability to control things at the post-transcriptional level which allow two component systems to interfere with others.

Glanville D. G., Han L, Maule A. F., Woodacre A, Thanki D, Abdullah I. T., et al. *PLoS Pathog* **2018**, 14 (5). While RitR was formerly known to function primarily within the *Streptococcus pneumoniae* system as an atypical two-component response regulator, this study has exploited the idea that it instead dimerizes and is able to bind to DNA only when Cys128 has been oxidized. The article describes different experimental procedures done to confirm this idea. These include β-galactosidase assays, Western blot analyses, nonreducing SDS-PAGE, and mass spectrometry; in detail, the processes by which red cabbage samples were used with three different additives to understand the effects of leaching in the body. The results were analyzed and were able to show that RitR regulates iron homeostasis in the bacteria in response to different intracellular hydrogen peroxide concentrations. They also demonstrated that Cys128 is capable of controlling pneumococcal nasopharyngeal colonization.

Gómez-Mejia A., Gámez G., Hammerschmidt S. *International Journal of Medical Microbiology* **2018**, 722-737. The article discusses two-component systems within pneumococcus bacteria. They vividly explain that two-component systems are known to play primary roles in *S. pneumoniae* with the use of their response regulators and histidine kinases. RitR, an orphan response regulator, doesn't have the typical aspartic acid residue found in the N-terminal; instead, it has an asparagine residue that is unable to transfer the phosphate from ATP. This system gives a newfound understanding of the bacteria as a whole. This article was also able to map the 8 TCS in pneumococci that have been associated with pneumococcal virulence. TCS05 and TCS12 have been studied and characterized the most in the bacteria, and within this article they were shown to be linked to competence, antibiotic resistance, and the regulation of multiple pneumococcal virulence factors. TCS have also been identified as key components in pneumococcal natural competence (the ability of a cell to naturally alter its genetics).

Ulijasz A.T., Andes D.R., Glasner J.D., Weisblum B., *Journal of Bacteriology*. **2004**, 186(23), 8123. The article assesses the idea of RitR, a response regulator, playing the key role of maintaining iron homeostasis in *Streptococcus pneumoniae*. Using a varied study of experimentation, researchers were able to test their hypothesis by growing, harvesting and purifying the protein to eventually conduct mouse infection studies, microarray analyses, and Northern blot analyses. This study concluded that RitR does repress the *piu* operon and is linked to the expression of genes correlated to the response of oxidative stress in the cell. In the future they would like to learn what specific factors go into regulating RitR in the bacteria.

Ulijasz A.T., Falk S.P., Weisblum B., *Molecular Microbiology*. **2009**, 71(2), 382. An in-depth analysis was completed to answer three questions pertaining to the protein RitR. Researchers wanted to know whether the protein actually got phosphorylated at all, which amino acid was potentially phosphorylated, and where is the amino acid specifically located. The researchers proved that RitR is phosphorylated by StkP and that

the mechanism used to do this is very different from typical response regulators. Various experiments were used including mass spectrometry analysis, in vitro phosphorylation and dephosphorylation, and Northern blot analyses in an effort to better understand the protein and its role in *Streptococcus pneumoniae* bacteria. The article concluded that there are many studies to be done in the future to further study the phosphorylation sites, as well as the interaction of RitR with PhpP and StkP.

INTRODUCTION

Metals are a necessary component for living systems to function properly. Some of their roles include activating proteins and enzymes involved in metabolic processes, maintaining homeostasis within the body, and keeping bacteria alive to proliferate. Therefore, all organisms require mechanisms for sensing small fluctuations in metal levels to maintain a controlled balance of uptake, efflux, and sequestration; and to ensure that metal availability is in accordance with physiological needs. This ability to sense metal ions is particularly important for bacterial pathogens to invade their hosts and cause disease. With many papers having looked into the roles of proteins and metals within the bacteria *Streptococcus pneumonia*, there is still more to be done regarding the bacteria's intracellular regulatory strategy. This bacteria is capable of causing infections like meningitis, an infection around the spinal cord; bacteremia, a bloodstream infection; and pneumonia, an infection of the lungs that causes the most deaths around the world. In order to understand and prevent these different illnesses, a clear understanding of the bacteria is required. Within the bacteria, iron has shown to be very essential in physiological processes. It keeps *Streptococcus pneumoniae* alive, activates proteins and enzymes involved in metabolic processes, and is used for expression of many important virulence determinants. While iron is necessary in the bacteria's functioning, it can also be very dangerous. It's dangerous because it cycles between two charged states, Ferrous (Fe^{+2}) and Ferric (Fe^{+3}). The cycling causes oxidative stress through reactive oxygen species (ROS) and the production of hydroxyl radicals; the radicals attack cellular macromolecules and promote cell death and tissue injury. In the actual bacteria system, there are two mechanisms that have been studied: RitR phosphorylation and RitR oxidation. In RitR phosphorylation, extracellular iron is recognized by the enzyme Stkp, which is a serine-threonine kinase, when extracellular iron is recognized, the intracellular domain is activated and will catalyze the transfer of a phosphate from ATP onto RitR. RitR is an important regulatory protein involved in iron homeostasis that when bound to DNA prevents iron uptake proteins from being expressed, but phosphorylation by the kinase causes RitR to dissociate from DNA, allowing for iron uptake. This is a very well documented linkage between sensing extracellular iron and telling the cell to bring the iron in, but there's little understanding of how the cell turns this mechanism off when there's already enough or too much iron inside the cell. In RitR oxidation, if there are oxidative conditions created within the cell, RitR can be oxidized to a disulfide that makes it a functional dimer. When RitR is in the dimer form it will bind effectively to DNA. The goal is to determine whether excess cellular iron will produce these oxidizing conditions that will drive the formation of this disulfide more effectively than in the absence of iron by using chromatography to purify the protein RitR to near homogeneity, then creating experimental conditions where the oxidation of the monomeric form of RitR into its dimeric form as a disulfide can be controlled.

MATERIALS & METHODS
Strains, Growth and Harvesting Conditions

RitR protein was grown in an overnight culture in an incubator shaker from -80℃ Rosetta strain stocks. They were grown in LB *E. coli* medium along with the antibiotic ampicillin (100mg/ml) at 30℃. The next day the culture was resuspended and grown in larger volumes with ampicillin added at 37℃. Using the UV-Vis spectrophotometer, the cell's optical density

was measured periodically at 600 nm until it reached ≅0.6. Once this OD_{600} value was reached, the cells were induced with 400 μM IPTG and incubated for 2-3 hours. Post-incubation they were centrifuged at 3,000 RPM, 4℃, for 10 minutes. The precipitate was then suspended in a 25 mM phosphate, 50 mM NaCl, and 2 mM DTT buffer along with 100 μM PMSF and lysed using a Sonicator for 10 minutes at an amplitude of 45 with 10 second pulses and 25 second rests. The temperature of the cells was maintained at or below 4℃ by suspending the centrifuge tube in an ice bath. After sonication the cells were centrifuged at 20,500 RPM, 4℃, for 20 minutes and then frozen overnight.

Purification

Ion exchange experiments were completed using a HiTrap Capto SP FPLC column equilibrated with a line A buffer of 25 mM phosphate, 50 mM NaCl, and 2 mM DTT (pH 6). The protein was eluted with a line B buffer of 25 mM phosphate, 1 M NaCl, and 2 mM DTT (pH 6). Fractions were collected at a flow rate of 2.0 mL/min with a 0-100% gradient over 50 mL for buffer B (Figure 1).

Size exclusion/gel filtration experiments were completed using a S300 FPLC column equilibrated with 25 mM phosphate, 50 mM NaCl, and 2 mM DTT (pH 6) buffer. Fractions were collected at a flow rate of 2.0 mL/min with a pressure of 0.5 atm (Figure 2).

Purified RitR was mixed with reducing loading dye and resolved using 15% SDS-PAGE gel. Proteins were stained with Coomassie for 5 minutes and then destained (Figures 3, 4).

DTNB Assay

The purified protein, RitR, was concentrated down to less than 5 mL and was reacted with 6 μM DTNB in degassed 25 mM Bis-Tris, 100 mM NaCl (pH 6) buffer. The reactions were conducted at room temperature using a UV-Vis spectrophotometer. The reaction that showed the conversion of DTNB to TNB via absorption was recorded at 412 nm. The molar absorptivity used to convert this to the concentration of reduced cysteine is 0.243.

Varied Hydrogen Peroxide Assay

A 1:100 dilution was performed by taking 9.8 mM concentration of Hydrogen Peroxide and diluting it with water to create a 98 mM solution. This stock solution was used to create 2 mM, 5 mM, 10 mM, 15 mM, 20 mM, 25 mM, 50 mM, 100 mM, and 500 mM Hydrogen Peroxide samples that incubated for 24 hours. With each sample, 50 μL of the purified protein RitR was added before the incubation period (Figure 5).

Fenton Chemistry Assay

A stock solution was created that included 20 mM RitR, 20 mM Fe(II) EDTA, and 0.6% Hydrogen Peroxide. 10 μL aliquots of this solution was taken after incubation periods between 5 minutes and 24 hours. Each of these samples was quenched with 100 mM Thiourea (Figure 6).

Fenton Chemistry Assay

A stock solution was created that included 20 mM RitR, 20 mM Fe(II) EDTA, and 0.6% Hydrogen Peroxide. 10 μL aliquots of this solution was taken after incubation periods between 1 minute and 1 hour. Each of these samples was quenched with 100 mM Thiourea (Figure 7).

Figure 1. Chromatogram showing the presence of RitR on the FPLC with an ion exchange column.

Figure 2. Chromatogram showing the presence of RitR on the FPLC with a size exclusion/gel filtration column.

Figure 3. 15% SDS-PAGE gel showing presence of RitR at 26 kDa after completion of ion exchange column.

Figure 4. 15% SDS-PAGE gel showing presence of RitR at 26 kDa after completion of size exclusion/gel filtration column.

Figure 5. 15% SDS-PAGE gel showing RitR in the presence of varied hydrogen peroxide concentrations.

Figure 6. SDS-PAGE gel of Fenton Chemistry Assay showing RitR in the presence of iron and hydrogen peroxide over an extended incubation period (5 minutes-24 hours).

Figure 7. SDS-PAGE gel of Fenton Chemistry Assay showing RitR in the presence of iron and hydrogen peroxide over an incubation period of 1 minute-1 hour.

DISCUSSION/RESULTS

Due to previous literature, the goal was to understand how phosphorylation and oxidation interplayed to make an effective iron sensory machine within *Streptococcus pneumoniae* by producing RitR and then oxidizing it to produce it in its functional dimer form.

The first experiment was conducted with outside suggestions that the reduced free thiol form of RitR could be oxidized to its disulfide form in the presence of hydrogen peroxide, a powerful oxidizer. In this experiment, the increasing concentrations of Hydrogen Peroxide displayed more intense bands growing which likely corresponded to the dimer form of RitR. After the 10 mM mark where concentrations kept increasing, the dimer's band intensity decreases though which suggests if the Hydrogen Peroxide concentration is too high, other chemical reactions will occur.

The next experiment focused on creating extremely dangerous conditions, which may be generated in the actual bacteria if there's excess iron and focused on whether the protein was being further oxidized or reduced to other states. This tested even harsher oxidizing conditions. In the test tube we created Fenton chemistry conditions which are known to generate the hydroxyl radicals. As time progressed the amount of monomer diminished, which is shown by the decrease in band intensity. This suggests that under these conditions the protein isn't just being converted from dimer to monomer, it's actually causing the degradation of the protein and this is not surprising given the really harsh conditions being produced by making these potent hydroxyl radicals.

The last experiment was conducted to further the second experiment and create RitR in its disulfide form. Based off of the SDS-PAGE gel, the time frame indicated more production of the dimer within a shorter incubation period. With this experiment, research determined that in order to show a significant increase of the dimerized protein, a shorter time frame was essential. At 30 minutes (lane 8) and 60 minutes (lane 9), the dimer is being lost again indicating that these times aren't going to be as useful if a substantial amount of the dimer form needs to be maintained. This gel also indicates that Hydrogen Peroxide alone doesn't produce oxidized protein which is what was noted in previous literature. Instead an environment where Iron is present as well as Hydrogen Peroxide is more beneficial in order to produce the dimeric form of RitR that ultimately binds to DNA well. When quantifying the band intensities associated with this experiment using densitometry, the time frame of 1-5 minutes had no significant difference in the amount of dimer relative to monomer, but there is a dramatic change in the ratio beyond the 5 minute mark.

Overall, it was noticed that with having the protein RitR sit in the test tube for longer periods of time by itself that it did become more dimerized by being gradually exposed to oxygen.

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Quantifying Engagement Levels in Interaction with a Human vs. an Avatar Interlocutor

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ABSTRACT

As computer graphics modeling, animation, and rendering techniques continue to advance, virtual avatars are increasingly becoming indistinguishable from their real-world counterparts. Previous research suggests that while virtual avatars are not yet exact replicas of people, spoken interactions with avatars vs. human interlocutors may not differ greatly. Using an augmented reality headset and a mock interview data collection scenario, we conducted a study into potential behavioral differences in spoken interactions when the human interlocutor was viewed as a human in the real world versus as a virtual avatar. In particular, this paper explores levels of engagement during verbal conversation in these spaces, comparing interaction with live humans with that of virtual avatar faces. By conducting this two-part mock interview experiment, we studied interactions when the interlocutor looks like a virtual avatar as opposed to a person. We analyzed and compared eye gaze patterns and galvanic skin response behaviors across the two interview scenarios. We also quantified and compared interaction engagement using analysis of speech prosody and rate as well as automatically transcribed verbal content.

1   INTRODUCTION

Augmented and virtual reality are useful in various means of communication. Snapchat filters are an example of augmented reality in social media [5] and virtual reality can also be used in communications via customer service [10]. Both augmented and virtual reality can be used as a means to analyze and improve these technologies for more effcient communication based on measuring engagement. Keshavarzi et al. used augmented and virtual reality applications as part of a rotation during an interview regarding the participant's dream house [1]. The 60-minute interview was conducted in four parts that each lasted 15 minutes, with the first part being a face-to-face interview. The remaining three parts were in a randomized order: 2D world via video conference, virtual reality via a headset, and augmented reality via a hologram. This experiment allowed Keshavarzi et al. to explore communication through augmented and virtual reality and conclude that numerous facial expressions play a large role in how engaged a person is during conversation [1].

The present study focuses on the perception of people interacting with computer generated avatars. The avatars were controlled using facial motion capture by tracking a researcher's facial movements [9] during the interaction with the avatar during the experiment, while the researcher spoke in real-time. These interactions with the avatars were compared to interactions with real people, also with a researcher in each interaction, to determine if there is any difference between the respective interactions. The interactions used a mock job interview format for a managerial position at an ACME retail store. The mock interview was conducted in two parts: one with the real person and the other with an avatar in a randomized order, so that we could compare the interactions between both interlocutors consistently among participants. The participants completed the entire interview using Magic Leap One augmented reality

goggles, which allowed us to collect eye-tracking data [4] throughout both interactions to compare them.

This experiment will address these research questions:

Q1: Can a person be as engaged in conversation with a computer avatar as they are with other people as measured by the following:
    A. eye gaze?
    B. galvanic skin response (GSR)?
    C. discourse, or speech?

Q2: Do people maintain the following conversational behaviors with an avatar as frequently as they would a real interlocutor as measured by:
    A. consistent eye contact?
    B. speech features such as prosody, including pitch and intensity, and speech rate, such as words and syllables per minute?

These research questions then motivated the following hypotheses:
    1. There is no significant difference in engagement when speaking with a human vs. an avatar.
    2. There is no significant difference in conversational characteristics when speaking with a human vs. an avatar.

2   RELATED WORK

2.1   Mixed Reality in Interview Settings Data Collection

Given the importance of a job interview, some are struck with uncontrollable anxiety. Kwon et al. proposed using virtual reality to help with interview anxiety [11]. Researchers constructed an interview setting and placed an individual in a mock interview setup with three virtual avatars, each with varying amounts of fidelity, and a real person. They then studied how the subject would react to the different types of interviewers. The researchers concluded that the brief fear of negative evaluation (BFNE) of all the participants did not differ substantially. They found little to no difference in anxiety levels when interacting with the virtual or real interviewers [11].

2.2   Effects of Augmented Reality

Bailenson et al. ran several experiments [2]. One focused on the psychology of subjects given their own avatar and recorded the reaction of subjects as their avatar was conducted through various tasks. The team found that the subjects were susceptible to the actions of the avatar, which is otherwise known as the *Proteus Effect*. The second experiment tested behavior towards the avatar. A subject was immersed in an augmented world which was set up in a room with an avatar sitting in a chair. The subject chose not to sit in the same chair as the avatar, even though he knew that no one was actually in it [17].

Another feeling that people often experience when interacting with avatars is known as the *uncanny valley*. This is an unsettling feeling that some people get when they see a humanoid figure that looks almost human. Geller explained that a well-known example is *The Polar Express* [7].

2.3   Measuring Engagement

Haider et al. looked at user engagement to determine which TED talks are engaging or not [8]. Results showed that the engagement level of the audience during a TED talk can be measured using speech characteristics [8]. The amount of speech we produce during a conversation can determine the level of engagement in conversation. Nakano et al. developed a machine learning system that predicted the level of engagement in an everyday conversation based on gaze behaviors and found that engaging questions that the machine provided worked well with complex conversations with the subject [15].

Naspetti et al. analyzed the eye-gaze from users for future research to be done for it to optimize the use of augmented reality [16]. They accomplished this by presenting the viewers with multiple paintings twice: once collecting eye gaze when the user was presented a painting and once when modifying

superimposed virtual squares in certain parts on the paintings. A scene influenced where the user was going to look, and this may have implications for how to immerse the user in an augmented reality [16].

3   METHODS

In order to see if engagement differed during spoken interactions between human versus avatar interlocutors, we conducted our interactions in a face-to-face format via a mock interview. The participant would wear the Magic Leap One, which is an augmented reality headset, for the duration of the entire interview. This interview was conducted in two parts: one with a human, and the other with the avatar. During the interview, we collected the following multi-modal data aligned with the start and end times of each interview part: eye gaze with the Magic Leap, galvanic skin response with a Shimmer3 GSR+ unit, and speech recorded with Audacity using a head-worn microphone (Figure 1).

Figure 1: Example of how a participant would engage in a mock interview during data collection.

3.1   Program Design

We used the Magic Leap One as our augmented reality headset as it supports collection of eye-tracking data. We built an application in Unity that presents an avatar face model that is controlled externally using facial motion capture via Faceware due to Unity's

compatibility with the headset. In Unity, we used black backgrounds with the avatars to create the augmented reality experience when the participants viewed them through the Magic Leap. Then using the Magic Leap creator terminal and specific input commands, we were able to select whether the avatar or the human went first and their gender. Similar to a Wizard of Oz methodology [10], we used the Faceware software package to perform the facial capture and transfer the captured expressions to the avatar outside of the experiment room and used speakers and BlueJeans videoconference software to communicate with the participant as the avatar interviewer. We used a male avatar constructed by Faceware, Victor, and a female avatar, Dani, created at Rochester Institute of Technology (Figure 2).

Figure 2: Virtual avatar interviewers as displayed within Unity: Victor (left) and Dani (right).

3.2   Experimental Design

We initiated a mock interview with one researcher, either male or female, conducting the interview. The researcher conducted one part of the interview and controlled the avatar during the other part. Each part lasted around the same amount of time and ranged from roughly two to five minutes. The order in which each of the participants spoke to the person face-to-face versus to the avatar was selectively randomized in such a way to ensure an approximately balanced distribution considering both the participants' and interviewers' genders. We thus varied the interactions by genders, such as male participant with female interviewer, to get as non-biased data as possible (Figure 3).
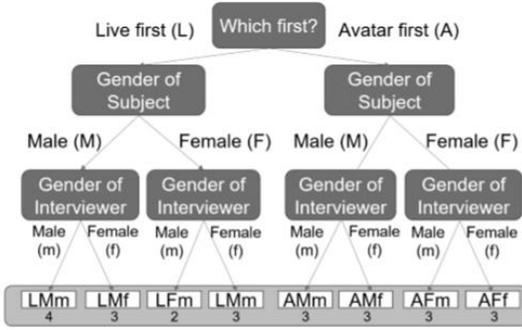
Figure 3: Distribution of participants based on interviewers' order and gender, with total number of participants per assignment.

Before the experiment, participants were screened to assure they could view the avatar through the Magic Leap. After screening, each participant was asked to complete a pre-questionnaire that double-checked and determined their eligibility to participate and if they had heard of augmented and/or virtual reality. Eligibility questions included if the participant wears glasses or not, if the participant could see well enough without their glasses if they wore them, and that they were aware of the risks that came with wearing the Magic Leap according to the company's website. These include various type of discomfort such as nausea and dizziness [19].

Prior to the experiment, two computers were set up with the BlueJeans video conference software: one in the room with the participant, and the other in a different room with a web camera for the researcher that would control the avatar during that portion of the interview. The researcher who was not conducting the interview would help the participant put on the Magic Leap, the microphone, and the Shimmer3. The Magic Leap would record a video, which we used to superimpose the eye-tracking data that it also collected; the microphone was connected to a computer that was collecting the audio data using Audacity; and the Shimmer3 was attached to the participant's ring and middle fingers on their non-dominant hand to ensure less noisy data (Figure 4).

Figure 4: BlueJeans was used in the experiment room for the avatar interviewer (left), and researcher talking to the participant using BlueJeans and controlling the avatar via Faceware (right).

Before starting the experiment, the researcher in the room would test that Audacity was recording the audio correctly prior to starting the experiment and data collection. After the Magic Leap was calibrated to the participant, the researcher with the participant would input commands into the computer to start the application with the avatar and the video recording. Depending on the randomized order of the interview parts, the inputted command would result in the participant either seeing the avatar or the human interviewer. Once the participant stated that they were ready to start the interview, the researcher would say, "We will start now." This audio cue, "Now," was said while pressing a button on the Magic Leap controller and the button on the Shimmer3 to synchronize the time stamps for the eye-tracking and galvanic skin response data. This also let the researcher conducting the interview know that they can start the first half of the mock interview.

After the first half of the interview was completed, the researcher would use the same audio cue and press the controller and Shimmer3's buttons to complete the data collection for the first half of the interview. Once the Magic Leap controller was pressed, this would allow the participant to see the other interviewer depending on the order of their interview. The participant took a short break while still wearing the Magic Leap, which allowed the researcher to transition from being the avatar to the live person or vice versa. Eyetracking and galvanic skin response data were not collected during this break to prevent noise. After the break, the participant completed

the second half of the interview, where the researchers followed the same steps to collect eye-tracking and galvanic skin response data. The participant completed a post-questionnaire reflecting on their experience and received compensation for their participation. We chose the following mock interview questions to encourage thoughtful answers from the participants and to make them feel as if they were actually completing an interview.

Mock Interview Questions

Part 1

    1. Tell me a little about yourself.
    2. Are you willing to travel?
    3. Do you see yourself working well with other people?
    4. Give me an example of where you have had to work on a problem in a team.
    5. What did you learn from the experience?

Part 2

    6. What do you like to do in your free time?
    7. What is your dream job?
    8. Why should we pick you instead of someone else equally qualified for the position?
    9. Tell me about a time when you made a mistake and overcame it.
    10. Where do you see yourself in five years' time?

4   Data Collection and Analysis

4.1   Demographics

We collected data from 30 participants, fifteen male and fifteen female. Data from four female and two male participants could not be included due to loss of eye-tracking data for one participant, loss of video data for two participants, inadequate video data for two participants due to a software bug, and one participant was unable to complete the experiment. Thus, we analyzed our multi-modal data from 24 participants: eleven female participants and thirteen male participants. The 24 participants were split evenly between first

interacting with the avatar or the live person and then with the respective counterpart. We still considered all participants' data collected from the pre- and post-questionnaires. Most participants were recruited on Rochester Institute of Technology's campus with the majority in between the ages of 18 and 24. Out of all 30 participants, 60 percent said that they were familiar with augmented and or virtual reality; this may relate to the data collection environment. The post questionnaire asked the participants how they felt their interview went from a scale of 1 (Awful) to 5 (Wonderful). There were 23 participants who rated their overall interview from 3 (Average) to 5 (Figure 5).

4.2   GSR Data Analysis

Galvanic skin response (GSR) is used to measure emotional arousal, and it is measured by the autonomic sweat glands in the skin [6]. When analyzing GSR data, we first passed the data points through a median filter to filter noise from recording skin response. Afterwards we normalized each of the participants' data by dividing by their mean GSR data during the entirety of the two mock interviews. By normalizing the data we are able to compare the data between all other participants and conduct peak detection [13].

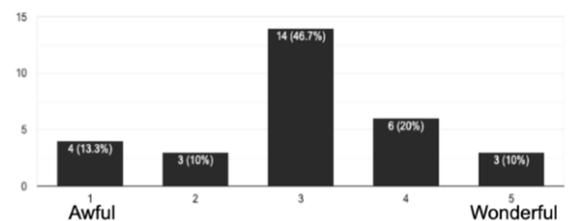**Figure 5:** Answers to 'How do you feel your interview went?'

4.2.1   Sequential GSR Analysis

Gathering data from the Shimmer3, we examined the galvanic skin response. Two sample *t*-tests were conducted to compare different sections of the experiment. We first separated the data from the interviews by the parts in which the mock interviews were conducted, and then analyzed them sequentially.

We ignored the interlocutor and separated the GSR data in the order in which they were recorded. Taking the average from each participant, we compared the means of the participants during the two parts of the mock interview (Figure 6).

GSR DATA

Figure 6: Distribution of the participants' GSR data separated in sequential order (t(23) $=$ $-0.60059, p = 0.554$)

4.2.2 Interaction Type Analysis

We also analyzed GSR by the type of interlocutor. We separated the averages of the participants by the type of interlocutor they had. For peak analysis we ran the data through another filter that removes all of the insignificant peaks. Finally we analyzed them by looking at their peaks, with a minimum peak distance of 1000 data points. Then we called a function to analyze the peaks in the filtered data (Figure 7).

GSR Peak Analysis

Figure 7: Number of Peaks per Minute based on the type of interlocutor (t(23) $=$ 1.0481, $p =$ 0.3055)

4.3 Speech Analysis

The audio files collected from Audacity were exported as wav files which were split into the interview parts. We manually found the first audio cue from the participant's mock interview using Audacity. Then FFmpeg was used to index the speech files into parts one and two of the interview using the eye-tracking data's timestamps. An inspection was done to ensure that the both parts of the interview were correctly indexed by checking the start and end points of the audio files. If the eye-tracking data did not have adequate timestamps, such as if the researcher did not fully press the Magic Leap controller to stop a recording, then the timestamps from the galvanic skin response data could be used to correctly index the audio files. Both eye-tracking and galvanic skin response timestamps were calculated to the millisecond, which was used to accurately index the start of both parts of the interview to create the audio files. The end points of the interview parts were rounded off to the next second to account for potential loss of synchronization for data collection between both sets of data. These parts of the audio file were run through Microsoft Azure's automatic speech recognition (ASR) software. The software output marked text files with timestamps that started from the beginning of their respective audio files and plain text files that had punctuation to show sentences. We calculated the Word Error Rate for four participants from one part of their experiment: two different files from each gender, with one file being an interaction with the avatar and with the live person. In these four files, the WER ranged from 0.064 to 0.144.

4.3.1 Prosody Analysis

Average Intensity Value

Figure 8: Average intensity values per interlocutor ($t(23) = 0.1329, p = 0.8954$)

Text grids were created through a Python script with the corresponding marked text file in order to align the respective audio file with the ASR text. We used Praat, which uses these text grids, to analyze the following speech characteristics: intensity (Figure 8) and pitch (Figure 9). A Praat script was used to calculate the mean value per characteristic for each word said by the participant, and then a mean of those means for the words was calculated using a python script. The file was next analyzed in R, where we visualized the data and ran a paired t-test per speech characteristic. There was no statistically significant difference in these speech characteristics.

Average Pitch Values

Figure 9: Average pitch values per interlocutor ($t(23) = 0.45001, p = 0.6569$)

4.3.2 Sentiment Analysis

The transcripts were analyzed using a sentiment functionality in Linguine [18] which took advantage of Stanford CoreNLP [12].

These analyses were downloaded as JSON files and then converted into csv files to calculate and analyze the average sentiment values. The sentences uttered by the participant, based on ASR transcription, could be assigned a value between 0 (very negative) and 4 (very positive). The average sentiment value was collected for both interactions per participant, and R was used to conduct a paired t-test. There was no statistically significant difference in sentiment values between both interactions.

Sentiment during Interview Parts

Figure 10: Average Sentiment Values per Interlocutor ($t(23) = 0.7643, p = 0.4525$)

4.3.3 Transcribed Speech Token Analysis

The marked text files were also used with the Transcribed Speech Token Analysis functionality in Linguine to analyze words per minute, syllables per minute, longest word time, number of words, total time for words spoken, and total time of the interview part in seconds. For each speech rate measure, a paired t-test was conducted in R. There is a statistically significant difference in both analyses of speech rate between both interactions. We also looked into removing outliers to see if this impacted the results; there still was a statistically significant difference.

Figure 11: Syllables per Minute per Interlocutor. (t(23) $= -3.5625, p = 0.001655$)

Figure 12: Words per Minute per Interlocutor. (t(23) $= -3.1804, p = 0.004169$)

There is also a statistically significant difference in the total time of the interview parts (t(23) $= 2.1341$, $p = 0.04372$), but no statistically significant difference in the longest word time (t(23) $= 1.1811$, $p = 0.2496$), number of words (t(23) $= -0.21848$, $p = 0.829$), or total time for the words spoken (t(23) $= 0.42347$, $p = 0.6759$).

5   Discussion

The study sought to investigate interactions with a person versus with a computer-generated avatar using multi-modal data: eye gaze, GSR, and speech data.

Looking into the different ways we analyzed our GSR data, we can visualize the levels of arousal from the participants during their interaction, and no matter how we split the two mock interviews, there was no statistically significant difference in either of the two (Figure 6).

When attempting to superimpose the eye tracking data onto the video, we discovered

that the Magic Leap's camera was positioned on the top right of the device, skewing the video of the Magic Leap sideways. Therefore, we had to resize the videos to fit the eye tracking data using linear interpolation. A manual check was also conducted that de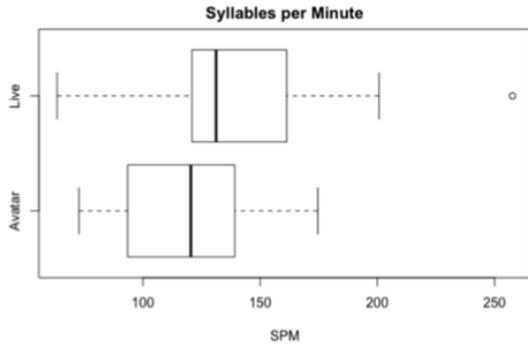emed the Magic Leap's eye-tracking software unreliable. Due to all these concerns, we were not able to conduct any analyses to determine if the participants maintained consistent eye contact. We would need an augmented reality headset with a more reliable eye-tracker in the future in order to successfully collect and analyze this data. The analyses from the speech data show that there are no differences when speaking with a human versus an avatar in measures such as pitch, intensity, and total number of words spoken. However, the speech rate analysis contradicts our hypothesis that there should be no difference in speech rate as a conversational characteristic.

To sum up, there is no difference in engagement when speaking with a human versus an avatar based on galvanic skin response and speech. However, there are some differences in conversational characteristics, specifically speech rate, when speaking with a human versus an avatar; we leave exploration for potential reasons for future work.

6   Future Work

Our research could apply to many professional fields and could investigate the initial response a person gets while interacting with a computer generated avatar; however, many other studies are needed to accurately comprehend this form of interaction. For instance, the cultural background of an observer has been shown to influence how gaze is distributed in the real world [14]. It would be compelling to look at how that same behavior would hold up against an augmented reality setup, if we were to bring participants from many different cultural backgrounds and analyze their eye gaze.

We note that having a peer conduct the mock interview might have lessened the level of arousal the participant felt; to better simulate a real interview, an older interviewer could

conduct the interview to further simulate a real interview. There are also many augmented reality devices are still under development; therefore, it would be interesting to explore how the realism of avatars may impact results.

Since both the interviewer and the interviewee are allowed to move freely, future work could explore the perspective invariant facial gaze analysis [3]. To be able to analyze eye gaze, Bennett et al. created a model to identify regions of interest in which the data from the participants were superimposed onto the videos and record the amount of time a participant spent looking in the region of interest [3]. In the future, eye gaze can be correctly collected with more reliable eye-tracking software in an augmented reality headset where we could use a similar model to analyze the data.

7   Conclusion

The study suggests that the level of arousal of the participant while being interviewed by the avatar and a live interlocutor remain the same. By aiming to achieve gender balance throughout the mock interview, we received a diverse data set of both male and female participants. We ran paired *t*-tests and saw that the GSR, sentiment, and prosody analyses showed no significant difference. Other speech characteristics and sentiment also do not differ significantly, with speech rate as the exception.

Acknowledgments

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The Relationship Between Future Orientation, Social Support, and GPA

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ABSTRACT

Future orientation (FO) is broadly defined as one's perception of their future (Trommsdorff, 1983). It has been shown to act as a protective factor for adolescents regarding substance abuse, risky behavior, and internalizing problems, as well as promoting higher academic success (Alm & Laftman, 2016; Chua & Milfont, 2016; Oshri, 2018). Most FO research has focused on children or adolescents, leaving a gap for young adults. Similarly, social support (SS) has been shown to act as a protective factor and promote positive mental health and academic outcomes (Kim & Bassett, 2019; Malecki & Demaray, 2006). FO develops and shapes itself in accordance with an individual's social context, including SS, making it valuable to study the two variables together (Trommsdorff, 1983). This study examines FO in college students and investigates the mediating effect of FO and SS on GPA. Participants were recruited through social media and data was collected through an anonymous online survey. The results indicate higher FO positively correlated with higher overall SS and GPAs; however, SS from a special person had a significant negative relationship with student's GPA scores after accounting for the variance in FO and overall SS. A possible explanation for this could be the type of SS received from those special others and the likely distraction they impose for the student's school work. Implications could include school resource centers drawing attention to these findings to increase awareness in students of how their FO and different sources of SS could be affecting their academic performance.

Keywords: Future Orientation, Social Support, College Students, GPA

LITERATURE REVIEW

Future orientation (FO) can broadly be defined as the way an individual envisions and thinks about their future. Throughout the history of research regarding FO, psychologists have approached the topic with different perspectives, such as possible selves, optimism, and time perspective (Markus & Nurius, 1986; Nurmi, 1991; Trommsdorff, 1983). Markus and Nurius claimed individuals have a possible self, which can be viewed as how they cognitively manifest their goals, aspirations, motives, and fears. A possible self is simply a mental representation of a person in future states. However, Nurmi believed motivation, planning, and evaluation were the most important factors relating to how people thought of their future. He claimed optimism was the key component that drove the behavior behind these three factors (1991). Trommsdorff proposed that the cognitive components and evaluation, which she referred to as affective components, were the most important in one's perspective of their future. She also believed that time perspective, the extent into the future one thinks ahead to, as well as the specific domain of life, such as family or occupation, matter the most in determining a person's level of FO (1975). Over the years, these perspectives have been adapted, revised, and combined by more recent researchers seeking to study FO (Crespo & Jose, 2013). Regardless of the perspective taken, FO can be understood as a concept that encompasses how a person thinks and behaves in response to their thoughts about the future.

Why Future Orientation Matters

FO is an important concept to study because it has been shown to act as a protective factor for adolescents (Alm & Laftman, 2016; Chen, 2013; Oshri, 2018). Chen (2013)

examined the role of interactive and independent effects of individual FO and school climates (school size, location, socioeconomic status) on problem behaviors in adolescents such as being dishonest, fighting, selling drugs, and abusing substances. He found a significant relationship with higher levels of FO associated with less reported problem behaviors. In a similar longitudinal study conducted by Alm and Laftman (2016), they found adolescents with high levels of FO were associated with lower rates of both delinquency and heavy alcohol use. This line of research suggests high levels of FO act as a protective factor against negative behavioral outcomes and substance abuse for teens.

Not only has FO been shown to promote more positive behavioral outcomes and decrease risks of substance abuse, but recent research has also indicated it helps facilitate more favorable mental health outcomes. Kim and Basset (2019) examined the mediating effects of teen's self-esteem and FO on the relationship between family stress and mental health problems to find that higher levels of FO were associated with fewer reports of mental health issues. This study shows that FO can act as a protective factor in the context of mental health. Furthermore, in Alm and Laftman's study (2016), participants with higher levels of FO had fewer internalizing symptoms such as stomachaches, headaches, trouble sleeping, anxiousness, and feelings of worry. These results further reinforce the importance of FO not only as a protective factor regarding an individual's mental well-being, but also physical well-being.

In addition to FO fostering more positive behavioral and mental health outcomes, it has also been shown to predict better well-being over time. Chua and Milfont's (2018) longitudinal study of participants aged 10-15 measured adaptive and maladaptive coping strategies and their relationship to FO and well-being over time. The findings indicate positive levels of FO predict a lower use of maladaptive strategies such as self-harming and substance use. It was also seen that positive levels of FO correlated with adaptive strategies such as resilience, social support, and problem solving

as well as an increase in well-being measured by vitality, happiness with weight, and adequate sleep (Chua & Milfont, 2019). These results highlight one of the mechanisms in which FO works to promote better health as coping strategies, but further research is needed to account for possible other mechanisms through which FO promotes positive outcomes for individuals.

How FO Relates to SS

The majority of FO research has focused on children or adolescents due to the critical periods of transition these populations face, which demand an increase in thinking and planning for one's future. Though this research offers valuable insight on the concept of FO and the variables affected by it, a gap remains for older age groups such as college students and adults. Another noticeable gap in research is the lack of studies measuring FO along with variables in the social environment, such as social support. FO and SS have both been shown to affect mental and physical health of students, but there is still potential for some hidden interaction or overlap to be going on that previous researchers have yet to find. Studying SS along with FO is valuable yet sparingly seen in any research to date. According to Trommsdorff, the process of development is often characterized by changes inside of the social environment. The social environment has a major impact on how an individual may form ideas and beliefs directly impacting their FO. Socialization is a long-life process in which one's ideas and beliefs about their future is shaped (Trommsdorff, 1983). The relationships formed and experiences had by an individual in their social environment can greatly impact their future perception. According to Nurmi (1989), plans, interests, and beliefs about the future are learned as well as adapted from social interactions. In a study aimed to investigate the role of perceived parental support and children's perceptions of the future, the results revealed that children with more perceived parental support were more likely to be optimistic and feel more confident about their future, thus displaying a high level of FO (Trommsdorff, 1978). In a more recent longitudinal study examining the effects of the

perceived connectedness to school and family contexts on students' FO, it was found that connectedness with school and family was positively linked to higher FO levels for the students (Crespo & Jose, 2013). Furthermore, in Wong and Konishi's 2019 study, it was found that student-teacher relationships and a sense of belonging were positively associated with higher reports of career and educational expectations. This study helps to show that support from peers and teachers in the educational setting increase optimism about the future, thus FO, for students.

SS has also been found to act as a protective factor, particularly for students with low socioeconomic status (SES) in terms of academic performance. Malecki and Demaray (2006) found a significant correlation between higher levels of SS and GPA scores in a sample of primarily Hispanic, low SES (measured by their participation in the free-lunch program), middle schoolers. This study seems to suggest that SS has different effects on different populations, as measured by socioeconomic class, which raises the question, what other differences are there for other variations in the student population? It could be possible these results were found because of the specific ethnic group that was used as a sample, which is why it is important for further investigation to be done on the effects of SS from various sources on GPA for a more representative sample.

Over time, FO research has focused largely on the adolescent population, which leaves plenty of room for more research to be done in the emergence and development of FO in the adult population. There are still many questions regarding how one's beliefs about their future are formed and the specific variables that play a role in affecting the development. FO is an important construct to examine due to previous findings suggesting it acts as a protective factor in terms of reducing problem behaviors such as substance use or internalizing problems (Oshri, 2018; Alm & Laftman, 2016). Similarly, SS has been shown to act as a protective factor in terms of academic performance, mental health, and physical health (Wong & Konishi, 2019; Malecki & Demaray, 2006). Yet, there is still a gap in the literature for

how these variables interact and overlap in the college student population. With all these previous findings in mind, it is important to move forward and look closer at college students' FO and SS levels along with the effect on their academics. College students are in a critical and demanding transitional period in their lives. Our first hypothesis is that FO will change across time in college students during their time in secondary education. Our second hypothesis is FO and SS will positively correlate with one another based on overlapping areas discovered in previous research. Our third and final hypothesis is that all three variables, FO, SS, and GPA, will intercorrelate.

Taken together, FO and SS levels are important factors to investigate in relation to college students' academic success. Our study used a scale of FO created from a global conceptualization of the concept which included questions about the individual's planning, motivation, as well as evaluation (Crespo & Jose, 2013). We used this scale because it encompassed the major components of FO and was a good starting point to evaluate the college student population with. To measure levels of SS, our study used the Multidimensional Scale of Perceived Social Support in order to capture SS from three distinct domains: friends, family, and special other. We choose this scale because it encompasses the important sources of friends and family, but also allows room for participants to report support from an entirely different domain of another special person. The special person could be interpreted as someone's significant other, friend with benefits, or any other type of untitled romantic relationship partner.

METHODS
Participants
Respondents were 99 students enrolled at Winthrop University, recruited through personal contacts as well as through emails from professors who offered extra credit for completion of the survey. The age range for participants was 18-26, with a mean age of 20 years old. There were 70 females, 26 males, and 3 transgender participants. They identified as

64% Caucasian, 23% African American, 8% Hispanic/Latino, 1% Asian, 2% Mixed, and the remaining 1% identifying as other.

Materials

The self-report survey contained a section on perceived SS from friends, family, and a special other, as well as a FO scale based on a global conceptualization of the concept. The measures used are described in further detail below.

Multidimensional Scale of Perceived Social Support (MSPSS)

Respondents completed the 12- item MSPSS (Zimet, 1988). This included 3 subscales of the different sources of perceived social support including friends, family, and special other. Answers were rated using a 7-point Likert scale ranging from 1 *very strongly agree* to 7 *very strongly disagree.*

Future Orientation Scale

The self-report measure used to account for FO included four items focusing on self-directed action. The scale included questions such as, "I often think about my future (what I want to do with my life)" and "I am serious about working hard now so that I have a good future." Answers were rated using a 5-point Likert scale starting at 1 *strongly disagree* to 5 *strongly agree* (Crespo & Jose, 2013).

Demographics

Participants reported their age, gender, current GPA, amount of credit hours received so far, race/ethnicity, as well as socioeconomic status for most of their childhood, and whether they were a first-generation college student.

Procedures

The survey was completed online via Qualtrics. It took a total of 5-10 minutes to complete. Before the survey began, participants were shown a consent form that informed them of the study's intent and ensured their participation was voluntary and anonymous. After agreeing to the consent form, participants were prompted to answer the MSPSS and the short FO scale created by Crespo and Jose (2013), followed by a short demographic section. After completion of the survey, participants were shown the debriefing form which explained that the study examined future orientation and perceived social support across college classifications.

RESULTS

To address the first hypothesis of this study, future orientation will change over time in college students, we combined the six freshmen with the 28 sophomores and ran a one-way ANOVA comparing the freshman/sophomore group with the 34 juniors and 31 seniors. See Table 1 for descriptive statistics. There was no significant difference found between these groups and their levels of future orientation, $F(2, 96) = 0.95$, $p = .39$. Due to this non-significant effect, standing was not considered in the rest of the analyses. To address the second hypothesis of this study that future orientation and social support would be positively related to each other, bivariate correlations and a two-step hierarchical linear regression were conducted. Our third hypothesis that FO, SS, and GPA would all intercorrelate was supported through the bivariate correlations discussed below.

Future Orientation, Social Support, and GPA

Bivariate correlations were conducted to examine the relationship between social support and future orientation (see Table 2). There was a significant positive correlation between future orientation and overall social support, $r(97) = .22$, $p = .03$. The only significant source of social support related to FO was significant other, $r(97) = .28$, $p < .001$. Two variables, family social support and future orientation, were also seen to positively and significantly correlate with GPA, $r(97) = .26$, $p = .01$, and $r(97) = .24$, $p = .02$, respectively.

To further examine the unique contribution of the three sources of social support and future orientation on GPA, a hierarchical linear regression was conducted (see Table 3). In step one, the three sources of social support were used to predict GPA, which accounted for a significant amount of variance, $R^2 = .11$ $F(3, 95) = 3.75$, $p < .01$. Family social support was revealed in this step as the only

unique factor to contribute to the prediction of GPA, $\beta = .40$, $p < .05$. In the second step, future orientation was added to predict GPA ($\beta = .30$, $p < .01$), accounting for a significant amount of variance in GPA, $\angle R^2 = .08$, $F (1, 94) = 0.08$, $p = .003$. This step revealed social support from a significant other negatively predicted students' GPA, $\beta = -.28$, $p = .03$.

DISCUSSION

Previous research has focused largely on FO as a protective factor for young children and adolescents, but minimal research has sought to examine how FO changes in college students across time and the implications their levels have on their domains of life (Alm & Laftman, 2016; Chen, 2013; Kim & Bassett, 2019). This study extended research of future orientation to the traditional college aged students and compared students' class standing with their levels of FO. Hypothesis one, that FO would differ across time in college students was not supported. A possible explanation for this could be the low amount of freshman obtained in the sample. First year students differ dramatically from second year students since freshman undergo a critical transition period when adjusting to college life in their first two semesters. The descriptive statistics show that the average mean for FO collected in this sample was 4.56 on a 5-point scale, suggesting our study either included many individuals with a high level of FO or a bit of self-report bias in answer sets happened. Another thing worth noting from the descriptive statistics is the mean GPA score was a 3.31, suggesting this sample included a majority of motivated and academically inclined students, which could have prevented a difference from appearing. Since there was not much variation or representation of students with lower GPAs, that could have affected the study's results and driven the mean of the average higher. Another noteworthy factor of this study's sample was the overrepresentation of female students, as slightly over 70% of the respondents were female. This could have affected the results because previous research shows women and girls have a higher level of FO than men (Oshri, 2018; Trommsdorff, 1979). Future research

could use a more representative sample and perhaps a longer scale of FO including reverse scored questions to account and cut back on any possible self-report bias.

In the current study, FO was seen to positively correlate with student's overall perceived social support, which supported hypothesis two that FO and SS would be positively related to each other. These findings were not shocking based on the previous findings of both FO and SS promoting similarly positive outcomes such as reduced mental health issues and undesirable loneliness and depressive symptoms (Lee, 2019; Chua & Milfont, 2018). Additionally, FO positively relates to adaptive coping strategies in college students; for example, the higher their levels of FO were, the more likely they were to utilize SS as a way to cope with college stress instead of using maladaptive strategies such as self-harm and substance abuse (Chua & Milfont, 2018). Yet, research to date has not examined the correlations between various sources of perceived SS, such as from friends, family, and a special person, which allows for ambiguous undefined relationships to be accounted for along with levels of FO in an emerging young adult population.

Hypothesis three, that FO, SS, and GPA were intercorrelated, was supported as it was seen in this study that FO was positively associated with GPA scores, suggesting that positive attitudes and thoughts of one's future are powerful enough to make a significant impact on student's academic performance. Family support was seen to be significantly associated with higher GPA scores for students, which supports previous research showing parental and overall family support promote middle school and college students' academic performance (Cheng, 2012; Trommsdorff, 1983). This study added to the literature examining family support in relation to college student's GPA, but contributed two other sources of support coming from friends and a special person as well as FO as a predictor (Cheng, 2011). This contribution is valuable because it revealed SS from a special person can negatively impact a college student's academic performance.

FO is an important construct to consider in students because positive perspectives of the future can motivate them to push through and excel in their studies if they believe it will be worthwhile for their desired future outcomes. Perceived social support is another important variable to consider since it has been shown in previous research to affect student's hope levels as well as academic performance and mental states of loneliness (Lee, 2019). The key finding of this study was that, after accounting for the effects of FO and overall SS, support from a special person was revealed to be negatively associated with student's GPA scores. A possible explanation for this trend could be that while family support offers a sense of comfort, security, and unconditional love, support from a special person could greatly differ depending on the temporal status of the relationship and the number of healthy traits the relationship possesses. A student in a romantically involved relationship could be distracted from their course work by their partner's needs and desires. Since this trend only appeared after accounting for the variance in FO on GPA, it is also possible that after taking away the optimism and hope one's partner can offer about the future and their desired outcomes as a unit, what is left over is spending quality time together and partaking in activities not related at all to their academics. As mentioned above, the sample used in this study was over representative of females, which could also impact the participant's perceptions of the support received from a special person. Since females often take on the caregiving role in relationships, it could affect the actual amount and quality of support they are receiving from what they consider to be a special person in their life. Future work should more specifically define the term special person and account for the traits and type of support received from that person throughout the relationship, as well as utilize a more diverse and equally representative sample to account for these discrepancies.

To conclude, not all sources of perceived social support have the same effect on school performance measured by GPA. While family support seems to be the most beneficial to students, followed by support from a friend, support from a special person, whether it be a significant other or simply a friend with benefits situation can potentially hurt more than help in terms of academic success. Future orientation can be a product of social conditions and play a role in the adaptation to changes in the social environment, including levels of perceived social support, which is why it is important to examine future orientation with social support levels and the impact on student's performance (Trommsdorff, 1979). Regarding practical implications for these findings, it is important for university staff members such as professors and advisors to be aware of these findings so they may aid students in maintaining optimistic and positive perspectives of their future. Concerning the findings of social support from a special other having a negative impact on GPA, it is essential for residence life staff at universities to be aware of these findings so that they may incorporate programming to enhance awareness about the impact of relationships on future orientation (i.e. characteristics of healthy and supportive relationships). It is important for students to know how romantic relationships and their differing dynamics can impact their academic performance.

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Table 1

Descriptive Statistics

	Min	Max	Mean	Standard Deviation
Future Orientation	2.75	5.00	4.54	0.46
Social Support- Significant Other	1.00	7.00	5.45	1.38
Social Support- Friends	2.25	7.00	5.56	1.15
Social Support- Family	1.25	7.00	5.17	1.39
Total Social Support	2.50	7.00	5.39	1.08
GPA	2.00	4.00	3.31	0.47
Age	18.00	26.00	20.18	1.49

Table 2.

Intercorrelations among Social Support Sources, Future Orientation, and GPA

	1	2	3	4	5
1. GPA	-				
2. Social Support- special other	-.05	-			
3. Social Support- friends	-.01	.61***	-		
4. Social Support- family	.26**	.48***	.46***	-	
5. Future Orientation	24**	.28**	.18*	.07	-

*$p < .05$, **$p < .01$, ***$p < .0001$

Table 3.

Hierarchical Linear Regression of Social Support and Future Orientation predicting GPA

	ΔR^2	β
Step 1	.11*	
Social Support Sig other		-.19
Social Support Friends		-.06
Social Support Family		.38***
Step 2	.08**	
Social Support Special other		-.28*
Social Support Friends		-.07
Social Support Family		.40***
Future Orientation		.30*
Total R^2	.19*	

*$p < .05$, **$p < .01$, ***$p < .0001$

Perceptions of African American Professional Relationships with Faculty at a Predominantly White Institution

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ABSTRACT

College can be a very critical time during a student's life. Many components contribute to the success of one's college experience. The relationships that college faculty have with students closely correlates to the students' overall college experience (Astin, 1993). In this study, we examined African American students and their educational careers at a predominantly white institution known as a PWI. Furthermore, when examining the educational career of African Americans, we particularly focused on the relationships that the students held with faculty members at the university. Using qualitative and quantitative methodology, we measured the general perceptions of student-faculty relationships by conducting a survey and face-to-face interviews with participants. We hypnotized that the stronger the relationship students held with faculty correlated to how well their college experience was. Findings from the study fill a gap in the literature of higher education and highlight that African American students sometimes find it difficult to relate to faculty members because of the underwhelming representation of diversity within the campus faculty. This study provides the foundations for future research exploring African Americans and the different factors that contribute to their overall educational experience, as well as undergraduate and graduate students' experiences at predominately white institutions around the country.

LITERATURE REVIEW

This year marks the 66th anniversary of the five court cases that made up the Brown vs. Board of Education of Topeka, Kansas (1954) which ruled that racial segregation of public schools was unconstitutional. Although the court case was mainly advocating for K-12 schools, the ability for African Americans to get a quality and equal education such as their white counterparts allowed them to gain additional knowledge and to want to learn more by attending college. Since this decision, a recent study showed that 36% of students in college today identify as African American (NCES) and attend either a Historically Black Colleges and Universities (HBCUs) or Predominantly White Institutions (PWIs). The rate of black students that attend college continues to rise and shows the value of why it is important to get an education. However, because more African American students are attending colleges, what supports are universities applying to help these students have a successful college experience? The purpose of this study is to look closely into the educational experiences of students of color at a predominantly white institution focusing on the three areas of student-faculty interaction, experiences of African American students in higher education, and underrepresentation of black faculty.

Experiences of African Americans in Higher Education

In the last twenty years, studies focusing on African Americans and their experience with higher education at a predominantly white institution (PWI) in the United States have become more prominent. The majority of African American students attend predominantly white institutions. Originally, predominantly white institutions were not built to accommodate and support African Americans in their educational career. Because of this, research has shown that African American students typically are not prepared for the experiences that they come across on a PWI's campus (Malaney & Shively, 1991). Regarding African American students adjusting to the social environment of college, research showed that students felt less support in the college social environment compared to the

support and comfort that they experienced in their home and high school communities (Schwitzer, Griffin, Ancis, Thomas, 1999). This same research showed that African American students at a predominantly white institution admitted that the transition to a PWI environment was difficult and they struggled with the process. With this transition, African American students did not feel welcome or supported on the campus of their PWI due to the lack of a support system for the students of color (Kuta, 2016). Students in this study commented on the support that African Americans received on this campus, "You don't have anyone who looks like you that you can go to, that's more advanced, that can give you advice, that can support you."

Multiple factors such as organizations that students joined, influences from family and friends at home, and institutional characteristics have been determinants of the type of experiences African Americans have had at a PWI (Guiffrida & Douthit, 2010). When looking at the social environment of a PWI for an African American student, many students have dealt with the feeling of being isolated and alone while also perceiving racism from the actions of others (Schwitzer, Griffin, Ancis, Thomas, 1999). These negative racial experiences have taken place inside and outside of the classroom. Also, participants in the study previously mentioned made a comment that stated, "The first time that I felt like a minority was at this school." The overall experience of most African American students at a predominantly white institution has affected multiple aspects of their well-being and contributes to the way that they perceive their environment.

Student-Faculty Interactions

Researchers have performed studies that took a deeper look into what impacts a student's college experience. The research showed that the relationship that a student forms with faculty closely connects to how positive their college experience is (Astin, 1993). Focusing on African American students, researchers have looked into whether the relationships that black students have with faculty differ based on the ethnicity of the professor. During the college years, professors have the most direct interaction with their students out of any other university member due to multiple class meetings a week. Looking closely at the research has shown that there has been a positive difference in the way African American college students interacted with faculty that were of the same race compared to other professors that are Caucasian (Young & Linda, 2007). The interactions between faculty and African American students can cause a vast impact on the student as a whole and their attitude towards the institution. Even to the extent that research has argued that African Americans' GPAs are affected by the interactions that they have with their professors (Cole, 2010).

In research done by Douglas Guiffrida, the term "student-centered" was used to describe how students viewed faculty who were supportive of their academic success, genuinely cared, and wanted the absolute best for the student. His research indicates that African American students tend to perceive most black faculty as a "student-centered" model because of the way that they go above and beyond in their approach to reach out (Guiffrida, 2005). These professors went above and beyond by giving career guidance, having a genuine concern about students' problems, and were invested in the students. Just because African American students felt they had a better connection with faculty members of the same race, however, did not mean that they have had completely negative experiences with white faculty; they just have not had overwhelmingly positive experiences compared to the ones that they had with black faculty. African American students believed that white faculty could not personally relate to the struggles that they encountered daily (Schwitzer, Griffin, Ancis, Thomas, 1999). About this, African American students would approach the faculty member that was most familiar to them in terms of race within their department.

Underrepresentation of Black Faculty

According to a recent study by the National Center for Education Statistics, research shows that only 23.2% of college faculty in the United States are minorities

(NCES, 2016). This data includes Black, Hispanic, Asian, Pacific Islanders, American Indian/Alaskan Native, and others who make up more than two races. Although the rate of minority and Black professors has gradually risen over the years, black students at predominantly white universities feel that they still do not have enough professors who are educated about their needs as a race. Students believe that one way that this can be changed is to provide faculty members with diversity training that serves as professional development so that white faculty members can become more sensitive to decrease the stereotyping of black students (Guiffrida & Douthit, 2010).

METHODS

Both qualitative and quantitative data were collected to help form the results of this case study. Taking a mixed methodology approach allowed the results collected to be more accurate by allowing students to expand on answers given. The data collected was to examine two big research questions. The two questions that were closely analyzed were, do the relationships that students have with faculty have an impact on their overall college experience, and do factors such as race play a part in the type of relationships that are formed? Participants included in this study consisted of undergraduate and graduate students from all academic classifications at a small, predominantly white institution, in the Southeastern part of the United States. The students varied in majors representing all five academic colleges at the university. African American, White, Hispanic, and Asian were the four ethnic groups that students who partook in the survey represented. Overall, the response rate for the survey was seventy-three participants. Sixty-two of the participants were females and eight were males.

The quantitative methodology consisted of a survey that was designed to examine students' thoughts and allow them the opportunity to express their feelings on their college experience and the relationships that they have had with faculty. The survey was distributed by email to all students through a listserve that students get daily at the university.

A link was provided for students to access the survey. Once consent was given, students were able to complete the survey. In total, the survey consisted of eleven questions. The questions were developed based on certain themes that the research focused on. The survey started by asking general questions about the students' demographics. Students were then asked several questions about their involvement, interaction, and positivity of the relationship that they had with faculty by choosing the category that best described their perception of the question. The next set of questions were open-ended, and students elaborated on ideas and thoughts that were presented in previous questions by typing their responses. If students selected any race listed besides white, they were asked additional questions about the relationship that they had with faculty of color specifically and their experience as a person of color at a PWI. These questions were also open-ended questions that allowed students to express their thoughts. Any student with the link to the survey was able to respond to the survey regardless of race. However, after all responses were recorded (n=73) and analyzed, the African American students' responses were pulled to further analyze.

Based on the responses that participants gave and their ethnicity, eight African American students were selected to attend individual face-to-face interviews. During the interviews, students were asked follow-up questions about their experience and relationship with faculty as well as given the opportunity to elaborate on responses that were given on the survey. A list of questions was comprised of students partaking in the interview before the interview was conducted. Some students were asked additional questions that other participants were not during the interview based on the response given to a question asked. Responses that students gave were recorded and the interview transcripts and survey data collected in the study will be used to identify recurring patterns or themes among students' experiences. The data collected was analyzed by looking at individual case studies which allowed an in-depth investigation of each response that participants gave.

RESULTS

The present study resulted in there being no significant quantitative difference in the relationship with faculty by the level of impact on the college experience $t(29)=-0.37$, $p=0.71$. The majority of the questions asked in the survey were about the importance of a relationship with faculty, comfort level, and significantly positive professional relationships. Focusing on all participants in the study (n=73), all students except six have had positive, somewhat positive, or overwhelmingly positive relationships with faculty. The six students who have had a neutral, somewhat negative or overwhelmingly negative experience with faculty have all identified as Black/African American. African American students alone have also had majority positive relationships with faculty. This does not mean that they have never had a negative encounter with a faculty member, but in general, have had more that were positive rather than negative. However, looking closely at the qualitative data that was collected has shown that the relationships created with faculty have caused an optimistic impact on students' college experience. The more positive the relationship, the more positive the college experience. Looking at the impact that faculty had on student's college experience 65% of students reported that the relationship created had a significant impact and 35% reported a slight impact on their college experience.

Regarding responses, African American students have created professional relationships with faculty members that are both African American and white. Although most African American students have identified having a better relationship with faculty of the same race because they feel more comfortable approaching those faculty members and they can relate to situations that those students have encountered. One student made the statement, "I built a closer relationship with the faculty members of color. I felt that I could relate to him and that he always asked how I was doing and helped me whenever I had questions that were both school and non-school related." In an open-ended response question asked in the survey, a student stated, "Faculty of color seems to have my best interest at heart because they know of the hardships we face as a race and want to see us doing well."

During individual interviews, questions regarding other factors such as diversity and inclusion, cultural bias, and support in the classroom were discussed with African American students about their personal experiences. When looking at if faculty talk about diversity and inclusion in the classroom, many students have not discussed issues such as race, religion, and LGBTQ in their classes for their major due to the curriculum that is taught. However, many have spoken on a general education course that the university requires students to take that incorporates students having to talk about current issues today. None of the students have been singled out because of their race, but some felt as if there are a few professors who sometimes make culturally bias statements that they are unaware of. Surprisingly, those same students have mentioned that most of the cultural bias that they received in the classroom comes from their peers of the opposite race that are in the class with them. Also, none of the students have experienced any form of racism or prejudice from their professors.

DISCUSSION

Although the research has shown that students have had positive relationships with the faculty members that they have worked with, there are always improvements that can be made. A few reoccurring concepts that students gave in their responses about ways that professors can improve the relationships that they create with students have been that professors should create more personal relationships and get to learn about the student outside of class. Suggestions on ways that this could be done was for teachers to have one-on-one meetings with students approximately twice throughout the semester to check in on them and get to know more about them aside from schoolwork. This can be done by asking students about their backgrounds, activities that they may participate in, and learning what students struggle with. This not only makes the student feel valued and as if the faculty cares, but it will allow the faculty member to learn

about their student and why the student conducts certain behaviors in the classroom. During this conversation, it is also important that the faculty member is open with the student about their life outside of the classroom. A few support strategies that students stated faculty members could provide to impact their relationship with their students are check-ins, being open, communicating effectively, be understanding, and to not stereotype every African American student because everyone's situation is different.

One question that students were asked was how important it was to have the faculty population reflect the student population, and students felt that the faculty population needed to match because African American students can see other successful African Americans that have accomplished similar achievements. Even though students felt this way, a reoccurring theme that appeared in students' responses was that they have not had many faculty that were a part of minority groups; because of this, some students could not answer all the questions about the relationships that they have had with faculty of color. Students even noticed the lack of diversity in the faculty at the university. During an interview, one student stated, "There does not seem to be a lot of diversity in the department." With this in mind, a closer look was taken into the diversity of the professors at the university. It was found that only 14.7% of faculty from all academic colleges come from minority groups such as Black, Asian, Hispanic, American Indian, and Pacific Islander. At the university 28% of students, undergraduate and graduate attend the university. This shows the underwhelming representation of faculty on this PWIs campus. This led me to take a look at the number of faculty across the country that are from underrepresented backgrounds. Nationally, what strategies are being put into place to recruit more faculty of color at universities across the nation? Further research can be done on strategies that predominantly white institutions can use to diversify their faculty at the institution.

CONCLUSION

Given the increasing number of African Americans that are attending predominately white institutions across the country, faculty members must understand how they can support African Americans in higher education to be successful. Faculty members do not realize the impact that they have on their students during their college experience. Faculty members can have both a positive and negative impact on their students. Faculty members should particularly think about the supports that they are offering all of their students to make their learning experience more relatable. But faculty members should also think about how they are supporting their African American students in a system that was not designed for their success.

Colleges and universities across the nation should promote diversity and explore initiatives to recruit faculty of color. Although African American students feel comfortable and have positive relationships with faculty of any race, African American students feel that they can relate to other African American professors due to the connection and relatability that students experience with others of the same ethnic background as them. With faculty members providing support to their students and having their students' best interest at heart, college students will have a better overall college experience.

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Process Goals Raise Academic Confidence and Performance of First-Generation College Students

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ABSTRACT

First-generation college students (FGCS) enter college less academically prepared than their peers (e.g., Atherton, 2014; Terenzini, Springer, Yaeger, Pascarella, & Nora, 1996). Additionally, FGCS encounter more academic difficulty and earn lower grades compared to their counterparts (e.g., Pratt, Harwood, Cavazos, & Ditzfield, 2019; Terenzini et al., 1996). As such, it is important to find ways to increase academic confidence and performance among FGCS. One potential avenue for doing so may be to influence their goal orientation when approaching academic work. Process goals focus on the steps needed to achieve a desired outcome, while outcome goals focus on the desired outcome itself (Freund & Hennecke, 2015). Research suggests that for difficult tasks, process goals result in greater levels of performance, lower feelings of anxiety, and higher perceptions of self-efficacy than outcome goals (e.g., Vallacher, Wegner, & Somoza, 1989; Zimmerman & Kitsantas, 1997, 1999). We manipulated goal orientation on a difficult task and then measured confidence and performance with respect to a subsequent pop quiz. We expected FGCS to exhibit lower confidence and performance compared to non-FGCS when instructed to adopt outcome goals; however, we expected no such differences when participants were instructed to adopt process goals. Participants consisted of 29 FGCS and 38 non-FGCS students in introductory psychology courses. All participants completed a challenging anagram task (Mattingly & Lewandowski, 2010). Students were randomly assigned to either the Process Goal Condition or the Outcome Goal Condition. After completing the task, they responded to research-created items designed to assess their academic confidence for the quiz. Results confirmed that FGCS benefitted from process goals.

LITERATURE REVIEW
Academic Struggles of First-Generation College Students

College brings with it many new and difficult challenges. This is especially true for first-generation college students (FGCS). In addition to dealing with financial burdens and family expectations, FGCS may also struggle with academic adjustment (Gibbons, Rhinehart, & Hardin, 2019; Pratt, Harwood, Cavazos, & Ditzfield, 2019). In fact, both previous and current research indicates that FGCS are more likely to face academic difficulty and earn lower grades than non-FGCS (Gibbons et al., 2019; Pascarella, Pierson, Wolniak, & Terenzini, 2004; Pratt et al., 2019; Terenzini, Springer, Yaeger, Pascarella, & Nora, 1996). As such, there remains an ongoing need among colleges and universities to continue to seek ways to support these students.

To date, several reasons for the academic challenges of FGCS have been proposed in the literature, including a lack of social and cultural capital, a lack in academic preparedness, lower campus involvement, and more hours spent working outside of class (Atheron, 2014; Gibbons et al., 2019; Pratt et al., 2019; Terenzini et al., 1996). Some of the early research on FGCS includes the work of Terenzini, Springer, Yaeger, Pascarella, and Nora (1996), who sought to examine the unique characteristics and experiences of this student group. They analyzed whether FGCS possess different characteristics before entering college, have different experiences while in college, and show different educational outcomes in math, reading, and critical thinking after the first year of college. The study was conducted as part of the National Study of Student Learning (NSSL), a federally funded, longitudinal study that sampled 3,331 students from 18 institutions

across 15 states. Regarding precollege characteristics, Terezini et al. (1996) found that FGCS were more likely to come from low-income households. They also scored lower on a standardized test of math, critical thinking, and reading comprehension. Before entering college, these students also reported lower degree aspirations, and they expected to need more time to complete their degree. While in college, it found that FGCS were more likely to take fewer credits their first year compared to non-FGCS (Terezini et al., 1996). They also reported studying less and working more hours off campus. As for end-of-year educational outcomes, non-FGCS made greater gains than FGCS in reading skills; however, there were no differences in mathematical and critical thinking scores between FGCS and their peers after the first year (Terezini et al., 1996). Pascarella et al. (2004) followed these students through their second and third years of college and analyzed net differences between the student groups. It was found that FGCS had lower grades than non-FGCS in the third year of college, even though they had completed fewer total credit hours (Pascarella et al., 2004). Compared to their peers, these students also worked more hours outside of class, exhibited lower levels of campus involvement, and were more likely to live off-campus. Taken as a whole, these findings suggest that the academic struggles of FGCS are partly non-academic in nature.

Recent research conducted by Atherton (2014) also suggests that FGCS might differ in their academic readiness for college. Using data from a sample of 6,280 first-year college students pooled from the years 1999-2009 who participated in the Cooperative Institutional Research Program survey, Atherton (2014) found that students who had two parents graduate from college were 20% more likely to report a high school GPA of a B+ or higher compared to students who did not. In the same study, it was also found that students who had two parents graduate from college were 38% more likely to score above the median for an SAT mathematics test and 48% more likely to score above the median for an SAT verbal test (Atherton, 2014). It is possible that these differences in academic preparedness for college—as measured by high school GPA and standardized test scores—may manifest themselves in lower academic confidence among students who are the first in their families to attend college. Indeed, research conducted by Gibbons, Rhinehart, and Hardin (2019) revealed that FGCS reported feeling relatively unprepared for the level of academic rigor in their college courses. Echoing the findings from Gibbons et al. (2019), Pratt, Harwood, Cavazos, and Ditzfield (2019) found that compared to non-FGCS, FGCS were more likely to report that they would "encounter more difficulty performing well academically." As suggested by Pratt et al. (2019), these findings may indicate a lower "perceived academic competence" among this student group. Given all of the aforementioned findings, current research on the topic has focused on identifying successful interventions that can improve college adjustment, retention and performance of FGCS (e.g., Gibbons et al., 2019; Pratt et al., 2019).

Advantages of Process Goals

One potential avenue for bolstering the efficacy and performance of FGCS may be to influence their goal orientation when approaching academic work. When given a task, one can have a goal for the process or the outcome (Freund & Hennecke, 2015). Process goals focus on the steps needed to achieve a desired outcome, while outcome goals focus on the desired outcome itself (Freund & Hennecke, 2015). Process goals appear to be more advantageous than outcome goals in facilitating progress towards a desired end result. Research conducted by Taylor, Pham, Rivkin, and Armor (1998) suggests that focusing one's attention on the process for a task allows one to consider the concrete steps needed to attain a certain outcome. Unlike process goals, outcome goals do not direct people's attention to goal-relevant means. In fact, outcome goals may serve as a hindrance to successful goal pursuit. Oettingen and Wadden (1991) found that those with positive fantasies of weight loss had the worst treatment outcomes in a longitudinal weight loss program. Researchers concluded that the fantasies interfered with weight loss, because although participants had an image of the

desired outcome in mind, they failed to consider the means (i.e., the process) needed to make that outcome a reality (Oettingen & Wadden, 1991). Freund and Hennecke (2012) also examined the effects of a process versus outcome goal focus on weight loss. Supporting the conclusions drawn by Oettingen and Wadden (1991), they found that women who reported focusing on the outcome of the diet (i.e., weighing less) lost *less* weight than women who reported focusing on the process of dieting (i.e., eating low-calorie and low-fat foods). By focusing attention on the relevant steps needed to be successful, process goals appear to facilitate progress toward a desired outcome better than outcome goals.

Other studies have shown that process goals are especially beneficial for new or difficult tasks. Zimmerman and Kitsantas (1997) found that setting a process goal was more advantageous for girls learning to play darts than setting an outcome goal. Girls in the process-goal condition (i.e., instructed to focus on how they threw the dart) showed higher levels of dart skill, self-efficacy, and interest in the game than participants in the outcome-goal condition (i.e., instructed to focus on earning the highest possible score). In a similar study, Zimmerman and Kitsantas (1999) found that a process goal was more beneficial than an outcome goal for high school girls learning how to combine multiple sentences. Students in the process-goal condition (i.e., instructed to follow the three-step strategy) showed higher levels of writing skill, self-efficacy, and satisfaction with their writing than girls in the outcome-goal condition (i.e., instructed to focus on writing a sentence with the least amount of words). Vallacher, Wegner, and Somoza (1989) found that when given a difficult speaking task, participants who focused on how they spoke (i.e., enunciation and increased volume) had less speech disfluencies, were less anxious, and felt their persuasion effectiveness to be higher than participants with the outcome goal of trying to be persuasive. These studies suggest that for new or difficult tasks it is more advantageous to focus on the process, or the "how," as focusing solely on the outcome can have detrimental effects for performance, anxiety, and self-

efficacy. Given these findings, it seems likely that FGCS may benefit from adopting process goals for their academic endeavors.

The Present Study

Our purpose was to explore the effect of goal orientation during a difficult task on students' confidence and performance when confronted with a subsequent pop quiz. We hypothesized that students who adopted process goals for the first task would have 1) less test anxiety, 2) more academic confidence, and 3) better grades when asked to complete the quiz, compared to students who adopted outcome goals. We expected process goals to be particularly beneficial for FGCS, who may be struggling more than non-FGCS to adjust to the academic rigor of college.

METHOD
Participants

Participants consisted of 68 undergraduate students currently enrolled in psychology courses at Winthrop University. Students identified as male ($n = 20$), female ($n = 47$), and other ($n = 1$). The sample included Caucasian ($n = 35$), African American ($n = 24$), Asian ($n = 4$), and Hispanic/Latino ($n = 2$) students; three students identified as Other. Students reported low income ($n = 16$), middle income ($n = 39$), upper middle income ($n = 12$) and high income ($n = 1$) socioeconomic statuses. The mean grade point average (GPA) was 3.2, and the mean age was 19. There were 29 first generation college students and 38 non-first-generation college students who participated in the study. All participation was voluntary. Students received extra credit from their course instructor for participating.

Materials and Procedure

After consenting to participate in the study, all participants completed a randomly distributed packet before receiving a pop quiz. The packet was divided into three sections. The first section contained six demographic items, followed by two surveys that measured two relevant trait-like variables for the study.

Grit. After responding to the demographic items, participants completed the Short Grit Scale (Grit-S; Duckworth & Quinn, 2009). This is a self-report measure for grit that

consists of eight items. Participants indicated the extent to which they agreed with each item, such as "Setbacks don't discourage me," using a 5-point Likert scale ranging from "Not at all like me" to "Very much like me." The Cronbach's alpha for the sample was .90.

Optimism. Following the Grit-S, participants completed the Life Orientation Test (LOT; Scheier & Bridges, 1994). This is a self-report measure for optimism that consists of six items. Participants rated the extent to which they agreed with each item, such as "In uncertain times, I usually expect the best," on a 5-point scale, anchored at 0 (*Strongly Disagree*) and 4 (*Strongly Agree*). The Cronbach's alpha for the sample was .85.

Following these items, there were instructions in the packet that told participants to wait for instructions from the experimenter before moving on to the next section. The second section of the packet included an anagram task, followed by two questions that assessed participants' perceptions of goal attainment for the task.

Anagram Task. Once indicated to begin, participants started on the anagram task. This was the only part of the packet to differ among participants. Participants were randomly assigned to one of two experimental conditions depending on the instructions and accompanying format for the anagram task in their packets. Participants in the Process Goal Condition were instructed to go through the process of generating several different letter combinations for each anagram. Participants in the Outcome Goal Condition were instructed to solve the anagrams, focusing on finding the one correct solution for each one. Both conditions had the same 12 anagrams (Mattingly & Lewandowski, 2012) and eight minutes to work on the task. The anagrams were chosen for their hard difficulty level.

Perception of Goal Attainment. Following the anagram task, participants answered two researcher-created questions designed to assess their perceptions of goal attainment for the anagram task. Specifically, they rated the extent to which they believed they had met the goals in the given instructions, using a 5-point Likert scale ranging from "Not at all" to "Very Much*,*"

as well as their performance on the task, using a 5-point Likert scale ranging from "Poor" to "Excellent." The Cronbach's alpha for these two items was .93. After responding to these items, students were told they would be completing a pop quiz for their psychology class.

Academic Confidence. Participants were then asked to respond to three researcher-created items to assess their academic confidence with respect to the upcoming quiz. Specifically, they indicated how confident they felt about the quiz (5-point scale, ranging from "Not at all" to "Very Much"), how likely it was that they would perform well (scale of 1-5, where 1 indicates "Not at all" and 5 indicates "Extremely"), and what grade they expected themselves to earn (scale of 1-5, where 1 represents an "F" and 5 represents an "A"). These items were adopted from a previous study (Nelson & Knight, 2010). The Cronbach's alpha for the sample for these three items was .96.

Test Anxiety. Following the questions that assessed academic confidence, participants completed the Cognitive Test Anxiety Scale (Cassady & Johnson, 2001). This survey was used to assess whether participants' experimental condition affected their anxiety about the upcoming pop quiz. Participants indicated the extent to which they agreed with each item, using a 4-point Likert scale anchored at "Not at all like me" and "Very much like me." This scale was slightly modified to assess students' current feelings of test anxiety. The modified scale consisted of 20-items. The Cronbach's alpha for the sample was .93.

Pop Quiz. Finally, the pop quiz was distributed. It consisted of 10 multiple choice questions that covered material taught in an introductory psychology course. After completing the pop quiz, participants handed in their packets and pop quizzes together. At this point in time, they received a debriefing form.

RESULTS

The researchers hypothesized that students who adopted process goals for the anagram task would demonstrate higher levels of academic confidence, lower levels of test

anxiety, and higher quiz grades than students who adopted outcome goals. It was also hypothesized that these advantages would be particularly evident among FGCS. In order to test these hypotheses, a 2x2 between subjects ANOVA was conducted on academic confidence, quiz grade, and test anxiety with Student Classification (FGCS, Non-FGCS) and Goal Orientation Condition (Process, Outcome) as the test variables. The hypotheses were partially supported. Significant effects in the hypothesized direction were found for academic confidence and quiz grade, but not for test anxiety.

Academic Confidence. There was a significant interaction between Student Classification and Goal Orientation Condition, $F(1,63) = 4.16$, $p = .046$ (see Figure 1). In the Outcome Goal Condition, FGCS were significantly less confident about the quiz ($M = 1.67$, $SD = .82$) than Non-FGCS ($M = 2.73$, $SD = .94$), $F(1,63) = 11.64$, $p < .001$, $d = 1.20$. In the Process Goal Condition, however, FGCS displayed a level of confidence ($M = 3.13$, $SD = .87$) similar to that of Non-FGCS ($M = 3.29$, $SD = .92$), $F(1,63) = .251$, $p = .618$. The ANOVA also revealed a significant main effect of Goal Orientation Condition, $F(1,63) = 20.94$, $p < .001$. Overall, students in the Process Goal Condition had higher levels of academic confidence ($M = 3.23$, $SD = .89$) than students in the Outcome Goal Condition ($M = 2.21$, $SD = 1.02$). There was also a significant main effect of Student Classification, $F(1,63) = 7.58$, $p = .008$. Non-FGCS were more confident about the quiz ($M = 3.04$, $SD = .96$) than FGCS ($M = 2.32$, $SD = 1.11$).

Quiz Grade. There was a significant interaction between Student Classification and Goal Orientation Condition, $F(1,63) = 4.26$, $p = .043$ (see Figure 2). In the Outcome Goal Condition, FGCS scored significantly lower on the quiz ($M = 2.69$, $SD = 1.92$) than Non-FGCS ($M = 5.59$, $SD = 2.58$), $F(1,63) = 9.77$, $p < .003$, $d = 1.27$; however, in the Process Goal Condition, FGCS scored similarly ($M = 5.54$, $SD = 3.78$) to that of Non-FGCS ($M = 5.71$, $SD = 2.39$), $F(1,63) = .035$, $p = .852$. The ANOVA also revealed a significant main effect of Goal Orientation Condition, $F(1,63) = 5.08$,

$p = .028$. Overall, students in the Process Goal Condition scored higher on the quiz ($M = 5.65$, $SD = 2.94$) than students in the Outcome Goal Condition ($M = 4.18$, $SD = 2.69$). There was also a significant main effect of Student Classification, $F(1,63) = 5.43$, $p = .023$. Non-FGCS scored higher on the quiz ($M = 5.66$, $SD = 2.44$) than FGCS ($M = 3.97$, $SD = 3.19$).

Test Anxiety. The ANOVA revealed no significant effects of Student Classification or Goal Orientation Condition on test anxiety, $Fs < 1.35$, $ps > .250$.

Perception of Goal Attainment. The 2x2 ANOVA was also conducted on Perception of Goal Attainment. There was a significant main effect of Goal Orientation Condition, $F(1, 63) = 5.08$, $p = .028$, $d = .60$. Overall, students in the Process Goal Condition ($M = 2.48$, $SD = 1.28$) felt they had met the goals in the anagram task better than students in the Outcome Goal Condition ($M = 1.86$, $SD = .74$). No other effects were significant, $Fs < .77$, $ps > .384$.

Trait-like Variables. An independent *t*-test was conducted on grit and optimism. FGCS did not differ from Non-FGCS in levels of trait-like grit, ($M = 3.19$ vs. 3.21), $t(65) = -.073$, $p = .838$. FGCS did not differ from non-FGCS in levels of trait-like optimism, ($M = 2.27$ vs. 2.29), $t(64) = -.098$, $p = .778$.
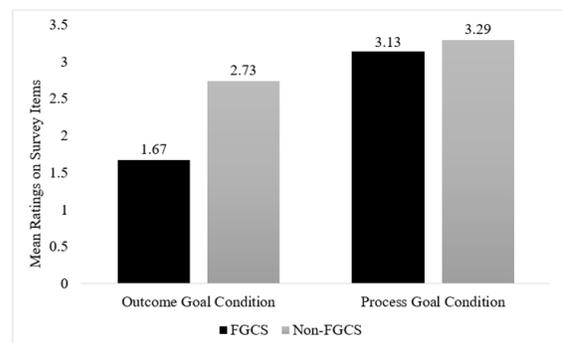

Figure 1. Academic Confidence as a Function of Student Classification and Goal Orientation Condition
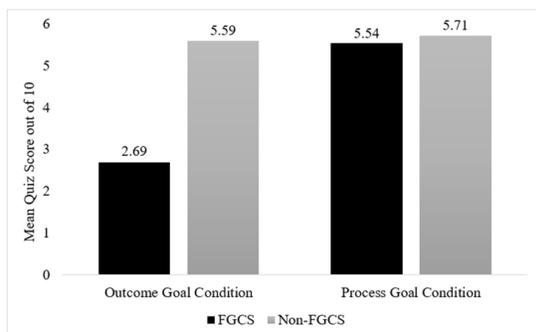
Figure 2. Quiz Grade as a Function of Student Classification and Goal Orientation Condition

DISCUSSION

We tested the effects of student classification and goal orientation on academic confidence, test anxiety, and quiz grade. Our hypotheses were partially supported. There were no significant effects for test anxiety; however, we did find significant effects for academic confidence and quiz grade. As expected, when adopting outcome goals, FGCS had lower confidence and performance compared to their non-FGCS peers; however, when adopting process goals, no differences emerged between the two student groups. Indeed, process goals elevated the confidence and quiz grades of FGCS to a level comparable to that of their peers. Our findings support studies that have found process (versus outcome) goals to provide advantages with respect to self-efficacy and performance (e.g., Zimmerman & Kitsantas, 1997, 1999). Our results also support previous research that suggests that FGCS are at an academic disadvantage compared to their counterparts (e.g., Atherton, 2014; Terenzini et al., 1996).

In conclusion, our findings contribute to the literature exploring mechanisms whereby college and universities can most effectively support FGCS (e.g., Gibbons et al., 2019; Pratt et al., 2019). We provide evidence that in addition to recommending student support services and other academic resources, teaching FGCS to adopt process rather than outcome goals for their academic work is a viable avenue for enhancing their confidence and performance.

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Silver Nanoparticle Biosynthesis and Calcite Biomineralization as a Precursor to Hydroxyapatite

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ABSTRACT

Antimicrobial hydroxyapatite (HA) offers preventive measure against surgical implant infection. Embedded silver nanoparticles (AgNP) represent one modification, but reliable synthetic strategies are relatively lacking. This study proposes a novel pathway to synthesize AgNP-doped HA using the fungus Fusarium oxysporum. This effort combines AgNP biosynthesis and calcite biomineralization for hydrothermal phosphatization to HA. Calcite biomineralization can be induced by urease positive fungi which catalyzes the hydrolysis of urea into ammonium and carbonate ions. These carbonate ions can bind to introduced calcium metal ions at the surface of the fungal hyphae to form calcite. Fungal quinones allow for the reduction of toxic silver ions in the environment to silver nanoparticles. Combining these two processes will result in silver nanoparticle doped calcite. Through the final step of this process, phosphatization, this product can be hydrothermally converted to hydroxyapatite that has retained the silver nanoparticles. X-ray diffraction and scanning electron microscopy enables confirmation of product and examination of AgNP-HA microstructure, where AgNP are expected to attach to the HA crystallite surfaces. The silver particles produced were not in the nanoscale dimensions, but energy dispersive spectroscopy confirmed successful binding of the silver particles to calcite in half of the test samples. Hydrothermal phosphatization to HA was unsuccessful in all samples. However, the fungal extraction technique used did not allow for a representative diffraction pattern for the samples that contained the largest amount of biomass. Additional extraction techniques will be explored in order to successfully separate the desired product from the fungal surface. Further effort will go into finding the optimum ratio of media to calcium chloride so that optimum fungal growth and calcite formation can be achieved. The second step of the pathway, the addition of calcium nitrate, will be eliminated and another phosphate source will be considered for phosphatization. This work investigates synthetic and analytical steps for production of safe and reliable implant materials.

Introduction

Surgical implants and grafts are suitable replacements for nearly all bones and bone-like material in the body. An ideal implant should endue the lifetime of the recipient, integrate to the bone environment, and resist infection. Unfortunately, 20% of implant failures are due to bacterial infection after implantation [1]. This issue can be mitigated if the implants are functionalized with antimicrobial material. The implant surface should inhibit the formation of bacteria biofilm and be present long-term via slow release. Studies have incorporated implant coatings with ions such as silver, copper, zinc, titanium, and strontium for their antimicrobial properties [2-5]. These coatings should also be able to favorably interact with osteogenic cells for integration with the bone matrix. Hydroxyapatite is a suitable material due to its ability to enhance bone formation and its capacity for ion substitution [6]. The incorporation of antimicrobial ions into

hydroxyapatite to be used for implant coatings can improve the odds of successful integration and decrease the chance of infection.

This project combines three known methods in order to synthesize silver nanoparticle doped hydroxyapatite. Calcite biomineralization can be induced by the formation of carbonate ions that react with calcium ions that are present in the environment. Fungi, bacteria, and algae are all bio-contributors to the precipitation of calcite in a natural setting [7]. The urease enzyme catalyzes the hydrolysis of urea into ammonium and carbonate ions [8]. These organisms can also be used to reduce toxic silver ions in the environment to silver nanoparticles. This process is mediated by fungal quinones in coupled reduction oxidation reactions [9]. Fungal nitrate reductase allows the silver ion reduction cycle to continue by reducing quinones to their original state [10].

Combining these two processes will result in silver nanoparticle doped calcite. Through the third method, phosphatization, this product can be hydrothermally converted to hydroxyapatite that has retained the silver nanoparticles [11]. *Fusarium oxysporum* was chosen as the biological contributor of this experiment because it is urease positive and it has been experimentally shown to reduce silver nanoparticles to an approximate size of 1nm [12]. This work proposes a novel pathway to synthesize silver nanoparticle doped-hydroxyapatite for use as a surgical implant coating.

1 Experimental
2.1 Media Preparation
Liquid media was prepared containing the following [9,13]: 4mM potassium phosphate dibasic trihydrate (Sigma-Aldrich 99%), 111mM dextrose anhydrous (Fisher), 0.2mM calcium chloride dihydrate (Sigma-Aldrich 99%), 2mM sodium chloride, 1.6×10^{-3}mM copper (II) sulfate pentahydrate, 1.4×10^{-2}mM zinc sulfate heptahydrate (Sigma 99.1%), 1.8×10^{-2}mM manganese sulfate monohydrate (Mallinckrodt100+%), 9×10^{-3}mM iron (III) chloride hexahydrate (Sigma-Aldrich 99%),

40mM urea (BDH), and 0.8mM magnesium sulfate heptahydrate (Fluka 99.5%).

The trace metals and salt solutions (not containing calcium chloride) were autoclaved, while the glucose, urea, and calcium chloride solutions were filter sterilized. Two 600mL stock solutions were made from a 2x solution of glucose, 10x solution of urea, 10x solution of trace metals, 10x solution of salts, and 10x solution of calcium chloride. The calcium chloride was added as the last step to avoid potential precipitation. The pH of the trace metal solution was 5.5, while the pH of the salt solution was 6.3.

2.2 Inoculation/Incubation
75mL of media was transferred to 8 sterile flasks. Using flame sterilization, a full loop of *F. oxysporum* (ATCC) 48112 culture was added to each flask. The flasks were incubated at 37°C for 72 hours and at 25°C for 24 hours all while shaking at 120rpm. The fungal growth was white and scarce.

2.3 Addition of Calcium Nitrate
Fungal biomass was filtered with Whatman filter paper, rinsed 3 times with deionized/sterile water, and resuspended in 75mL distilled H_2O within autoclaved flasks. Flasks were incubated for 72 hours on a shaker (120rpm). This process occurred for flasks C-A and C-B.

Fungal biomass was filtered with Whatman filter paper, rinsed 3 times with deionized/sterile water, and resuspended in 75mL of 20mM calcium nitrate within autoclaved flasks. Flasks were incubated for 72 hours on a shaker (120rpm). This process occurred for flasks 1-A, 2-A, and 3-A.

Fungal biomass was filtered with Whatman filter paper, rinsed 3 times with deionized/sterile water, and resuspended in media/calcium nitrate mix within autoclaved flasks. Flasks were incubated for 72 hours on a shaker (120rpm). This process occurred for flasks 1-B, 2-B, and 3-B.

2.4 Addition of Silver Nitrate
The fungal biomass of flasks C-A and C-B were filtered with Whatman filter paper, rinsed 3 times with deionized/sterile water, and resuspend in 75mL distilled H_2O within autoclaved flasks. Flasks were incubated for 72

hours at 37°C on a shaker (120rpm). Concentrations of silver nitrate were varied for each group [9].

The fungal biomass of the remaining flasks were filtered with Whatman filter paper, recorded pH of filtrate, and rinsed 3 times with deionized/sterile water. The biomass of flasks 1-A and 1-B were resuspended in 75mL of 1mM of silver nitrate (Sigma-Aldrich 99%). The biomass of flasks 2-A and 2-B were resuspended in 75mL of 5mM of silver nitrate. The biomass of flasks 3-A and 3-B were resuspended in 75mL of 10mM of silver nitrate. All flasks were covered with aluminum foil and incubated for 72 hours at 37°C on a shaker (120rpm). In all of the flasks, excluding the controls, the media turned dark brown. The control flasks remained colorless.

2.5 Extraction/Analysis

Samples of filtrate were taken for pH, UV-Vis, and DLS analysis. A small portion of hyphae was removed for SEM.

Fungal biomass was transferred to a 50mL centrifuge tubes and washed 6 times with an identical volume of 20% alcohol in de-ionized water. Calcite crystals were repeatedly washed with 20% alcohol and allowed to dry.

2.6 Phosphatization

The synthesized calcite and phosphate source were combined in a 5:3 ratio. The solution was transferred to a 50mL beaker. Approximately 10g deionized water was added and allowed to stir on a hot plate while the pH was recorded. The solution was cloudy and white. The solution was transferred to a 23mL Teflon container and autoclaved for 24 hours at 200°C. The samples were centrifuged and washed 3 times, twice with distilled water and once with ethanol. They were then analyzed with X-ray diffraction and SEM.

2 Results and Discussion
3.1 Fungal Growth

After the second growth phase, the fungus grown in each sample was massed on an analytical balance. Group B, which received medium during the second growth phase, contained the greatest amount of fungal biomass. These masses were significantly greater than Group A, which only received calcium

nitrate during the second growth phase. Sample 3A had the least amount of biomass while Sample 2B had the greatest amount of fungal biomass. The fungal biomass was recorded for each sample and is shown below in Figure 1.

Figure 1. Fungal Biomass after Second Growth Phase
*Note that the samples that did not receive media are marked by a darker color

3.2 Silver Reduction

Silver nitrate was added at concentrations of 1, 5, and 10mM. Silver reduction was evident with a yellow color change. All test samples demonstrated this color change, with the greatest change occurring with the addition of 5mM of silver nitrate. This color change indicates that silver nitrate reduction was greatest when the fungal biomass was the greatest and at 5mM. No color change was present in the control. Figure 2 is shown below.

Figure 2. Color Change after Addition of Silver Nitrate

3.3 SEM Imaging and Elemental Analysis

The fungal samples were prepared on stubs with carbon tape and visualized using a scanning electron microscope. Figure 3 demonstrates calcite formation and silver particles present on fungal hyphae. The silver particles detected were no less than 1um in size,

which indicates that nanoparticles were not stabilized. Figure 4 demonstrates calcite formation with embedded silver particles.

Figure 3. SEM of Calcite Formation and Silver Particles

Figure 4. SEM of Calcite Embedded with Silver

Elemental analysis was used to confirm the composition of the synthesized materials. Significant amounts of calcium, carbon, and oxygen in the ration of 1:1:3 confirmed the presence of calcite formation. The presence of silver was confirmed due to being present in greater amounts than the other trace metals. The elemental analysis tables are shown in Figure 5. The presence 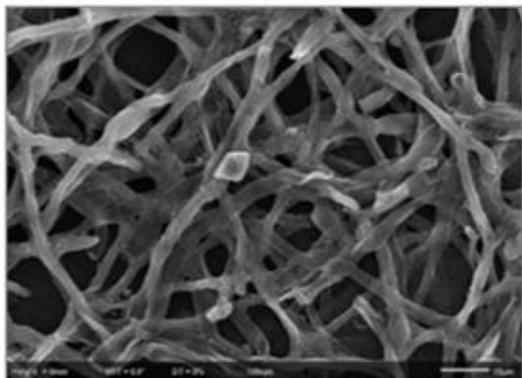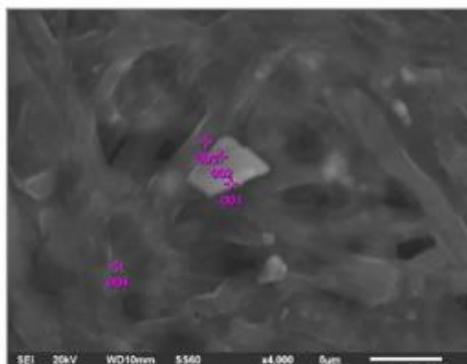of both calcite and silver were confirmed with elemental analysis, due to significant amount of silver and calcium present, and is shown in Figure 6.

Formula	mass%	Atom%	Sigma	Net	K ratio	Line
C	18.64	29.18	0.01	105902	0.0497603	K
O	47.75	56.12	0.07	188917	0.3014610	K
Ca	30.77	14.43	0.04	1202283	1.0819262	K
Au	2.84	0.27	0.04	55932	0.0674189	M
Total	100.00	100.00				

Formula	mass%	Atom%	Sigma	Net	K ratio	Line
C	71.65	80.97	0.02	519411	0.2705700	K
O	21.34	18.11	0.06	69113	0.1222672	K
Na	0.12	0.07	0.01	2493	0.0023485	K
P	0.43	0.19	0.01	15904	0.0139374	K
Cu	0.24	0.05	0.02	1781	0.0065921	K
Ag	3.26	0.41	0.03	72205	0.0880885	L
Au	2.97	0.20	0.04	55779	0.0745387	M
Total	100.00	100.00				

Figure 5. Elemental Analysis of Calcite (left) and Silver Particles (right)

Formula	mass%	Atom%	Sigma	Net	K ratio	Line
C	38.38	52.40	0.02	246509	0.1223231	K
O	39.99	40.99	0.06	185722	0.3129835	K
Na	0.31	0.22	0.01	6451	0.0057903	K
Al	0.22	0.13	0.01	9357	0.0050608	K
Cl	0.31	0.14	0.01	13955	0.0111591	K
Ca	12.77	5.23	0.03	520656	0.4948116	K
Ag	3.34	0.51	0.03	87928	0.1021851	L
Au	4.68	0.39	0.04	101142	0.1287502	M
Total	100.00	100.00				

Figure 6. Elemental Analysis of Calcite Embedded with Silver

The elemental analysis findings are summarized in Table 1. Every sample was positive for calcite and silver particles. Samples 1A, 2B, and 3A tested positive for calcite embedded with silver particles. This finding indicates that the third step in the pathway was successful. Calcite was present in both control samples. This is due to calcium chloride being used a starting material in the growth medium. Although unexpected, this finding confirms that the second growth phase can be skipped if a calcium source is used during the initial growth phase.

Table 1. Detection of Calcite and Silver Particles in Elemental Analysis		
	Calcite	Silver Particles
Control A	✓	X
Control B	✓	X
1A	✓	✓
1B	✓	✓
2A	✓	✓
2B	✓	✓
3A	✓	✓
3B	✓	✓

3.4 Phosphatization

The final products of phosphatization were analyzed using x-ray diffraction to

determine if hydroxyapatite conversion was successful. None of the samples were converted to the hydroxyapatite product. Sample 1B, shown in Figure 7, underwent the most significant change, being converted to calcium hydroxide and silver phosphate. The diffraction pattern of Sample 2B, shown in Figure 8, showed evidence of only silver being present. This anomaly can be accounted for by the fact that sample 2B had the greatest fungal biomass. Silver coated the fungal hyphae, and because the calcite was not extracted from the fungus, the amount of silver masked the signals of other materials present. The greatest obstacle to conversion of calcite to hydroxyapatite was the extraction of calcite from fungus.
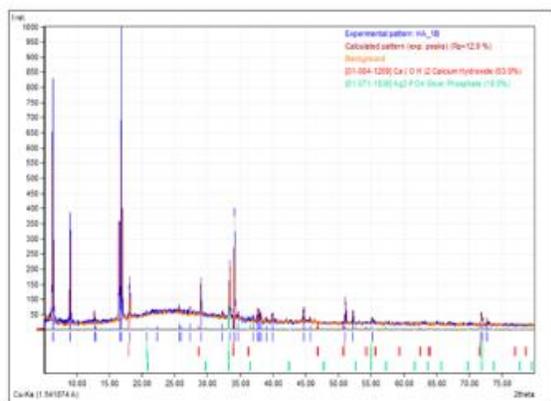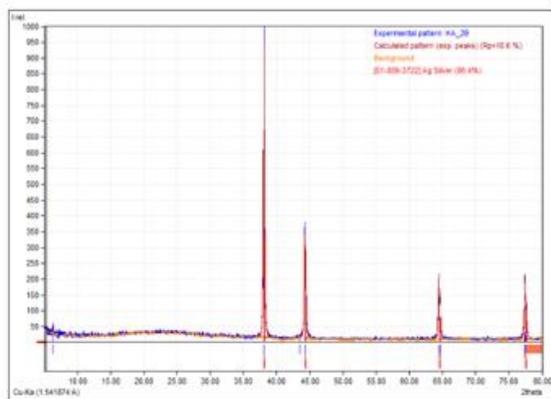

Figure 7. Diffraction Pattern of 1B

Figure 8. Diffraction Pattern of 2B

3   Conclusion

Greatest fungal mass was obtained using calcium nitrate media mix. The increase in biomass confirms that media should be incorporated when any chemical is added during the process. Both controls were positive for calcite due to the use of calcium chloride as one of the trace metals in the media. There was evidence of combined calcite and silver particle formations in half of the test samples, which indicates that the third step of the pathway was fulfilled. Phosphatization was unsuccessful for conversion to hydroxyapatite in all samples. The unsuccessful conversion is most likely due to the fungus being attached to the calcite surfaces which would not allow for full contact with the phosphate. The extraction technique also did not allow for a representative diffraction pattern for the samples that contained the largest amount of biomass. Due to the silver particle aggregation, nanoparticle dimensions were not stabilized, and the filtrate could not be used for dynamic light scattering. Moving forward, an alternative extraction technique must be considered. Further effort will go into finding the optimum ratio of media to calcium chloride so that optimum fungal growth and calcite formation can be achieved. The second step of the pathway will be eliminated, and another phosphate source will be considered for phosphatization.

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Marijuana in the American Political Landscape

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Adolphus G. Belk, Jr., Ph.D. (Mentor)

INTRODUCTION

In 1936, the courtroom was no place for a parent, just as the defendant oftentimes is not a child. Before beginning the trial that would determine his fate, high school student Bill was a well to do, all-American boy. He did well in school, played sports, was popular, and was in a relationship with a joyous girl named Mary. Bill was taking a ride with his friend Jimmy to a diner across town when a mysterious man in a lavish, bright purple suit approached them. He asked for a ride back to his home and invited the boys upstairs, where they met a promiscuous neighborhood woman and a mindless college dropout who were under the influence of a novel, euphoric drug. Both Bill and Jimmy immediately enjoyed the rush that the neon colored substance gave them, and they began to frequent the lavish man's house. There, the drug took over their mental state, encouraging Jimmy to drive recklessly and injure someone in a hit and run while Bill began to engage in lewd acts outside of his relationship. Bill invites Mary, his girlfriend, to the mysterious man's house. She would be tricked into ingesting the drug, sexually assaulted, and mistakenly shot by the drug supplier who would frame an intoxicated Bill for the heinous crime. Bill, the wayward boy in the 1936 movie *Reefer Madness,* and all of his friends were under the influence of marijuana – "a violent narcotic, an unspeakable scourge, the real public enemy number one" (*Reefer Madness).*

Less than a century after the release of '*Reefer Madness,'* the "public enemy number one" is now legal for recreational and medicinal use in eleven U.S states and Washington, D.C. Despite this shift offering evidence of change, marijuana legalization is still a hot button issue due to debates over its medicinal harms and benefits, its illegality as a schedule one drug, its social reputation for promoting "subpar citizenship," and its ability to yield consistently high profits. Even with the number of recreational users increasing, more states legalizing/decriminalizing use and possession, and marijuana policy reform being repeatedly discussed by major political pundits, the American federal government consistently fails to create effective marijuana policy because modern day legislators still share and promote the traditional views that informed early, harsh anti-drug initiatives. These ideals are disseminated across pockets of the American population in the form of stereotypes, negative judgement of marijuana users, harsh anti-drug policy that prioritizes coercive, racially motivated punitive efforts, and the inability of the public to access accurate information about marijuana. American marijuana policy should reflect newly adapted convictions that move towards a decriminalized, regulated state that benefits the American people and the economy.

This study aims to provide clarity into the marijuana policy debate by incorporating the feelings of Americans into the policy process. After decades of failing to meet drug policy goals and racially driven coercive measures, it is evident that the federal government needs to create an alternate route in drafting, implementing, and enforcing marijuana policy. As a democratic society, the most important step in changing policy is engaging the public in the policy process. To begin the process of identifying marijuana policy flaws in the eyes of constituents, this study will utilize two surveys intended to measure different aspects of the marijuana policy debate. First, we will aim to provide support for long-standing relationships between political party and feelings towards marijuana. Furthermore, we will measure the American federal government's ability to gain the trust of the people in its dealings in marijuana and general marijuana knowledge. This study will also compare differences in two temperaments heavily involved in political thought processes between marijuana users and nonusers. The findings of this study, in

conjunction with an analysis of previous literature, will be used to shed light on different avenues policymakers can utilize to mobilize the marijuana industry, its users, and the general public as active participants in the American political system.

Background

The first record of marijuana legislation comes from the 1619 Virginia Assembly, which passed a bill requiring every farmer to grow hemp since it could be used as legal tender in Virginia, Maryland, and Pennsylvania. Hemp production played a significant role in the colonial economy until it was replaced by other products after the American Civil War, but marijuana (the dried, shredded flowers from the hemp plant) regained popularity in the nineteenth century as it began being used in medicine and could be bought over the counter at many pharmacies in the United States. The over the counter sale of marijuana was regulated by the 1906 Pure Food and Drug Act which required all products with cannabis in them to be clearly labeled (Marijuana Timeline).

At the conclusion of the Mexican Revolution in 1910, Mexican immigrants who moved to the United States were negatively stereotyped based on their assumed associations with marijuana. Mexican people had been using hallucinogenic drugs for some time, and it took up a negative connotation when the Spanish associated it with being one with the devil and state of insanity: "Cannabis came to gain this reputation in the 19th century, when it starts to appear as a recreational substance that's smoked in cigarettes and is overwhelmingly concentrated in some of Mexico's most marginal environments – prisons and soldiers' barracks… so you have this drug that's kind of associated with danger and indigenous Mexico, then in these environments associated with violence and danger" (Waxman 2019).

Cannabis use quickly became associated with Mexican immigrants, worsening the existing prejudice many Americans already harbored towards the marginalized group: "Marijuana Menace" ads began to appear that implied a relationship between Mexican immigrants, marijuana use, and a rise in violent crimes. These sentiments pushed the United States into a decade full of fearing the recreational drug. The record unemployment numbers of the Great Depression further increased sentiments towards Mexican immigrants and their association with marijuana. The increasing concern caught the attention of the federal government, which immediately poured funding into research that suggested a link between the drug, violent behaviors, and frequent use amongst minority communities (PBS 1998). The Federal Bureau of Narcotics, founded in 1930, urged states to adopt the Uniform State Narcotic Act in 1932 due to its rising popularity and research findings that link use to social deviance. Between these two years, twenty-nine states would pass votes to outlaw marijuana.

One year after the debut of "*Reefer Madness*," a staple in the then nationwide campaign against "evil weed," the Marijuana Tax Act was passed. This act criminalized the possession of marijuana at the federal level, deemed its class as severe as heroin, and imposed a tax on marijuana purchases for certain medical conditions (PBS 1998). Despite the sentiments against marijuana, World War II would re-popularize hemp through the "Hemp for Victory" campaign, where farmers were highly encouraged to grow hemp as other materials needed to make supplies for soldiers grew scarce. Although hemp had again found a place in American culture, the recreational use of marijuana was becoming more scandalous. By 1956, mandatory sentencing for all drug possession including marijuana had become federal law, with a first-time possession charge resulting in a minimum sentence of 2-10 years and up to $20,000 in fines (PBS 1998).

Marijuana began rebuilding its recreational reputation during the 1960s as its use became popular among otherwise outstanding citizens (the white upper middle class). Both President John F. Kennedy and Lyndon B. Johnson commissioned research committees to further investigate marijuana, under which the presidential committees released reports stating that marijuana use had no connections with inducing violent behavior or "graduating" to harder drugs (PBS 1998).

The questioning of marijuana policy throughout the 60s, in conjunction with federally commissioned reports and a changing socio-political climate, led to Congress repealing a majority of mandatory drug penalties in 1970. The Comprehensive Drug Abuse Prevention and Control Act differentiated marijuana from other illegal substances and removed mandatory minimum penalties and sentencing for people caught in possession of small amounts (PBS 1998). The election of Richard Nixon as president would lead to the 1972 creation of the Shafer commission, which was tasked with the creation and regulation of federal drug laws. After suggesting that personal use of marijuana should be decriminalized, President Nixon rejected the idea.

Despite this federal obstacle, eleven states would successfully vote to decriminalize marijuana with other states reducing their marijuana penalties (PBS 1998). In 1974, the first official marijuana magazine made its debut. "High Times," initially popular for its detailed pictures of budding marijuana plants, paraphernalia, and encouraging the de-stigmatization of marijuana, is also credited with bringing to light "the way so many lives have been destroyed by an inept and misguided war on drugs" (Garner). "High Times" was especially popular among late adolescents, and its then bold claims about the harmlessness of marijuana were countered in 1976 by a nationwide parent movement targeting the legality and morality of marijuana. This movement is considered successful, and with help from the Drug Enforcement Administration and the National Institute on Drug Abuse, the infamous 1980's War on Drugs had found its roots (PBS 1998).
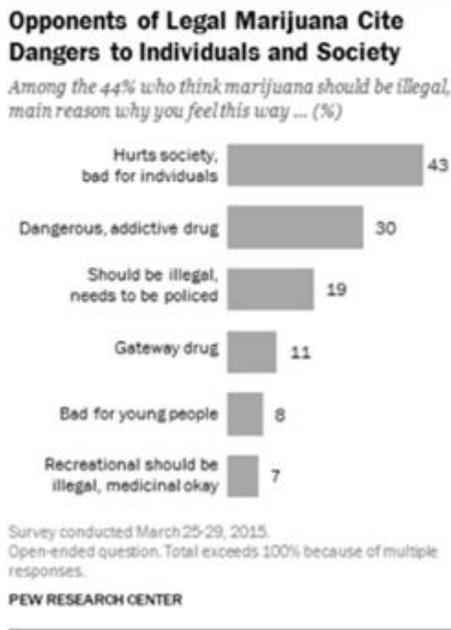
The War on Drugs had been recognized, and President Ronald Reagan's signing of the 1986 Anti-Drug Abuse Act federally re-associated marijuana use with violent crime and social deviance, working in tandem with the Comprehensive Crime Control Act passed two years earlier, and re-established mandatory sentencing for marijuana use and possession (PBS 1998). Marijuana penalties would now be determined by the amount of the drug involved, causing one hundred marijuana plants to result in the same penalty as being in possession of one hundred grams of heroin. The infamous "three strikes" policy would later be added to the ADA Act of 1986, which allowed for leaders of drug organizations to face the death penalty and for repeat offenders to face life sentences (PBS 1998). Although President George H.W. Bush declared a new War on Drugs during a televised speech in 1989, individual states continued to push policies that were in contention with federal law regarding marijuana. In 1996, California voters passed Proposition 215, allowing the sale and use of marijuana to terminally ill patients and those with serious, painful diseases (PBS 1998).

Since 1996, marijuana use and policy has been widely contested and supported, oftentimes with evidence from one side directly refuting evidence from the other. With arguments for and against the legalization of marijuana, including its effect on the economy, society, race relations, and educational attainment, the modern American constituency is still somewhat divided on the hallucinogen. A Pew Research Study in 2019 reports that 67% of Americans support the legalization of marijuana with 32% opposed – this is in comparison to 63% of Americans opposing legalization in 2000. Seventy-eight percent of Democrats and Democratic leaning independents support legalization, whereas only 55% of Republicans and Republican leaning independents feel similarly. By generation, a majority of Millennials (76%), Generation X (65%), and Baby Boomers (63%) support legalization. 64% of the silent generation, those who were children during the 'Reefer Madness' decade, oppose legalizing marijuana (Pew Research Center). An analysis of the interaction between generation and party suggests that millennial Republicans support the legalization of marijuana (71%) almost as much as Millennial Democrats (78%). Republicans in Generation X show 55% in favor, Baby Boomer Republicans show 49%, and roughly three-quarters of Silent Generation Republicans oppose legalization (76%) (Pew Research Center 2019).
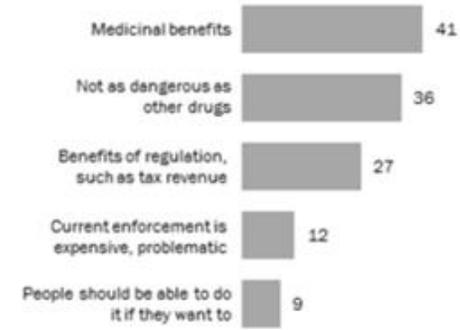
In a separate survey using a different sample, Pew Research Center also finds that as of 2019, 68% of men support legalization

compared to 64% of women. Race comparisons show that 69% of whites, 67% of blacks, and 63% of Hispanics are in support of legalization. Thirty-two percent of Americans are only in support of medicinal legalization. 68% of Democrats are in support of total legalization versus 49% of Republicans, with Republicans being 10% more likely than Democrats to only support medicinal legalization (38%; 28%). An age analysis suggests that the younger the person, the more likely one is to support legalization for recreational and medicinal purposes (Pew Research Center 2019). In a 2015 PEW study entitled, *Opponents and Supporters of Legal Marijuana Cite Dangers and Benefits*, reasons for support towards or opposition of legalization varied. Reasons for opposition or support can be seen in the graphs below:

Opponents of Legal Marijuana Cite Dangers to Individuals and Society

Among the 44% who think marijuana should be illegal, main reason why you feel this way ... (%)

Reason	%
Hurts society, bad for individuals	43
Dangerous, addictive drug	30
Should be illegal, needs to be policed	19
Gateway drug	11
Bad for young people	8
Recreational should be illegal, medicinal okay	7

Survey conducted March 25-29, 2015.
Open-ended question. Total exceeds 100% because of multiple responses.

PEW RESEARCH CENTER

Many Supporters of Legalization Cite Marijuana's Health Benefits

Among the 53% who think marijuana should be legal, main reason why you feel this way ... (%)

Reason	%
Medicinal benefits	41
Not as dangerous as other drugs	36
Benefits of regulation, such as tax revenue	27
Current enforcement is expensive, problematic	12
People should be able to do it if they want to	9

Survey conducted March 25-29, 2015.
Open-ended question. Total exceeds 100% because of multiple responses.

PEW RESEARCH CENTER

Pew Research Center 2015, Opponents and Supporters of Legal Marijuana Cite Dangers and Benefits.

Increasing support for legalization amongst Americans and the actual legalization of marijuana has brought another question to the forefront: how should the Federal government respond to individual states' legalizing marijuana? In every case the law of the land prevails, but according to a 2015 Pew Research Center study, 59% of Americans believe that states who have legalized marijuana should be subject to federal law enforcement or penalty. Fifty-four percent of Republicans and 58% of Democrats specifically oppose the enforcement of federal marijuana law over state law. Another 2015 study has shown that 72% of Americans believe that enforcing federal marijuana laws are economically costly to the country. This sentiment is echoed when views are analyzed by party, as 78% of Independents, 71% of Democrats, and 67% of Republicans believe marijuana laws are financially egregious (Pew Research Center).

Another important factor in the legalization debate involves morality and societal concerns of widespread usage. As of 2018, 65% of Americans believe that it is morally sound to use marijuana versus 35% who do not. Religiosity is a consistently important factor in all aspects of American life, with 74%

of non-church goers believing marijuana is morally acceptable compared to just 41% of church-going Americans (Jones 2020). Young adults, ideological liberals, and ideological moderates view the morality of marijuana on the same morality level as alcohol usage. Ideological conservatives are more likely to believe alcohol is less immoral (75%) than marijuana use (47%) (Jones 2020).

Although a majority of Americans support the legalization of marijuana, 51% of Americans surveyed in 2013 reported that they would feel uncomfortable if marijuana was used around them, with people aged sixty-five and older being twice as likely to be uncomfortable (74%) than those aged thirty and below (35%). Women are more likely to feel uncomfortable in the presence of marijuana than men (57%; 44%) (Pew Research Center, 2019). Some of this discomfort can be explained by examining the reasons behind opposition. According to a Gallup poll, 79% of Americans who oppose legalization believe it will increase intoxicated driving and car accidents. 69% still believe marijuana use will lead to other drugs, with 62% fearing an overall increase in usage. 54% of people believe marijuana causes detriments to one's health (Jones 2020).

Despite changing marijuana culture, one archetype that has been a prominent feature of both sides is that of the stoner stereotype. From speculating childhood favorite cartoon characters were under the influence (i.e, 'Shaggy' from *Scooby Doo)* to modern day TV such as '*Mac and Devin Go to High School*,' there have been many portrayals of marijuana users' interactions with society and others. A 2019 study that assessed descriptors of people who are thought to use marijuana found strong associations with the words 'irresponsible,' 'lazy,' 'sick,' and 'black.' The same study found weak associations with marijuana use and the words 'healthy,' 'elderly' and 'opportunistic' (Mikos and Kam 2019). Marijuana users are also thought to be more likely to drop out of school (Rogers 2018). "Cannabis advocates are pushing to dispel the idea that people who toke up still live on the couches in their parents' basements and spend their waking hours eating Cheetos and playing video games" (Rogers 2018).

Despite the attempts by cannabis advocates, some scientific research is producing evidence that seems to substantiate the claims of the stereotypical stoner. Researchers have spent a great deal of time investigating the effects of marijuana's hallucinogenic ingredient: delta nine tetrahydrocannabinol (THC). Overall, THC "acutely impairs learning, produces psychosis like effects, and increases anxiety" among frequent users (Curran et al. 2016). Adapting the long-standing belief that physiological processes affect outward behavior, many researchers suggest that frequent use of marijuana negatively interferes with eCBs – the human body's natural lipid system that manages motivation, learning and memory, emotional regulation, and reward. Marijuana users are at a much higher risk of developing amotivational syndrome. Amotivational syndrome, characterized by lacking the motivation to complete tasks, go to work, insincerity about the future, and overall lower self-efficacy, occurs due to repeated compromise of eCBs (Curran et al. 2016).

In addition to this amotivational syndrome perpetuating the stoner archetype, frequent marijuana use has also been shown to significantly alter the composition of the medio-temporal lobe. Specifically, the amygdala, which is essential in anger management and expression, shrinks with prolonged usage (Lorenzetti et al. 2015). Cannabis withdrawals can also damage physiological function in the brain, with symptoms including irritability, headaches, emotional distress, irregular sleeping patterns, and permanent alterations to brain structure (Currant et al. 2016). These alterations appear in the acute effects of ingesting marijuana (what gives the feeling of being high), but are prolonged after the drug wears off. Cognition deficits are an important acute effect. Curran et al. write that "cannabis-induced deficits in working memory are seen more in the ability to manipulate information while it is 'online' (i.e. mental arithmetic) than in the ability to simply retain information for brief periods of time (i.e. remembering a telephone number before dialing it" (2016).

LITERATURE REVIEW

The primary goal of general anti-drug policy is to reduce the number of drugs produced, sold, and trafficked into and/out of any area, and to decrease the number of severe drug users. According to the Institute for Policy Studies, an analysis of U.S drug policy shows a history of exacerbating race relations for political gain (2014). Both domestic and international initiatives champion the use of coercive methods, and include using military violence overseas to destroy coca, opium, and cannabis plants. At home, state and local governments used federal funds to enact violent police operations against drug users – who oftentimes had never committed a violent crime themselves (Institute for Policy Studies 2014). In addition to consistently failing to meet drug policy goals, "exploitation of exaggerated fears of drug users and drug traffickers – usually depicted as racial minorities and foreigners – has always been a staple of those promoting tough antinarcotics measures" (Institute for Policy Studies 2014).

The first attempt at anti-drug policy in the United States came out of San Francisco in 1875, which forbade and penalized smoking opium. Chinese immigrants were portrayed as the vessel for the drug into America, and this was used as political ammunition as white immigrants competed with them for jobs and other resources (Institute for Policy Studies 2014). After the Shanghai Opium Commission of 1909 highlighted key faults in American drug policy, the Harrison Narcotics Act of 1914 aimed to strengthen domestic narcotics control. However, this expansion of federal power would cause contention amongst the Southern, conservative members of Congress. To gain their support, Congressmen exploited poor race relations by painting the drug addicted Negroe as nemesis – raping white women, robbing local stores, and inciting other acts of violence (Institute for Policy Studies 2014).

The Institute also cites that "Enactment of the 1937 Marijuana Tax Act was a reprise by whites seeking economic advantage, here against Mexican workers in competition for agricultural jobs during the Great Depression. The press carried sensational (but false) stories of marijuana-caused violence by Mexicans…" (2014). The late 1960s saw a significant increase in recreational drug use among white protesters, the poor and working classes, and even abroad in the U.S. Armed Forces. Then New York governor Nelson Rockefeller publicly and harshly supported harsh sentencing for drug offenders, and President Nixon would begin the infamous "War on Drugs." Despite the substance of his policies focusing on rehabilitation and treatment for drug addicts, his public use of militant language against offenders is what carried through to modern drug legislation, resulting in the following picture of the War on Drugs:

> Washington's war on drugs has not achieved its stated goals of reducing either the quantity of drugs or the level of drug consumption in the U.S., as evidenced by the fact that addicts and more casual consumers spend between $40 and $50 billion a year on illegal drugs. Instead, both sides of the drug equation—drug trafficking and drug enforcement—have become extraordinarily lucrative industries, providing both licit and illicit incomes to criminal syndicates, corporations, politicians, and law enforcement bodies in the U.S. and abroad (Institute for Policy Studies 2014).

Another stark difference between American marijuana policy and that of other nations is that it still relies on poor race relations as a promotion tool (Winterbourne 2012, 1). National survey data paints a different picture than the one by the War on Drugs: after randomly analyzing drug tests of major corporations' employees, it was found that consistent marijuana use over one's lifetime was lower in Hispanic and African-American employees than their white counterparts. Also refuting the popular belief that minority children are more likely to engage in adolescent marijuana use, "Survey data gathered from American students in 7th through 12th grade display lower usage of both licit and illicit drugs in the African American students, as well as lower rates of marijuana use in the Hispanic populations compared to white students for

almost every year since 1975" (Winterbourne 2012, 3).

Despite these findings and others similar to it, an analysis of police enforcing marijuana policy shows that there is a strong implicit bias towards minority communities. Winterbourne reports that:

> Instances of prejudiced police action, such as those discovered by Andrew Golub in his analysis of New York City's police records—where African Americans comprised 51% of traffic stops despite only comprising 26% of the population—further display the bias plaguing police efforts. Similarly, Maryland police records of stop searches show that 70% of those stopped are African American, while this ethnicity only accounts for 17% of drivers in Maryland (2012, 6).

Both African Americans and Hispanics are more likely to be subject to racially biased court proceedings as a result of the long-term race drug association. Minority groups, when compared to whites, have significantly increased rates of pre-trial incarceration, lack of proper defense, immediate job loss, conviction rates, and overall punishment severity (Winterbourne 2012, 4). In addition to this, the gradual intensification of the War on Drugs has had significant effects on anti-drug policy that are evident today. The United States has been responsible for jailing more people than China, Russia, Iran, and Cuba – all countries that America has considered oppressive throughout history. This is because the U.S. African-American and Hispanic prison population grew over 900% - from 200,000 to 2 million – when judges in states such as New York were forced to handout harsh sentences for low-level drug crimes. Of 1.5 million drug arrests in 2014, 80% were for possession only – half of this being marijuana (Drug Policy Alliance 2020).

Additional policy analysis suggests that current drug laws are egregiously costly to the U.S. economy. Annually, the United States spends between $26 and $58 billion dollars including costs for incarcerating drug offenders and methods to enforce drug laws (Winterbourne 2012, 2). Not included in these costs are drug education programs and the maintenance of treatment facilities. Despite these significant efforts, the goals of U.S. drug policy have yet to be made. Winterbourne states that "it becomes clear that America is dumping money into a system which has failed to display any significant deterrence or reduction in illegal drug use by either the country's youth or adult populations" (2012, 2).

METHOD
Participants

This study utilized two separate surveys (a preliminary and general survey) and samples. For both studies, participants were recruited on a college campus and through social media. Incomplete survey data was deleted based on the progress report generated by Qualtrics. Incomplete surveys were considered those with less than ninety percent progress out of one hundred. Participants from the preliminary study were comprised of 21 men, 66 women, and 2 gender nonbinary people ($N = 89$). Approximately 58% of this sample identified as Caucasian, 33%, as African American, 8.9% as other. Eighty-eight percent of participants were between the ages of 18 and 30, 2.2% 31-42, 4.5% 43-54, and 4.5% 55-64. Fifty-eight percent of participants identified as Democrats, 7.9% Republican, 15.7% Independent, and 18% expressed other political affiliations. Of this sample, 28.1% of people had used marijuana or cannabis within the past 30 days and 71.9% did not.

Participants from the second study were comprised of 35 men, 99 women, and 3 gender nonbinary people ($N = 137$). Approximately 56% of this sample identified as Caucasian, 27.2% as African-American, 11% Hispanic, and 5.8% as other. Ninety-seven percent of participants were between the ages of 18 and 30, with 3.1% aged 31 and over. Fifty-eight percent of participants self-identified as Democrats, 13.1% Republican, 15.3% Independent, and 13.1% expressed other political affiliations. Of this sample, 28.1% of participants had used marijuana or cannabis within the past thirty days, and 71.9% did not. All participants encountered the same survey for their sample on an online system.

Materials and Procedures

Both surveys were administered through an online platform. The first survey was comprised of 43 questions. To assess participants' political ideologies, we created an additional scale. We took 9 platform items from the Democratic National Convention (Democrats.org) and 9 platform items from the Republican National Convention (GOP.com). A sample Democratic item was "People who make more money should pay more in taxes," and a sample Republican item was "Planned Parenthood does more harm than good." Following each statement, participants rated their level of agreement on a 5-point Likert scale, where 1 represented "Strongly Disagree" and 5 represented "Strongly Agree." Participants were asked to self-identify with their political party as well.

Next, participants encountered researcher-created questions that were based on heavily researched perceptions of marijuana and those who use it from the Pew Research Center. Sample items include "Marijuana users have difficulties handling and expressing their emotions." In addition to general perceptions, we also asked questions about the perceptions of government regulation of marijuana. A sample item from this topic includes "The federal government puts too much energy into enforcing marijuana laws instead of more pressing issues." Participants responded to these prompts on a 5-point Likert scale. Finally, participants who took the first survey answered demographic questions relating to age, race, gender, political affiliation, and frequency of marijuana use.

The second survey was comprised of sixty-two questions. First, participants answered a brief ten question quiz on marijuana and marijuana policy taken from two pre-published quizzes used in previous research articles (The Christian Science Monitor 2011; Miller et. al. 2017). Sample questions include, "Which state was the first to decriminalize possession of marijuana?" and "Which of the following tests for marijuana use can detect use for up to 90 days later?" Participants chose from multiple choice answers for all ten questions. Following the quiz, participants encountered a trust in government scale originally published to measure how much Americans trust different government agencies (Grimmelikhuijsen et al. 2015). This scale was researcher-adapted to measure how much Americans trust government in its specific dealings with marijuana and marijuana policy. Sample items include, "If I needed to access marijuana for medical purposes, I would trust the federal government's process to obtain it" and "The federal government provides accurate information to the public about the benefits and risks of marijuana." Responses were recorded on a 5-point Likert scale.

Following this, participants encountered the twenty-one question Tromso Social Intelligence Scale (Silvera et al. 2001). This scale was researcher-adapted to measure socio-political awareness and intelligence (how people navigate political discussions, manage disruptive political feelings, and engage in political conversations) between marijuana users and nonusers. Sample items include, "I have a hard time getting along with people whose political beliefs differ from my own" and "I can often understand what others really mean through their expression, body language, etc." Answers were recorded on a 5-point Likert scale. Next, participants encountered a ten question, pre-published scale measuring the ability to handle and regulate emotions (Gross et al. 2003). Sample items include "When I am feeling positive emotion, I change the way I'm thinking about the situation" and "I control my emotions by not expressing them." A 5-point Likert scale was used to record responses. Finally, participants answered demographics questions relating to educational attainment, GPA (if applicable), political affiliation, age, race, gender, and frequency of marijuana use.

STUDY 1 RESULTS AND DISCUSSION

Please reference the following scoring table for information about how the scales were computed.

Scale Name	Minimum Score	Maximum Score	Constructs Measured
Party Platform Scale	9	38	Lower scores indicate more identification with DNC. Higher scores indicate more identification with RNC.
General Feelings towards Marijuana	9	30	Higher scores indicate more negative feelings towards general marijuana.
Perceptions of Marijuana Users	31	55	Higher scores indicate more negative bias towards those who use marijuana.

Study 1 aimed to identify some general feelings of marijuana, those who use it, and political affiliation. Total opposition for legalization in this sample is, thus, our sample is not completely representative of the Gallup poll's reported 60% of adults being in favor of legalizing marijuana, and instead reflects a population heavily in opposition. This may be because participants in this survey were heavily condensed in the Southern United States - a strong, consistent Republican block that was mobilized most notably by Reagan's War on Drugs. These anti-drug sentiments are still present in the South, which could cause our sample to deviate from the national average.

In general, the more people opposed marijuana positively correlated with perceiving users in a negative light, $r(89) = .244$, $p = .021$. Specifically, the more participants identified with the DNC platform, the less negatively they felt about marijuana in general, $r(89) = -.530$, $p < .001$, which is consistent with the Democratic party being led by numerous pro-legalization politicians. An inverse relationship proved significant with Republicans, $r(89) = .494$, $p < .001$. There was a significant difference between people who had used cannabis within the past thirty days and those who had not in terms of general feelings towards marijuana, $t(87) = -3.521$, $p = .001$. There was also a significant difference between the two groups in the likelihood of perceiving marijuana users in a negative light, $t(87) = -2.353$, $p = .021$. Both of these findings suggest that those who use the drug do not feel severely impacted by it compared to those who refrain from use.

The more participants identified with the RNC platform, the more likely they were to feel that marijuana legalization would put the health and safety of the American public at risk $r(89) = .537$, $p < .001$. These participants were also more likely to believe that marijuana users are irresponsible, $r(89) = .270$, $p = .011$; lazy, $r(89) = .232$, $p = .029$; and less intelligent than non-users $r(89) = .227$, $p = .032$. RNC identifying participants were less likely to support a candidate who supports legalizing marijuana $r(89) = -.450$, $p < 001$ and less likely to believe enforcing marijuana laws took up unnecessary parts of the federal government's budget $r(89) = -.353$, $p = .001$. These findings further establish how impactful decades of anti-drug policy have been on Republican identifying voters in today's political landscape.

Further analysis explored the relationship between race and different components of the marijuana legalization debate. In general, there were no significant differences between Caucasian people and people of minority descent in terms of general feelings towards marijuana, $t(87) = .487$, $p > .005$, or perceptions of marijuana users $t(87) = .788$, $p > .005$. Additionally, there were no significant correlational relationships between different races and their specific beliefs about marijuana (neither race was more likely to believe that marijuana users were lazy, irresponsible, dishonest, etc.) There was also no statistically significant relationship between marijuana use and race, $r(89) = -.020$, $p > .05$. This data suggests that the views of the American people when it comes to opposing the legalization of marijuana, racial underpinnings are becoming less of a factor in the fight against legalization. This may be because people are more often referring to medical risks and benefits about marijuana to make decisions on their support.

STUDY 2 RESULTS AND DISCUSSION
Please reference the following scoring table for information about how the scales were computed.

Scale Name	Minimum Score	Maximum Score	Constructs Measured
Federal Government Trust	12	57	Higher scores indicate less trust in the federal governments dealings of marijuana.
Socio-Political Awareness	21	81	Higher Scores indicate higher levels of socio-political awareness.
Overall Emotional Regulation	10	44	Higher scores indicate better ability to regulate emotions.

Study 2 aimed to identify how much people trust in the federal government's dealings with marijuana. Participants in this sample trusted the federal government to a small degree, ($M = 42.8$, $SD = 9.1$), allowing us to infer that constituents are expecting more from the federal government in this aspect than what is being given. When asked to share where people wanted to see improvement in the federal government's marijuana dealings, well over half (64.8%) of participants mentioned concerns with decriminalization policy. Study 2 also aimed to seek out differences in socio-political awareness and emotion. On average, participants in this sample were socio-politically aware in less than some, not all, aspects, ($M = 55.6$, $SD = 9.6$). Participants were also able to regulate their emotions in less than some, but not all, aspects, ($M = 25.1$, $SD = 5.7$).

Further analyses show that the more participants trusted in the federal government's handling of marijuana/marijuana policy, the higher their levels of socio-political awareness, $r(136) = .197$, $p = .022$. Participants with high levels of socio-political awareness also tended to have high levels of emotion regulation, $r(134) = .256$, $p = .003$. Those with high levels of trust in the government's dealings with marijuana tended to be non-smokers, $r(137) = .228$, $p = .007$. When people who used marijuana within the past 30 days were compared with those who had not, there was a significant difference in trusting the federal government with marijuana dealings between the two groups, $t(135) = -2.717$, $p = .007$. However, there were no significant differences between socio-political awareness or emotion regulation between users and non-users, $t(134) = 1.086$, $p > .05$; $t(132) = -.564$, $p > .05$, suggesting that there may be no relationship between marijuana use and either construct.

There was a significant difference among the four parties on trust in the federal government's dealings with marijuana, $F(3, 133) = 4.415$, $p < .05$. Post hoc testing revealed significant differences between Republicans, ($M = 36.8$, $SD = 9.1$) and Independents, ($M = 47.1$, $SD = 8.6$). There was a significant difference among the four parties socio-political awareness levels, $F(3, 132) = 3.408$, $p < .05$. Post hoc testing revealed that that Republican, ($M = 54.2$, $SD = 12.4$), Democrat, ($M = 54.7$, $SD = 9.1$), and Independent, ($M = 54.9$, $SD = 8.4$) identifying people were significantly different from those who identified as Other, ($M = 62.2$, $SD = 8.0$). There was no significant difference between parties among emotional regulation, $F(3, 130) = .854$, $p > .05$. Differences between parties further reflect differences in legalization beliefs among their leaders and affiliates, giving an explanation as to why many states have taken the legalization matter into their own hands.

Overall, participants were able to identify that true effects of marijuana on the brain did not include diminished sense of hearing (72.8% answered correctly). However, a vast majority of respondents (86.1%) incorrectly identified California as the sole federally funded grow site for marijuana research (correct answer: Maine, 7.3%). Sixty-one percent of respondents selected California again when asked if they could recall the first state that decriminalized marijuana (correct answer: Oregon, 25.5%). When participants were asked which president was the first to acknowledge having possessed cannabis, the top two selections were Barack Obama (39%) and Franklin D. Roosevelt (37.2%) (correct answer: George Washington, 18.4%). This suggests that knowledge about marijuana and its role in America is not disseminated in a way that is consistently attainable to the public, causing people to rely on the stereotypes and misinformation put forth by anti-drug legislation.

Further analyses of this data also looked for differences according to race. In general, there is no significant difference between how much trust Caucasians and people of minority

descent have in the federal government's dealings of marijuana, $t(134) = .459$, $p > .005$. There is also no significant difference between Caucasian and their minority counterparts' in sociopolitical awareness, $t(133) = -.686$, $p > .005$, or emotional regulation ability $t(131) = .935$, $p > .005$. After performing tests to analyze for relationships between race and specific feelings, no significant relationships were found. Again, these findings further support existing evidence of a constituency that is moving away from the assumptions of the past and is looking to other sources to create their opinions. These findings also indicate that the federal government is not one of the sources that citizens look to for information about marijuana, which provides a considerable explanation for state governments to move at their own pace.

CONCLUSION

Our data suggests that the federal government's inability to create effective marijuana policy for the United States of America has left people in a state of disarray. Across decades, the United States has developed and enforced some of the harshest drug policy in the world. These policies have led to increased policing and incarceration rates among minority communities, the perpetuation of stereotypes and misinformation throughout society, and a focus on punitive instead of rehabilitative practices. Our findings suggest that the American people have not forgotten this history, resulting in current low levels of trust in the government's ability to oversee marijuana policy. One contributing factor to this could be the split between Democrats and Republicans on the legality of the drug and risks to its users, with some evidence suggesting Republicans today are echoing sentiments from the Reagan era that characterized marijuana users as societal deviants.

Despite these beliefs still being present in today's society, our data suggest that Americans are beginning to erase the notions of relating race with marijuana use, and there was no difference in the rate of marijuana use between Caucasian people and people of minorities. Knowledge of marijuana and its role in America was significantly low across the entire sample. Based on our results, the federal government should first prioritize adapting policies that will restore trust in their abilities to responsibly regulate marijuana. In order to do this within the American two-party system, Republicans and Democrats must first come to a consensus about the legality of marijuana. Given that Republicans are more likely to be against legalization, one way to come up with this support is to emphasize the impact marijuana legalization has had on the economies of the states who have legalized it.

Economic motivation has been cited by many legalized states as playing a large factor in their decision to move forward. As of 2019, Colorado reported approximately $302 million in profits from the taxes and fees on both medicinal and recreational marijuana, with over $1.7 billion dollars in sales. If federally legalized, marijuana sales could create $105.6 billion dollars in aggregate federal tax revenue (Krishna 2020). In addition to the tax revenue, "A 2016 RCG Economics and Marijuana Policy Group study on Nevada says that legalizing recreational marijuana in the state could support over 41,000 jobs till 2024 and generate over $1.7 billion in labor income" (2020). An additional aspect to legalization is decriminalization, which can also lead to saved expenditures from federal agencies. Dr. James Austin of the National organization for the Reform of Marijuana Laws states that:

> The criminal justice system, ranging from police to corrections, now allocates a significant portion of its budgets arresting, prosecuting, sentencing and incarcerating marijuana users, dealers and others involved in the illegal drug infrastructure (e.g., transporters, manufacturers of drug paraphernalia, etc.) (2005).

If changes are made to what is considered criminal, expenditures at the national level will decrease by as much as $120.6 million in every year, with the bulk of the savings benefitting the courts ($68.5 million) followed by police officers (James 2020).

In conclusion, our study suggests that the role of marijuana in the American political

landscape is constantly changing. Although legalization is increasing among states, people still lack trust in the federal government's ability to handle marijuana policy. This is in large part due to the underpinnings of current and past U.S anti-drug policy that still affect minority communities today. In addition to this, legalization continues to be a major issue that divides the American two-party system. Republicans, who still hold traditional views in terms of marijuana, are the most important body of people pro-legalization policymakers need to target. By emphasizing the benefits it can have for the economy, especially given current economic conditions and a future full of rebuilding, the federal government would provide the action people have been long demanding, boosting government trust among everyone.

This study had many limitations. Both surveys were administered during the covid-19 pandemic, thus restricting the sample to only those who have internet access. Both sample sizes were predominantly comprised of people from a Southeastern liberal arts university in the United States, limiting access to the full range of views expressed by people in different regions. Limited resources and software were available to the researchers at the time this paper was written, inhibiting abilities to conduct more in-depth analyses.

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Acknowledgments

Scholars Work Published Elsewhere

Many of our Scholars have generated multiple research products this year. Several Scholars completed Honors Theses and/or shared their work through Winthrop's 2020 Showcase of Undergraduate Research and Creative Endeavors (SOURCE). Also, several Scholars submitted their research with their Mentors for presentation at professional conferences or for publication in peer-reviewed professional journals. Here are some highlights.

- Nicholle Lewis (McNair Mentor: Dr. Matthew Stern), Marlin McKnight (McNair Mentor: Dr. Jason Hurlbert), and Maya Whaley (McNair Mentor: Dr. Merry Sleigh) presented at the Annual Biomedical Research Conference for Minority Students (ABRCMS) in fall 2019.
- Veronica Worthington's research submission with Dr. Matthew Hayes and Dr. Melissa Reeves for the 2020 Southeastern Psychological Association meeting received a Psi Chi Regional Research Award.
- The abstract of Juliana Quay's research with Dr. Jason Hurlbert was accepted for presentation at the American Society for Biochemistry and Molecular Biology (ASBMB) meeting and will be published in *The FASEB Journal*.
- Mattin Avalon and her Mentor Dr. Mike Sickels are submitting their work for publication.
- Gabrielle McGee's manuscript with Dr. Donna Nelson has been accepted for publication.

Scholars

Each of your research products, including these articles, reflects a long revise-and-submit process. Thank you for your responsiveness and diligence throughout that long process. The high quality of your research reflects well on you, your faculty mentor, and the program. Your excellence and persistence through unprecedented obstacles this year is awe-inspiring.

Mentors

McNair faculty mentors provide graduate-level research support to McNair Scholars. Our students and program could not be successful without your expertise and sacrifices. Thank you for the opportunity to partner with you to serve these outstanding students. My gratitude to you, and for you, is boundless. The work you do with each Scholar is the most important aspect of our program.

Stephanie Bartlett

One of the things that is unique about Winthrop's McNair program is our Writing Coach. Stephanie Bartlett has spearheaded the support and documentation of our Scholars' written deliverables for eight years. Her efforts are critical to the success our students have enjoyed in their research products, graduate admissions offers, and graduate fellowship awards. Serving as Editor of this *Bulletin* is only one aspect of her role. Our program outcomes would not be as impressive without your meticulous feedback. Thank you, Stephanie, for your exceptional service to Winthrop's McNair Program.

Dr. Matthew Hayes

Thank you, Dr. Hayes, for using your extensive methodological and statistical expertise to ensure every Scholar is able to complete the high quality research required by our funder, the U.S. Department of Education. You make yourself available to McNair students, faculty, and staff throughout the year to help refine research questions, strategize data collection, plan for and run analyses, as well as interpret findings. I am particularly grateful to you for helping Scholars understand what Scholars can, should, and should not conclude from their statistical analyses.

Many Thanks

Thank you Drs. Jason Hurlbert and Gloria Jones for teaching each cohort of Summer Scholars about scientific writing and effective communication. Thank you, Amanda Cavin, for your valuable contributions to the summer research internship that initiates each Winthrop McNair Scholar. Thank you, Jasmine Goode, McNair Alumna and G.A., for sharing your wisdom, perspective, and time to support Scholars and your fellow staff.
Thank you, Barb Yeager, for the countless ways you improve and support this program. Just one example is your contribution of the artwork on the cover of this *Bulletin*.

The Winthrop McNair Scholars Program prepares undergraduates who meet first generation and low-income and/or underrepresented criteria to be successful in Ph.D. programs through a variety of services including research experience, workshops, graduate admissions and financial aid assistance, test preparation, and travel to present research and explore graduate programs.

Since 2009, and through 2023, Winthrop's program is funded by a renewable multi-year TRiO grant from the U.S. Department of Education (PR/Award No.: P217A170094). $253,032 in annual federal funds helps 30+ eligible, outstanding students complete research and prepare for graduate study. This year, federal funds represent approximately 73% of program costs. Winthrop and the Winthrop Foundation will contribute the remaining 27% of the budget with approximately $95,000 in cash and in-kind matches.

Winthrop's program is successful because of the excellent work and persistence of our Scholars; expertise and effectiveness of our Mentors; dedication of our staff; support from our Dean and Vice Provost; funding from the U.S. Department of Education, our institution and Foundation; and guidance from our Advisory Board.

Each year, Winthrop's McNair Advisory Board selects new participants through a highly competitive application and interview process. All McNair Scholars complete intensive summer research internships, and several have earned awards for their work. See http://digitalcommons.winthrop.edu/mcnair/ for examples of their research.

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About the Artwork

The image on the binding was developed by our Executive Support Specialist, Mrs. Barb Yeager. It is adapted from the image *Rainbow Paint Splatter* originally found here: https://www.pngfind.com/mpng/ioRJTTx_paint-interesting-art-color-colour-rainbow-splash-rainbow/