McNair Journal

FALL ■ 2011

McNair Scholars Program
University of Missouri

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RONALD E. McNAIR POST-BACCALAUREATE ACHIEVEMENT PROGRAM

On the Cover: Anoff Cobblah, Department of Physics and Astronomy, Physics and English Major

MU

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Message from the Director

It is with great pride that I introduce this outstanding collection of articles from the 2010-11 participants of the MU McNair Scholars Program. The papers presented here represent the culmination of a year's worth of research and scholarly activity. They reflect the energy, creativity and effort of the scholars, themselves, as well as the careful guidance, support and diligence of their faculty mentors. Five very diverse topics are explored and reported in their entirety within this interdisciplinary journal. While their subject matter and journalistic styles may differ, they, along with the other McNair Scholars listed in this publication, are to be commended for their persistence and dedication to this rigorous undergraduate research experience that will benefit them greatly in their pursuits of graduate studies.

Since 1989, the McNair Program has been a University-wide effort that continues to attract students and faculty mentors from a variety of academic departments and fields of inquiry. Students have had the opportunity to learn about the importance of earning an advanced degree, while gaining the skills and tools that will guide them through their future academic journeys. The program proudly bears the name of astronaut and scientist, Dr. Ronald E. McNair, who died in the Challenger explosion in 1986. His accomplishments and high standards set an outstanding example for these developing scholars.

I am truly honored to be associated with an initiative such as this. So many faculty, staff and administrative members of the MU community have worked to ensure a supportive and cohesive environment that prepares these exceptional students for graduate programs. We are proud to highlight the work of these talented young researchers, in this, the nineteenth edition of the *MU McNair Journal*. Our best wishes go out to all of them as they continue to move along their scholastic continuum.

NaTashua Davis
Director
McNair Scholars Program

The McNair Scholars Program

BACKGROUND

College students who are considering study beyond the baccalaureate level realize their dreams through the McNair Scholars Program at the University of Missouri-Columbia (MU). MU was one of the original fourteen universities selected to develop a program established by the U.S. Department of Education and named for astronaut and Challenger crew member Ronald E. McNair. The purpose of the program is to provide enriching experiences that prepare eligible students for doctoral study.

PROGRAM ELEMENTS

One of the most exciting aspects of the McNair Scholars Program is the opportunity for junior or senior undergraduate students to participate in research experiences. McNair Scholars receive stipends to conduct research and engage in other scholarly activities with faculty mentors from the areas in which they hope to pursue graduate study. These research internships are either for the academic year or for the summer session and are under the supervision of faculty mentors. For academic year internships, students work a minimum of ten hours per week during the fall and winter semesters. Summer interns work full-time for eight weeks.

McNair Scholars also attend professional conferences with their mentors, go to graduate school fairs, prepare for graduate school entrance exams, receive guidance through the graduate school application process and obtain information on securing fellowships, graduate assistantships, and loans. Participants learn about graduate school life, advanced library skills, and effective ways to present their work. At the completion of the research internships at MU, McNair Scholars make formal presentations of their research to faculty and peers at the McNair Scholars Conference and submit papers summarizing their work. Students who participated as juniors the previous year continue in the program during their senior year for graduate school placement and to further develop their skills.

ELIGIBILITY

Participants must meet grade point average standards; be U.S. citizens or permanent residents; and qualify as either a first generation college student with an income level established by the U.S. Department of Education, or a member of a group that is underrepresented in graduate education.

All students who wish to be involved submit an application to the program. A committee composed of faculty members and representatives from both the graduate dean's office and the McNair Scholars Program selects participants and approves faculty mentors. Research internships are offered to those students who are juniors or seniors and are identified as having the greatest potential for pursuing doctoral studies.

Preparation of an Ultra-high Vacuum System for Heteroepitaxial Film Growth

ANOFF 'NICK' COBBLAH

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Department of Physics and Astronomy

Nick is a junior from Sedalia, MO. who is majoring in both Physics and English. Nick is a recipient of the Brazeal Honors College Endowed Diversity Scholarship who spent the summer continuing his research as part of the College of Arts & Science's Undergraduate Research Mentorship Program.

I. INTRODUCTION

Within the last few decades, much progress has been made in understanding the surface morphologies of epitaxial thin film growth (the growth of a thin film onto a substrate) and the many processes that affect these morphologies, such as growth temperature, crystal geometry, edge and corner diffusion, and deposition angle [6]. This question of how atomic-scale processes create particular structures is an increasingly important one. Many of the commercial applications for epitaxially grown thin films, such as semi-conductor fabrication, require defect-free films. And as the quest to minimize the physical size of our technology continues, so does the demand for greater control over the growth process. Glancing-angle deposition (GLAD) [Fig. I] has been shown to be a growth process which can provide particularly great structure control, and has a variety of technological applications [1]. And yet many of the physical growth features associated with off-normal deposition have yet to be adequately explained. For this reason, further research into the effect of angle of deposition is highly important. To that eventual end, I modified a vacuum chamber so that, in the process of creating thin film samples, the evaporant path could be better controlled.

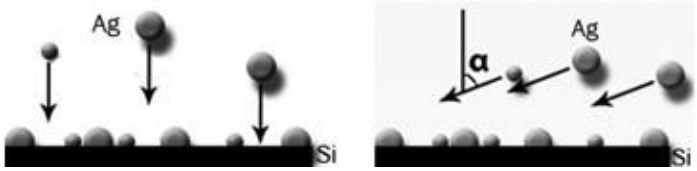


Figure I: (a) Silver deposited normal to a silicon substrate. (b) Silver deposited through GLAD ($\alpha > 70°$).

a. The Growth Process of a Thin Film

A common method of thin film growth is through physical vapor deposition (PVD), in which the evaporant undergoes a phase transition from a vapor above the substrate to a solid on the substrate. The film then grows through the process of nucleation, as the vapor flux condenses. Adsorbed atoms (adatoms) diffuse along the substrate surface, joining with other adatoms to form a nucleus, joining other nuclei, or reevaporating from the surface [Fig. II]. These nuclei grow and eventually become the thin film in one of three growth regimes. In Frank-van der Merwe growth, the adatoms are strongly bound to the substrate and so the film grows in uniform monolayers. In Volmer-Weber growth, the adatoms are strongly attracted to one another, and so they form adatom islands on the surface of the substrate. Finally, in Stranski-Krastanov growth, the adatoms

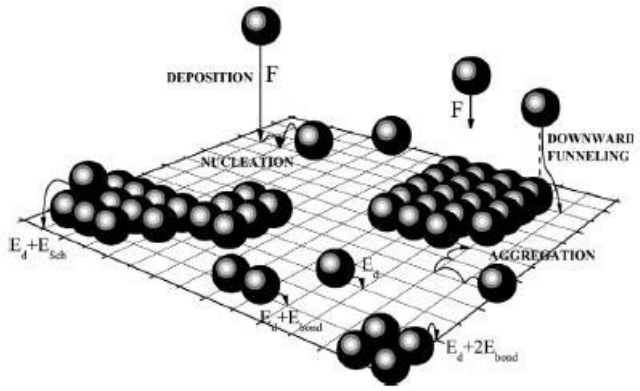


Figure II: Schematic of island nucleation. Taken from reference [7].

attracted to the substrate initially grow in monolayers, but later islands are formed atop this layer [1]. The structure of the thin film formed is highly dependent on the crystal geometry of the substrate, the growth temperature, and of course the angle of deposition [6].

b. The Mechanics of Angle of Deposition

The effects of angle of deposition are most striking in the case of Volmer-Weber growth. For flat surfaces, angle of deposition is of little consequence. But the growth of adatom islands presents a microscopic topography which will affect the trajectories of the incident atoms [1,8]. Impinging atoms are focused on the regions next to the front edges of adatom islands in a process known as steering [8, 9], and so novel growth structures occur. This effect is most predominant in GLAD, in which the incident vapor flux is set at an angle of $\alpha > 70°$ [Fig. I]. This oblique angle causes ballistic shadowing, as the growing columnar structures block other areas of the substrate. The nuclei behind these columnar nuclei fall into their "shadow" and are extinguished, while other columns continue to grow, receiving greater portions of the evaporant flux [Fig. III]. Because the initial condensation of the evaporant onto the substrate is stochastic, it follows that the growth of the columns is stochastic as well. Hence, not all of the columns formed are identical. The morphology of the thin film—which is composed of these columnar structures—varies with the material used [1].

Figure III: Illustration of ballistic shadowing. (a) The columnar structures have grown to the point where they are blocking the shorter columns behind them from evaporant. (b) The columns receiving flux continue to grow, while those blocked did not.

c. The Effects of Angle of Deposition

The effects of angle of deposition at moderate angles have traditionally been viewed as negligible, as it was assumed that the deposited atoms would be homogeneously distributed over the surface [2]. However, Borovikov et al. have demonstrated

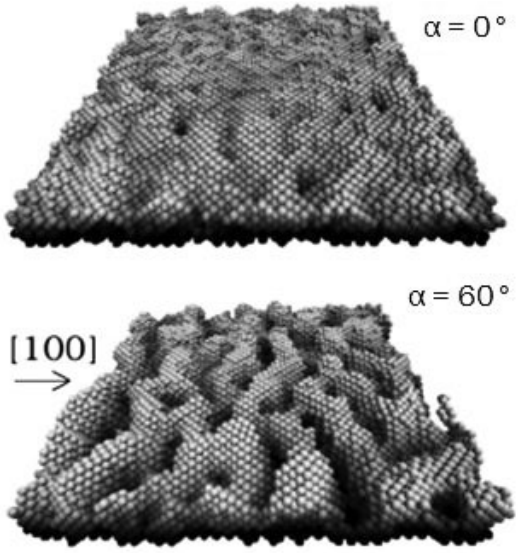


Figure IV: Surgace morphologies for 7 monolayer parTAD films at 40 K, for normal and 60° deposition. Taken from reference [3].

that the effects of moderate angle of deposition ($\alpha \approx 30°$) must be considered in Cu/Cu growth, in low-temperature growth systems especially [2, 3]. The ballistic shadowing caused by off-normal deposition is in constant competition with surface diffusion, which tends to pull atoms from the high concentration columns to the low concentration shadowed areas [1]. At low temperatures, this thermal activity is limited, and so the angle of deposition has a greater impact. Using a parallel temperature-accelerated dynamics simulation and molecular dynamics simulation, the moderate-angle deposition ($\approx 60°$) was found to create "valleys" in the thin film [Fig. IV], which Shim et al. cited as the source of a compressive strain measured in thin films. However, evidence has also been found that this strain may be the result of an unusual number of vacancies beneath the films surface [4, 5]. Further analysis of the degree to which angle of deposition does affect strain within the thin film is therefore of interest.

d. X-Ray Reflectivity

In the past, most *in situ* (performed in vacuum) experimental studies of film growth utilized only surface sensitive techniques, allowing for little investigation into the mechanisms of the subsurface [5].

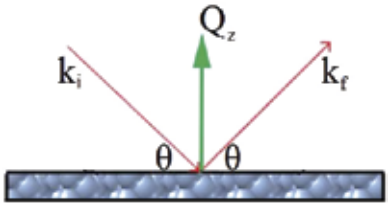


Figure V: Schematic of X-ray reflectivity. Q_z = momentum transfer, k = the wave vector, θ is exaggerated.

Without this knowledge, understanding of film growth is limited. X-rays, however, are able to probe below the surface of solids, making x-ray reflectivity a critical tool [11,12]. X-ray reflectivity (XRR) was a technique first utilized by L.G. Parratt [13], which is now used to analyze a wide variety of materials. The aim of this method is to reflect x-rays from the surface of the sample, usually at low grazing angles, and to measure the intensity of the x-rays reflected [Fig. V]. This measured XRR spectra of the film is fit to a theoretical electron density profile by regression analysis, which gives information on film thickness, density, and roughness.

II. METHODS

a. Materials and Instruments

Working towards our ultimate goal of investigating the effects of angle of deposition in the heteroepitaxial system, it is the purpose of this phase of experimentation to modify the vacuum chamber in the Miceli lab [Fig. VI] to better control the path of the evaporant. In its former state, the low-energy electron diffractor (LEED) was in danger of being compromised by the evaporant. The shutters meant to protect the LEED must therefore be enlarged to some degree. The effectiveness of these shutters will be tested by the creation of a Ag/Si (7x7) sample because the Ag/Si (7x7) system has a large electron contrast between substrate and film. For this purpose, high purity silver (at least 99.9%) will be used as the source of the evaporant, while a silicon sample (approximately 1.00 cm2 in size) will act as the substrate. The growth of the thin Ag/Si film will be performed within a vacuum chamber capable of reaching ultra-high vacuum (pressures in the vicinity of 1.00 X 10^{-10} torr). Attached to the chamber is a probe arm, upon which the silicon sample is mounted, which is capable of rotating the sample to various, measurable degrees off the normal of the deposition path, allowing for the varying angles of deposition required. The chamber is also capable of measuring the temperature of the sample by thermocouple, the pressure inside the chamber by ion gauge, and is equipped for low-energy electron diffraction (LEED). Following the completion of the growth, x-ray reflectivity scans will be performed in the x-ray chamber on site.

b. Procedure

Modification of the Chamber Shutters

By treating the evaporant as a cone diverging from a point source [Fig. VII], the necessary areas of Shutter 1 and Shutter 2 [Fig. VIII] will be calculated, taking into account the limitations of the chamber's size. The additional area will then be added by spot welding the extra material onto the shutters. The effectiveness of the shutters in blocking the LEED will be modeled by using a light source.

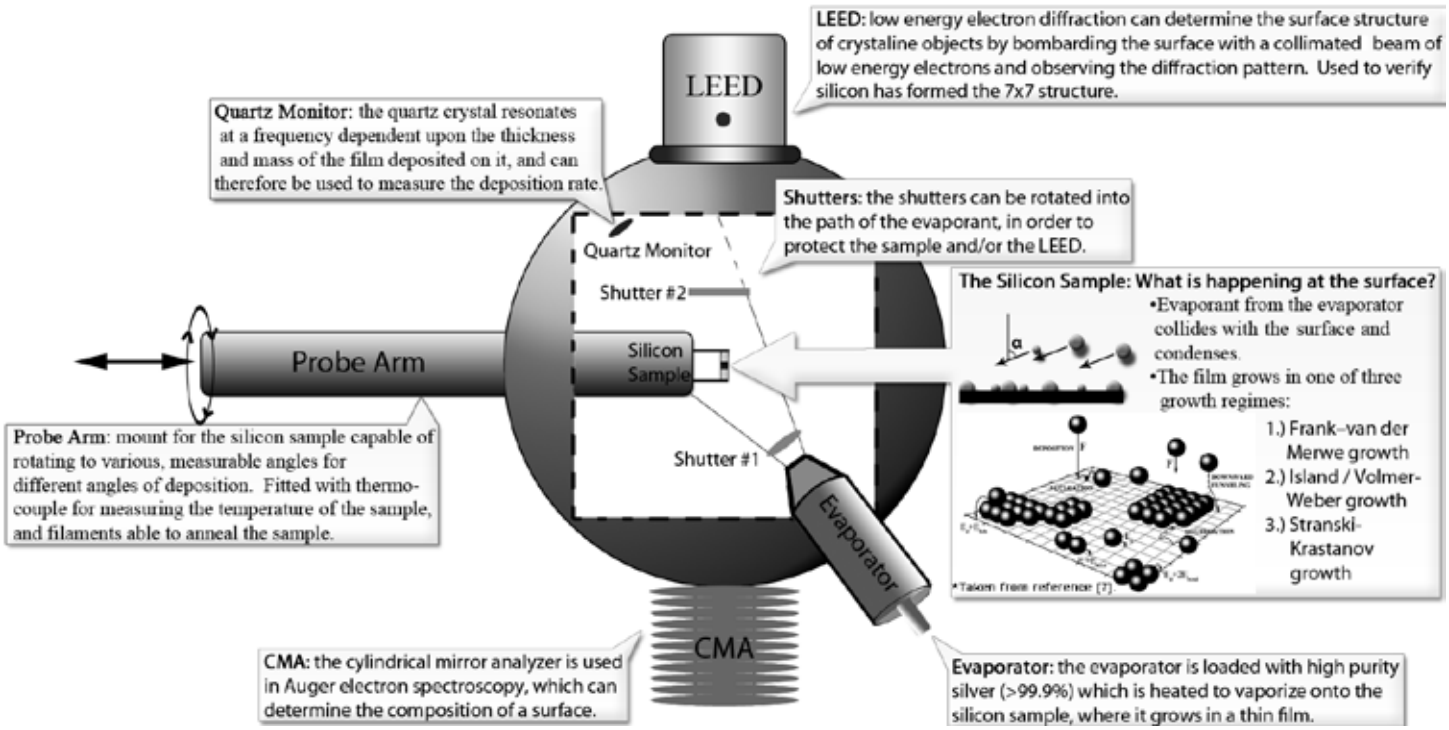
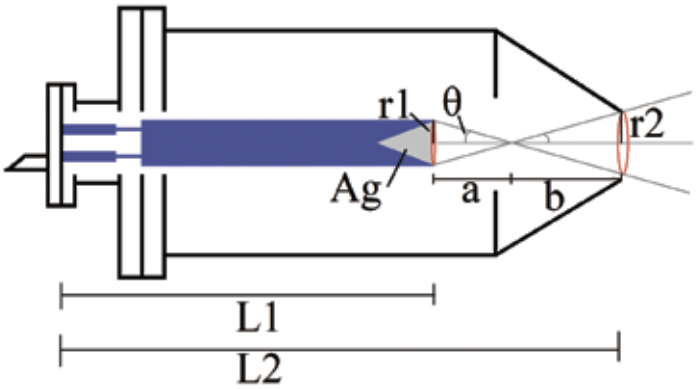


Figure VI: Diagram of the vacuum chamber.



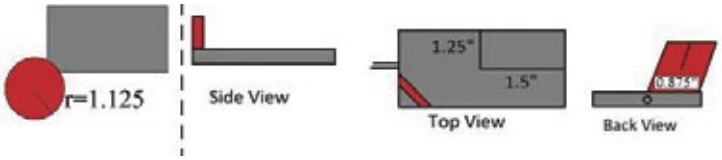


Figure VII (left): Diagram of the evaporator. L1= 29.0 cm, L2= 34.7 cm, r1= 1.1 cm, r2= 1.5 cm, a= 2.4 cm, b= 3.3 cm, Θ= 24.6°.

Figure VIII (above): (a) Shutter 1. (b) Shutter 2 (slide) (c) Shutter 2

Preparation of the Silver and Sample:

Because the silver source material shows signs of silver sulfide contamination, it will be necessary to clean the silver. A bath of 7.3 ml of sodium carbonate and 7.3 ml NaCl in 500 ml of water, poured over 113 cm^2 of aluminum foil can draw the sulfur ions to bond with the aluminum ($3Ag_2S + 2Al \rightarrow 6Ag + Al_2S_3$). Once the silver is clean, the silicon sample can be mounted on the probe arm and set in the center of the vacuum chamber. The silver source material can be loaded into the evaporator.

Preparation of Chamber:

The vacuum chamber and all instruments attached will be prepared using standard ultra-high vacuum (UHV) procedure. The chamber will be "baked out"; that is, the chamber will be wrapped in heat tape and its temperature will be raised to force any radicals attached to the walls inside the chamber, or any of its attached components, to be pumped out, allowing for pressure to reach UHV. The filaments of the ion gauges, evaporator, and CMA will be out-gassed to remove any deposits which may have built up, and the chamber will be checked for obvious leaks. The chamber should be brought down to around 1.0 X 10^{-8} torr by a series of pumps, and with the help of the titanium sublimation pump should reach around 1.0 X 10^{-10} torr.

Creation of the Sample

A high voltage will be applied to the silicon sample to anneal it, using a pyrometer to verify when the correct temperature has been reached to form the 7x7 pattern. This pattern will be verified by the LEED. The silver will then be evaporated onto the silicon 7x7 sample, with the goal of using a previous evaporation rate to deposit 20 monolayers (47.2 Angstroms). The sample will then be removed from the chamber and x-ray reflectivity scans will be taken.

III. RESULTS

Shutter Modifications:

The necessary area of Shutter 2 was shown to be 1.93 square inches, and the necessary area of Shutter 1 was shown to be 0.69 square inches. Shutter 2 was modified to block the LEED completely from the evaporant path, and a light source modeling the evaporant demonstrated that the new coverage was sufficient.

Silver Purification:

Figure IX: (a) Silver Sulfide before cleaning. Dark spots on ≈ 20% of Surface (b) Silver after cleaning. No dark spots.

As seen in Figure IX, the proposed method of cleaning the silver sample resulted in no visible trace of the silver sulfide originally present after 20 minutes, suggesting that the silver was at the 99.9% purity needed for further experiments.

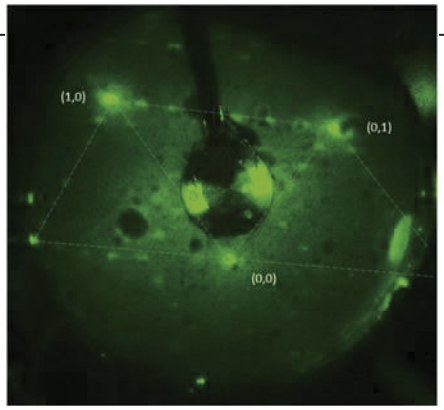


Figure X: LEED pattern of Si 7x7.

Figure XI: Ag/Si (7x7) sample, showing evidence of silver deposition everywhere but at the corners (covered during deposition).

Creation of Ag/Si Sample:

The chamber reached a pressure on the order of 10^{-10} torr, and a voltage of 990 V was applied to the silicon sample in order to anneal it. The 7x7 reconstruction was verified by the LEED, which demonstrated the associated diffraction pattern [Fig. X] [14]. Silver was then evaporated onto the sample at a temperature of 1260 °C (36 V) for 3 minutes, while the chamber pressure was 1.0 x 10^{-7} torr. Prior to deposition, the temperature of the sample was 58 °C, but rose to 75 °C during deposition. Upon removing the sample from vacuum, clear evidence of silver deposition was observed [Fig. XI]. X-ray reflectivity data was collected [Fig. XII, XIII].

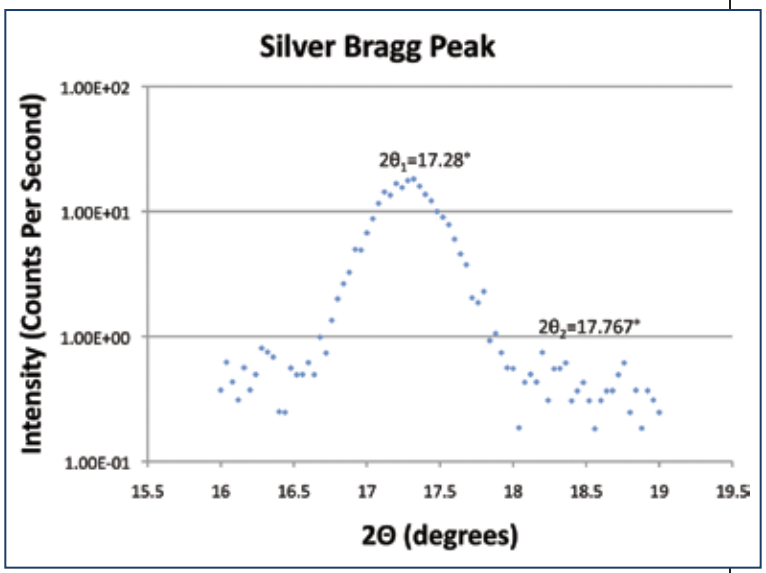


Figure XII: Ag/Si reflectivity measured near the Ag Bragg peak.

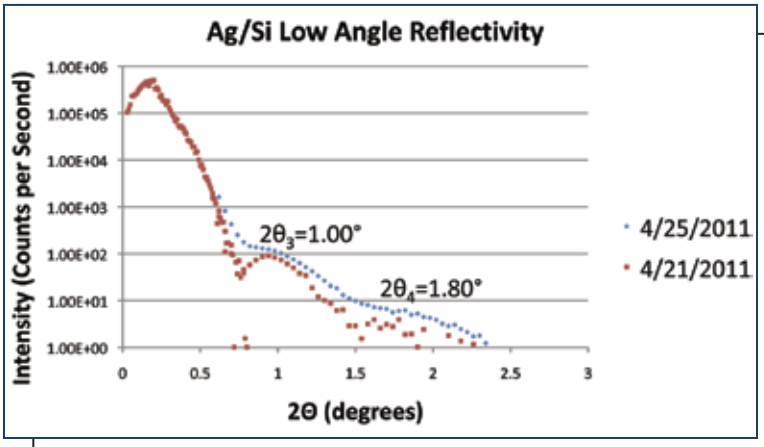


Figure XIII: Ag/Si reflectivity measured at low angles.

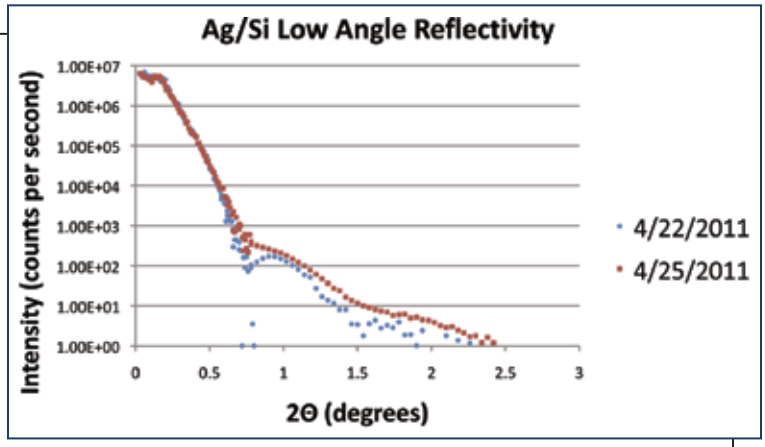


Figure XIV: Ag/Si Low Angle Reflectivity with the footprint corrected.

Sample thickness was calculated in three ways:

Method One: Ag Bragg Peak

From the measurements about the Ag Bragg peak [Fig. XII], it can be shown that

$$I \propto \frac{\sin^2\left(\frac{NQc}{2}\right)}{\sin^2\left(\frac{Qc}{2}\right)},$$

where N= the number of atomic planes and C is the interatomic spacing of Ag.

$$\text{so that } \Delta Qc = \frac{4\pi}{\lambda}(\sin\theta_2 - \sin\theta_1)\frac{c}{2} = \frac{\pi}{N}$$

The thickness of the film is then

$$d = Nc = \frac{\lambda}{2\Delta\sin\theta} = \frac{0.70926\ \text{Å}}{2(\sin(8.8835^\circ) - \sin(8.64^\circ))} = 84\ \text{Å}.$$

Method Two: The Scherrer Equation

In this approximation based on the Ag Bragg peak [Fig XII],

$$B(2\theta_1) = \frac{0.94\lambda}{d * \cos\theta_1},$$

where B(2θ) is the full width at half maximum for the Bragg peak

In the Bragg peak measurements, $B(2\theta_1) = 0.4827^\circ = 0.00850$ radians. The thickness of the film can be approximated as

$$d = \frac{0.94\lambda}{B(2\theta_1) * \cos\theta_1} = \frac{0.94 * 0.70926\ \text{Å}}{0.00850 * \cos 8.64^\circ} = 79\ \text{Å}.$$

Method Three: Low Angle Reflectivity

In the low angle reflectivity [Fig. XIII], the film thickness

$$d = \frac{2\pi}{\Delta Q} = \frac{\lambda}{2\Delta\sin\theta} = \frac{0.70926\ \text{Å}}{2(\sin(0.90^\circ) - \sin(0.50^\circ))} = 50.8\ \text{Å}.$$

Figure XIV shows the low-angle x-ray reflectivity data once it had it has undergone footprint correction. Because of the shifting angles of x-ray incidence, at very low angles some of the x-ray beam intensity does not hit the sample, leading to lesser intensities at lower angles. This must be corrected for accurate analysis.

The final XRR data in Figure XV is currently being modeled in MLayer in order to obtain an electron density profile on the thin film.

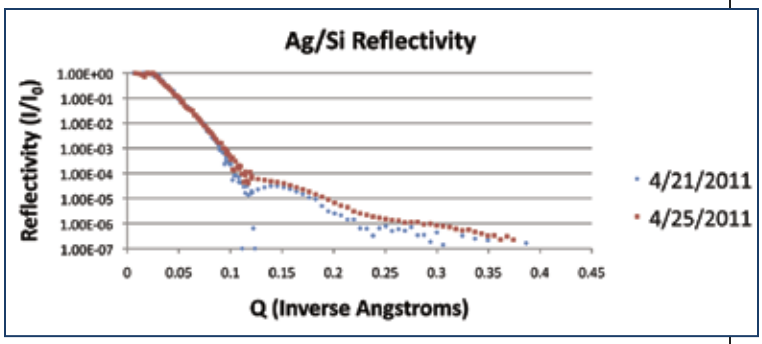


Figure XV: Final XRR data for the Ag/Si sample

IV. DISCUSSION

Ultimately the goal of this phase of the experiment was accomplished. The modifications made to the chamber showed evidence of being successful. During the simulation deposition using the light source and during the actual deposition, the shutter which was modified preformed well. In addition, the suggested method for removing silver sulfide from silver seemed to completely remove the tarnish.

However, the chamber will most likely require modification in the future. The quartz monitor was not working during the creation of this Ag/Si sample, and so the deposition rate could not be effectively monitored. The calculations of the approximate thickness of the deposited layer show that the previous evaporation rates are likely not accurate. Our initial goal was to deposit 20 monolayers of silver (47.2 Angstroms), but two of our three approximations show a film thickness of at least 34 monolayers. Although this shows that our settings were likely in the right range, further characterization of the evaporator and its heating should be performed. An initial characterization suggests that the 36 V applied was too high, and that 27 V probably would have been sufficient [Fig. XVI]. It should be noted that determining the proper deposition rate for the evaporator without the quartz monitor would be difficult, however, given the slow response time of the thermocouple and the difficulty in verifying the thermocouple's readings. It should also be noted that the approximations made about the silver film thickness were made somewhat difficult given the nature of the data collected. The position of θ_4, the peak of one of the bumps in Figure XIII, was difficult to estimate, which may explain the significant difference between the low-angle

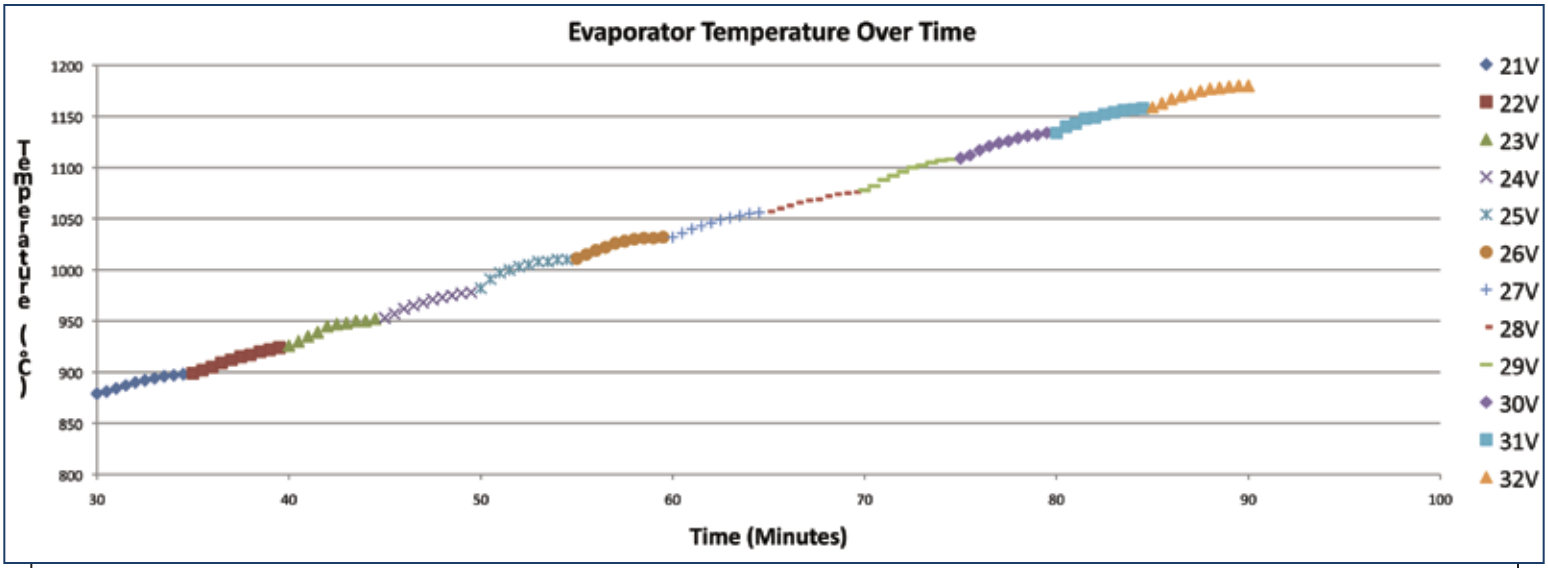


Figure XVI: Characterization of the evaporator temperature over time, at various voltages.

approximation and the other approximations.

However, a sample was created, and so a significant step has been made towards the eventual goal of creating samples at various angles of deposition. It has been verified that the chamber is in working order now, and can deposit silver onto the silicon sample while protecting the LEED.

V. ACKNOWLEDGEMENTS

I would like to thank Professor Miceli, Shawn Hayden, Michael Grumlich, Yiyao Chen, and Jesse Kremenak for their help and suggestions, as well as the entire McNair Scholars Program for their support. We are also thankful for the financial support of the National Science Foundation, DMR-0706278; the Petroleum Research Fund, 41792-AC10; and the Arts and Science Alumni Organization Faculty Incentive Program.

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Global Positioning System Analysis of Fault Motion Along the Southern Portion of the Dead Sea Fault, Jordan

WILLIAM JOSEPH COCHRAN

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Department of Geological Sciences

Joe grew up in Holts Summit, MO. and is a senior majoring in Geological Sciences. He is the recipient of the Pearl Todd Sando Geology scholarship, the Edmond and Mary Raymond Geology scholarship, and the 2010 recipient of the Undergraduate of the Year award in Geology. Joe has served as the President of the Geology Club and is a member of the American Association of Petroleum Geologists (AAPG) student chapter. This Fall, he will pursue his Master's degree in Geology at MU where he received an assistantship and the opportunity to continue to work under the guidance of his mentor Dr. Gomez. His future plans include obtaining a PhD in tectonics and earthquake geology and becoming a research professor.

INTRODUCTION

The Dead Sea Fault (DSF) ranks among the large strike-slip faults in the world, extending ~800 km in length. This fault system has one of the longest, and most complete historical records of large (M > 6.5) earthquake occurrence, going back more than 2000 years. With such a history of large and devastating earthquakes, studies of the DSF during inter-seismic periods can provide pertinent information, such as locking depth, slip-rate, maximum magnitude earthquake, and recurrence interval. During these periods, the stresses that build up occur as the result of the two lithospheric plates being locked together, which impedes motion along the fault. When these stresses become too great, a yield strength is reached and the fault slips, releasing energy throughout the region, i.e. an earthquake.

The purpose of this research is to use GPS (Global Positioning Systems) measurements to calculate the strain that accumulates as the fault is loaded by plate motions along the southern section of the DSF. These measurements will help resolve variability among previously suggested slip rates, constrain the depth at which the fault is locked, and provide appropriate information so that a recurrence interval can be determined when these results are combined with seismological data. Previously reported slip-rates, to date, vary from 2-8 mm/yr (e.g., Le Beon et al., 2008; Klinger et. al., 2000b). Furthermore, with many large cities located near the fault (e.g. Jerusalem and Amman, each with more than 2 – 3 million people), this information is also pertinent for proper earthquake hazard assessment.

REGIONAL TECTONICS

The plate tectonics in the Eastern Mediterranean region is characterized by the collision and convergence among the Arabian and Sinai (part of the African plate) plates with the Eurasian plate (Jackson and McKenzie, 1988; Rotstein and Kafka, 1982). Active plate boundaries associated with the region include the North and East Anatolian Faults, the Zagros collisional mountain belt, the Dead Sea Fault (DSF), and the Red Sea Rift system in the south (Fig. 1). Playing a major role in the tectonic framework of the region, the DSF accommodates the left-lateral motion between the Arabian and Sinai plates, and traces for more than 800 km from the Gulf of Aqaba and the Red Sea to the East Anatolian fault in southern Turkey.

The DSF consists of three main sections (e.g., Quennell, 1958, 1984; Garfunkel, 1981): A 300 km-long (southern) section from the Gulf of Aqaba, through the Dead Sea and Jordan Valley, and into the Sea of Galilee; a 200-km-long section across Lebanon (Lebanese Restraining Bend) and a 300-km-long (northern) section through northern Syria into southern Turkey. On a

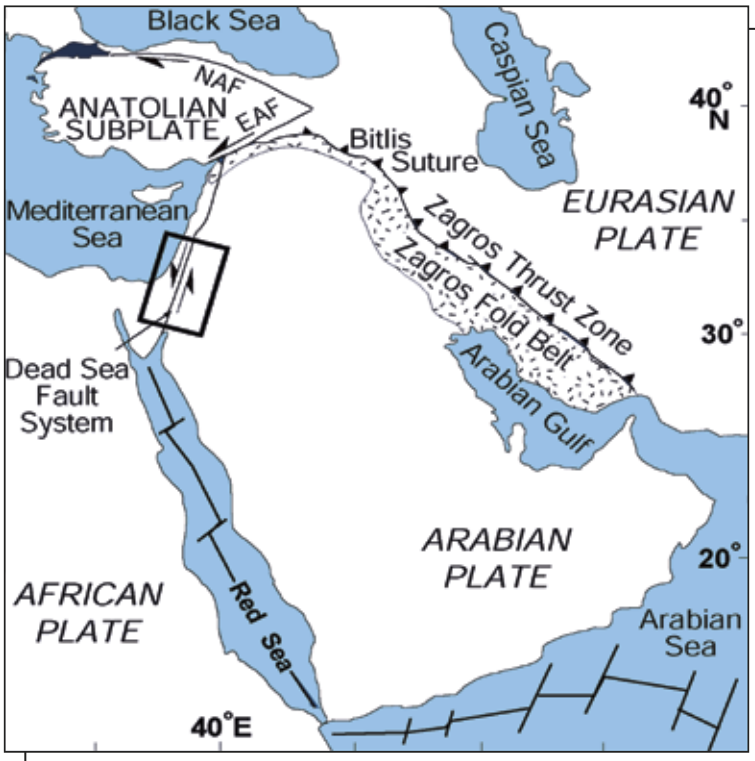


Figure 1. Tectonic setting of the Eastern mediterranean region. The bordered area indicates the study region. Abbreviations NAF and EAF rrepresent North and East Anatolian fault..

regional scale, volcanism and igneous activity have occurred during the Quaternary mainly on the eastern side of the DSF (i.e. the Arabian Plate) composed primarily of basaltic flows (e.g., Garfunkel, 1989; Steinitz and Bartov, 1991; Ilani et al., 2001). When the Dead Sea began to rift, magmatic materials intruded areas closer to the fault (Garfunkel, 1989; Ilani, et al., 2001).

Geologic observations suggest a total, left-lateral offset of 107 km since initiation of the fault 15-20 million years ago (Quennell, 1958; Freund *et al.*, 1970; Garfunkel, 1981). Two episodes of displacement are suggested to be accountable for this offset: The first episode occurred in the Middle to Upper Miocene (16-5 million years ago) and had a total displacement of 62 km (Quennell, 1958, 1984; Freund et al., 1970). The second episode of movement began in the Lower Pliocene (~5 million years ago), with a total displacement of 45-km in the south and 25-km in the north (Quennell, 1958, 1981; Freund, et al., 1970); this episode continues today. This episode is suggested to correspond with the oceanic spreading center of the Red Sea (Hempton, 1987). The excess displacement may be partly accommodated by horizontal shortening of the Palmyride fold belt (e.g., Quennell, 1984).

By using geologic methods, estimates of slip-rates averaged over timescales of thousands to hundreds of thousands of years are possible. These estimates are relatively insensitive to the earthquake cycle, but are vital to understanding the paleoseismic activity and behavior. These approaches assess geologically recent (Quaternary) features such as offset stream channels or out-wash features (alluvial fans). Klinger *et al., (2000a)* estimated a slip-rate of 2-6 mm/yr along the Wadi Araba Fault section (south of the Dead Sea), by observing the displacement of a large alluvial fan with a depositional age of 44-170 thousand years. Niemi *et al. (2001)* also studied the displacement along the Wadi Araba Fault by looking at 3 alluvial fan deposits cut by the fault. A slip-rate 4.7 ± 1.3 mm/yr was concluded to be the average for the last 15 thousand years (Niemi et al., 2001). Ferry *et al., (2007)* used various offset drainages in the northern Jordan Valley to determine an estimated slip-rate of 4.7-5.1 mm/yr for the last 47.5 thousand years. Gomez et al. (2003) used trench excavations along the 200-km Serghaya fault in Lebanon to find a slip-rate of 1.4 ± 0.2 mm/yr during the Holocene. Along the northern section of the DSF, slip-rate studies are limited, with Meghraoui *et al. (2003)* estimating a 6.9 ± 0.1 mm/yr slip-rate for the Holocene using offset Roman aqueducts, while Gomez *et al. (2006)* found a long-term slip-rate of 3.3-4.0 mm/yr by dating a igneous formation and measuring the displacement. Slip-rates are generally consistent up to the northern section, which could mean excess strain accumulation and a larger earthquake ahead.

Earthquakes along the DST have been moderate over the last century, but many large and devastating earthquakes have been revealed in earlier centuries (Ambraseys and Jackson, 1998; Sbeinati et al., 2005; Ben-Menahem et al., 1991). The instrumental records (past ~100 years) do not show any large earthquakes (Mw >7.0). Thus, a need to look at historical documents and conduct paleoseismic studies (i.e., studies of pre-historic earthquakes using geologic techniques) is apparent. Aside from the 1995 earthquake in the Gulf of Aqaba (Mw =7.4), the southern DSF has not experienced a large (Mw >7.0) earthquake since 1588 (Ambraseys, 2006). In the Araba Valley, Klinger *et al. (2000b)* describes the only four well documented earthquakes, which occurred in AD- 1068, 1212, 1293, 1468. Sbeinati *et al. (2005)* looked at seismicity along the northern DSF (Syria) from 1365-1900 AD and found 18 earthquake Mw >7.0, with the last event occurring in 1837.

As an example of a paleoseismic study, Marco *et al. (1996)* used earthquake-induced features in lake sediments along the southern DSF to estimate an average repeat time of large earthquakes (ML >5.5) of 1600 years. Hamiel *et al. (2009)* looked at lake sediments in the Dead Sea Basin, plus normal fault displacement in the Jordan and Wadi Araba, to try and piece together the seismicity along the DST for the last 60,000 years. Furthermore, they looked at historic and instrumental records so that a more complete data set could be used for analysis using the Gutenberg-Richter relationship. Looking at the data from the Dead Sea Basin, a recurrence interval for magnitudes greater than 6.8 between 59-49 thousand years ago was ~900 years, and from 44-16 thousand years ago it was ~1700 (Hamiel et al., 2009). The latter is similar to the recurrence period determined by Marco *et al. (1996)*.

An alternative method of estimating a fault slip-rate involves the use of geodetic techniques and the application of theoretical models of the earthquake cycle to relate observed deformation to fault kinematics. Hence, GPS results on the DSF provide a basis for geodetic slip estimates. Along the southern DSF, Wdowinski *et al. (2004)* used a profile-based elastic dislocation model (based on Savage and Burford, 1973) to estimate a slip-rate of 3.3 ± 0.4 mm/yr and locking-depth of 12 km based on 11 GPS stations. Using the same type of model, Le Beon *et al. (2008)*, found a slip-rate of 4.9 ± 1.4 mm/yr and a best-fit locking depth of approximately 12 km and an uncertainty of approximately 10 km. In comparison, Gomez *et al. (2007)* studied the 200-km long section across Lebanon and found 4-6 mm/yr of relative plate motion. These results seem to agree with Holocene-averaged slip rates associated

with the fault. Alchalbi *et al. (2010)* used GPS measurements along the northern DSF and found a slip-rate of 1.8-3.3 ± 0.7 mm/yr. This value is considerably lower than rates determined in the central and southern areas, but is consistent with the amount of displacement during the two episodes of movement; the north had 25-km of movement while the south had 45 km.

METHODS

The methodology behind this research project involves the following four steps:

1. Global Positioning System (GPS) Data Acquisition
2. Processing the Raw GPS Data
3. Modeling the Geodetic Results
4. Seismological Integration of the Data

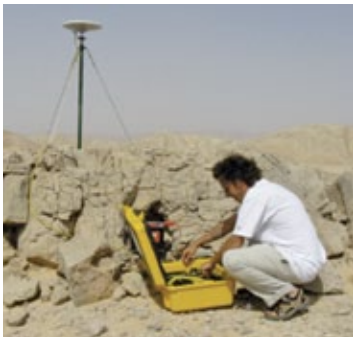


Figure 2. Field photograph showing the GPS antenna (positioned on the rock) and receiver box (yellow case). The GPS data is transferred from the geodetic-grade antenna to the receiver, where the information is stored on a card.

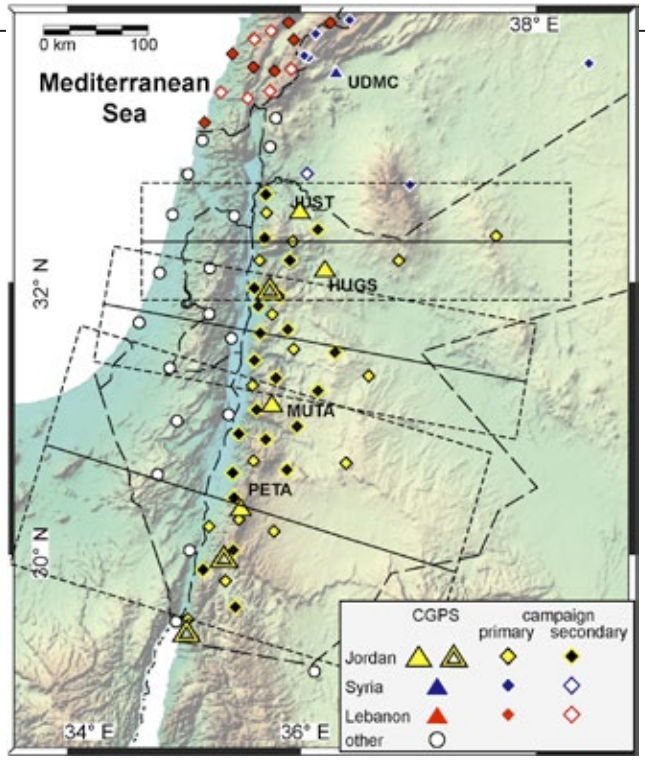


Figure 3. Topographic map of the GPS survey sites in Jordan, Syria, Lebanon, and surrounding regions. The labeled sites are continuous GPS stations. The dotted line represent our profile area; Jordan Valley-north, Dead Sea Basin-central, Wadi Araba-south.

The first step involves the use of high-precision GPS instruments in order to accurately locate each stations position in our survey. High-precision GPS instruments, in contrast with more familiar GPS receivers, are able to determine the position with 3-4 mm accuracy. The high-precision derives from analysis of the high-frequency "carrier" signal, rather than the time signal as used by typical GPS instruments (e.g., hiking and car navigation). Common errors associated with positioning include troposphere and ionosphere interference, and the differing standards ("clocks"), which serve as a reference among the receiver and the satellites (Herring et al., 2009). High-precision GPS receivers, specifically Trimble model R7, were used with geodetic-grade antennae in order to obtain an accuracy (3-4mm) needed for this project. The fixed-height antenna masks (1.1574 m) used insured a stable and consistent collection of data, and each site was measured continuously for 24 hours. Specifically for this project, GPS data were collected during field work in Jordan from May 23- June 20, 2010 from 38 survey sites (Fig. 3). These data were compiled and processed with previous campaign data, as well as regional continuous stations, from 2005-2009.

GAMIT/GLOBK (Herring et al, 2009) software package was used to analyze raw GPS signal data. The GAMIT software loosely constrained each stations position while producing a covariance matrix of the network. Also, stations in the International Terrestrial Reference Frame (ITRF2005) were processed with the data collected, which was crucial for stabilization. The loosely constrained site coordinates were then transferred to GLOBK software, where the GPS network was rotated and stabilized to fit into the ITRF2005. This stabilizes not only the survey sites position, but also the stations velocity. When combined with data from previous campaigns, a time series was generated to remove obvious outliers, and view the change in the survey sites positions over time (Fig. 4). For a more complete velocity field, GPS velocities of Le Beon et al (2008) were rotated to fit our Arabia-fixed reference frame by minimizing the misfit of the CGPS stations common between the two studies.

The next step involves the numerical modeling of the GPS velocities to estimate the fault parameters, using an elastic dislocation model, following the method of Savage and Burford (1973). This model assumes that the two plates are moving horizontally past one another while being locked from the surface to some depth (Savage and Burford, 1973). The equation used to determine how velocity changes near the fault as a function of distance from the fault is:

$$v(x) = a + V/\pi * \arctan(x/D), \quad (1)$$

where v is the velocity parallel to the fault, a is a constant, V is the slip-rate, x is the distance from the fault, and D is the locking-depth. This equation allows for variance among the locking depth and slip-rate until a best-fit curve is found. GPS velocities alone will not constrain the slip-rate to the appropriate accuracy. Thus, application of this model is necessary for proper analysis.

With the slip rate and range of locking depths, all variables needed to determine the rate of seismic moment accumulation are present. This is the amount of energy being stored by the fault since the last major earthquake. The equation is as follows:

$$Mo' = \mu * A * D', \quad (2)$$

where μ is the shear modulus (30 Mega Pascal), A is the area (length and range of down-dip widths [i.e. locking depth], and D' is the slip rate. This value is needed, in part, for a determination of a recurrence period for large (M = 7.2) earthquakes along the southern section of the DSF.

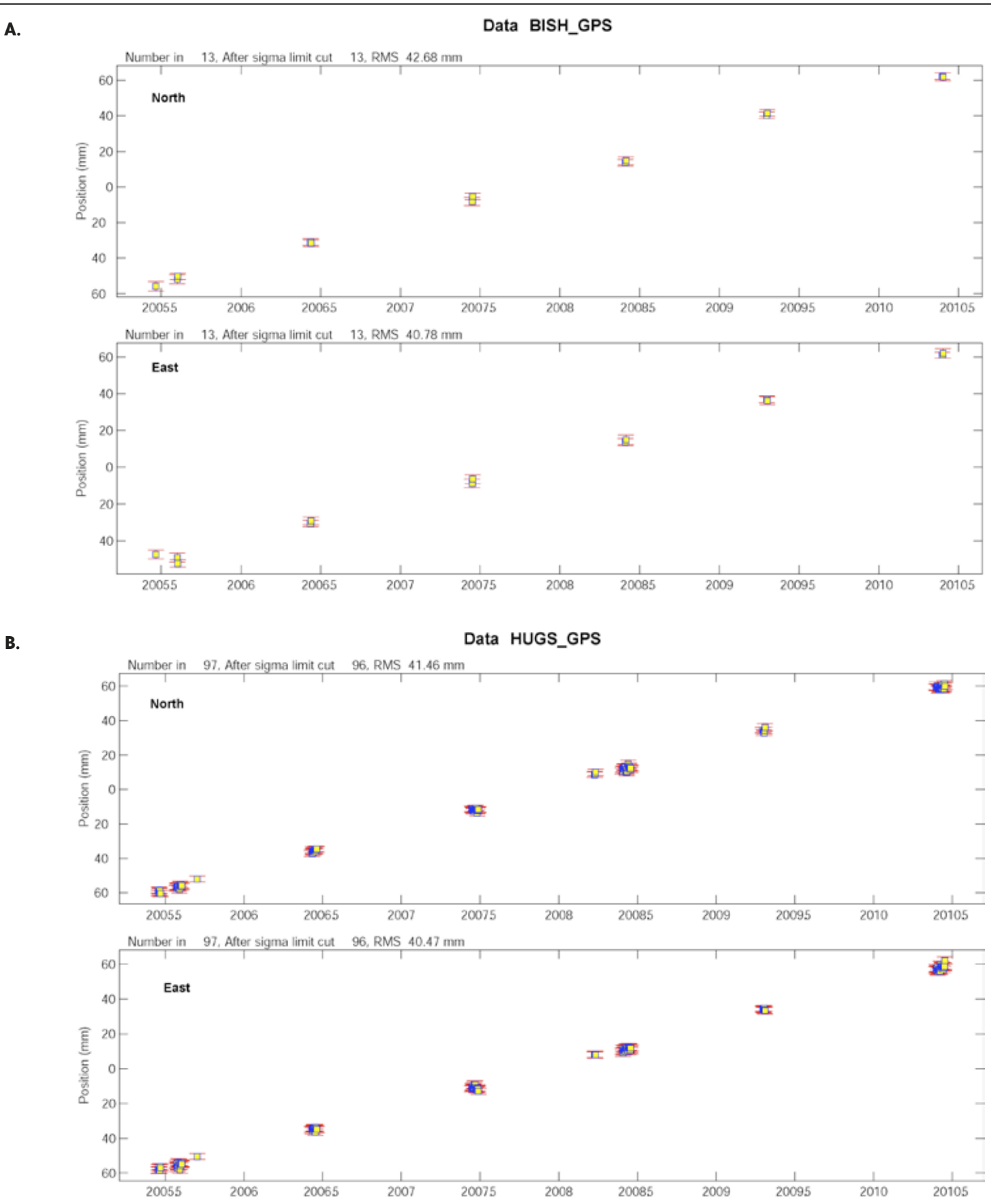


Figure 4. Time series generated from processed GPS measurements over 5 years, 2005-2010. Shows the migration of position with time. (a) Time series of a GPS survey station, BISH. (b) Time Series of continuous GPS station, HUGS.

By dividing the moment produced by a M = 7.2 earthquake by the moment accumulation rate determined by the geodetic data, we can determine the return period for these large events. Using an earthquake catalog from the International Seismological Center (ISC) for the past 30 years, we constructed a histogram relating the magnitude of each event with the recurrence (i.e. using the Gutenberg-Richter relationship), and calculated the moment release rate through integration. In order to obtain a more accurate moment accumulation rate, the moment released from the smaller earthquakes was subtracted from our geodetic accumulation rate, resulting in a net moment accumulation. With our data, since there is a range of possible locking depths, we calculated a range of the net moment accumulation. By having a rate at which the strain is accumulating, and the moment released during an Mw =7.2 earthquake, a recurrence interval along this section of the fault was found.

RESULTS AND MODELING

Our GPS velocity map (Fig. 5) shows the present day movement along the DSF, with the velocity vectors showing consistency among one another. This map shows the left–lateral movement of the Sinai plate relative to Arabia along the transform, along with their standard errors (circles). Larger errors indicate that the stations time series is not long enough to produce robust results. These data, however, still provide us with the relative motion along the transform, which when stabilized with Arabia, should be zero.

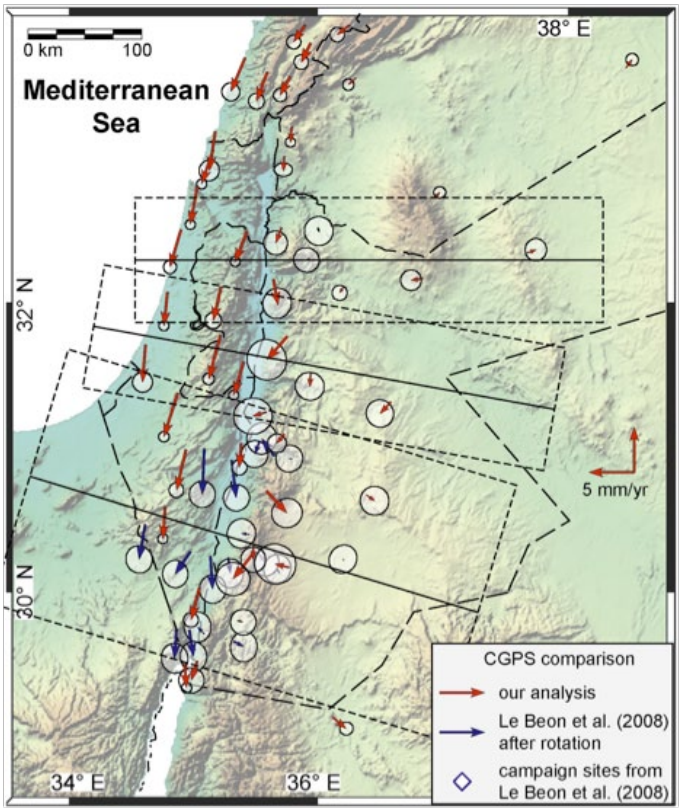


Figure 5. GPS vector map showing the velocities of survey sites relative to stable Arabia. The dotted lines represent the relative area of each of the three profiles used for elastic dislocation modeling.

In order to determine the parameters of the fault (i.e. slip rate, and locking depth); we constructed three profiles (Jordan Valley, Dead Sea Basin, and Wadi Araba) along the velocity field perpendicular to the fault. Along the Wadi Araba (south), the strike of the fault is WNW-ESE and progressively becomes more E-W in the north. Application of a 1-D elastic dislocation model (Savage and Burford, 1973) assumes an infinitely long strike slip fault and uses equation (1) to determine a range of locking depths and slip rates that best fit the data (Fig. 6a-c). Our data suggests a preferred slip rate of 4.2 ± .4 mm/yr along the Jordan Valley Fault, 5.0 ± .8 mm/yr in the Dead Sea Basin, and 4.5 ± .7 mm/yr across the Wadi Araba Fault, respectively. Using a normalized probability distribution, a mean slip rate of 4.1 ± .3 mm/yr was found. These values are much higher than previously reported slip rates in the northern and central DSF (e.g. Gomez et al., 2007; Alchalbi et al., 2010). The locking depth ranges from 10-18 km, from the northern profile to southern profile, which agrees with other suggested depths along the southern and central DSF (e.g. Wdowinski *et al.* 2004; Gomez *et al.* 2007; LeBeon *et al.* 2008). Also, the peak probability of the total range of slip rates and locking depths with 1-σ confidence is shown in Figure 7.

Determining the return period for the characteristic earthquake involved the moment accumulation rate, found using our geodetic data, less the moment release rate, which was obtained using Gutenberg-Richter relationship (Fig. 8). This plot compares the frequency of earthquakes with magnitude. To obtain a more accurate value of the net rate of seismic moment accumulation, we subtracted the moment release rate of instrumentally recorded seismic data (4.7×10^{16} Nm/yr) from the geodetic moment accumulation rate. We assumed the physical parameters of our characteristic earthquake (Mw = 7.2). This resulted in a range of values for our netmoment accumulation rate from 9.2 x 1016 to 1.4 x 1017 Nm/yr. Comparison of the moment released by our characteristic earthquake (e.g. Ambraseys and Jackson, 1998; Klinger et al., 2000b) with the net moment accumulation suggests a recurrence period of 600-1300 years, depending on the depth of locking. This value corresponds with previously reported recurrence periods along the Wadi Araba fault, i.e. southern profile (e.g. Klinger et al., 2008b), as well as recurrence periods for earthquakes in the Dead Sea basin (e.g. Hamiel et al., 2009).

DISCUSSION

The GPS measurements show that there is in fact present day strain accumulation along the southern DSF. This left lateral deformation can be seen by the GPS velocities, which show station velocities across the fault moving in the NNE-SSW direction. Also, velocities on the East side of the southern DSF show zero motion, which is accurate in our Arabia-fixed reference frame. Furthermore, the slip rate solutions found for the Jordan Valley and Wadi Araba are statistically identical. The Dead Sea Basin, however, shows much higher slip rate and does not provide an accurate solution for this area. This is, in part, due to the structural complexity throughout the Dead Sea Basin and not being able to properly model this region. Further analysis will focus on more accurately modeling this region.

When the elastic model is applied to the derived GPS velocities, a slip rate of 4.1 ± .3 mm/yr and a locking depth of 10-

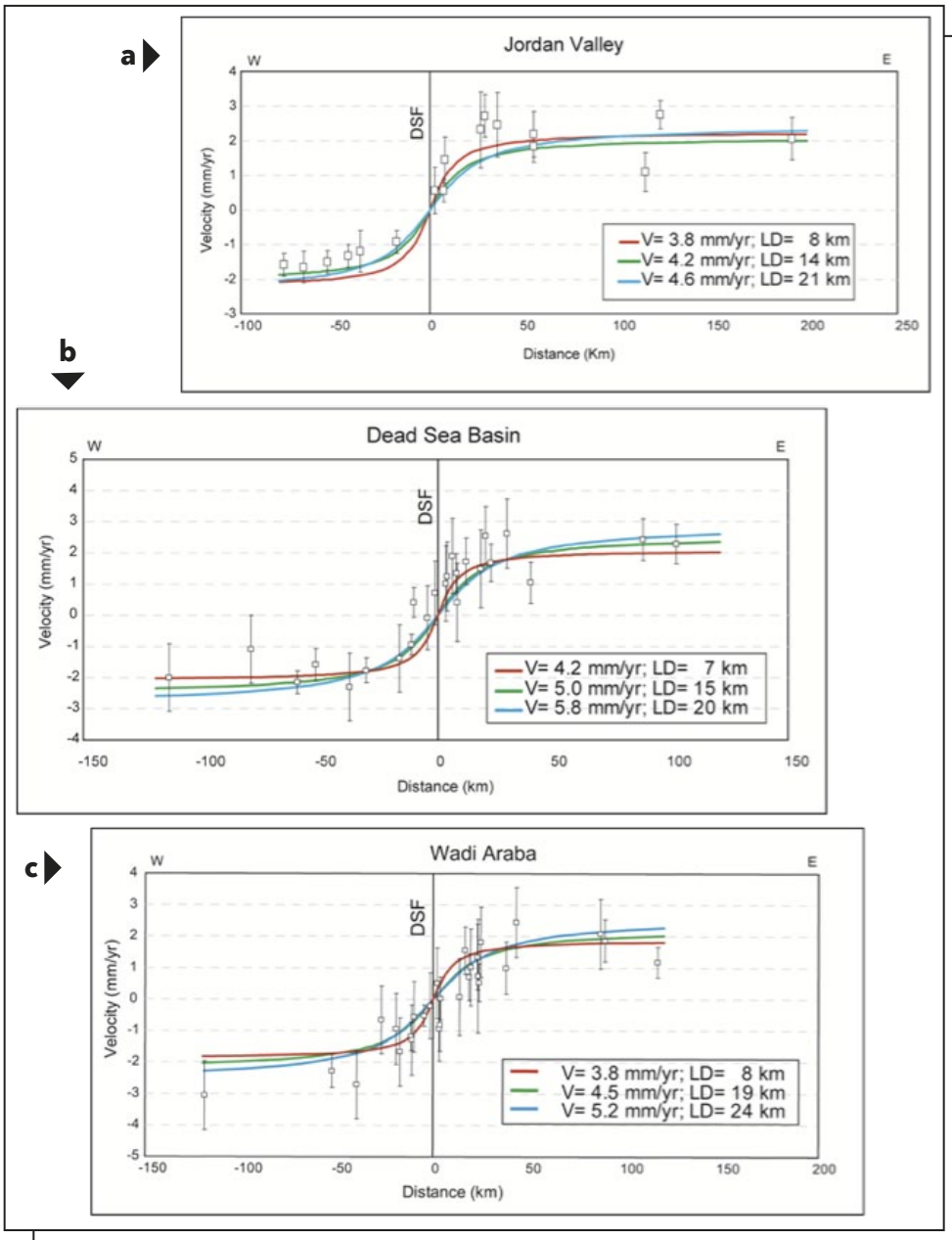
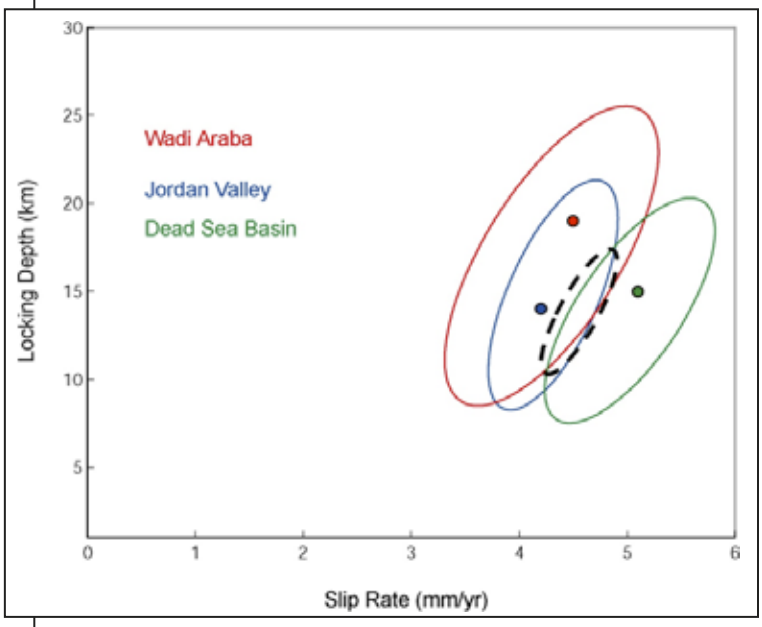
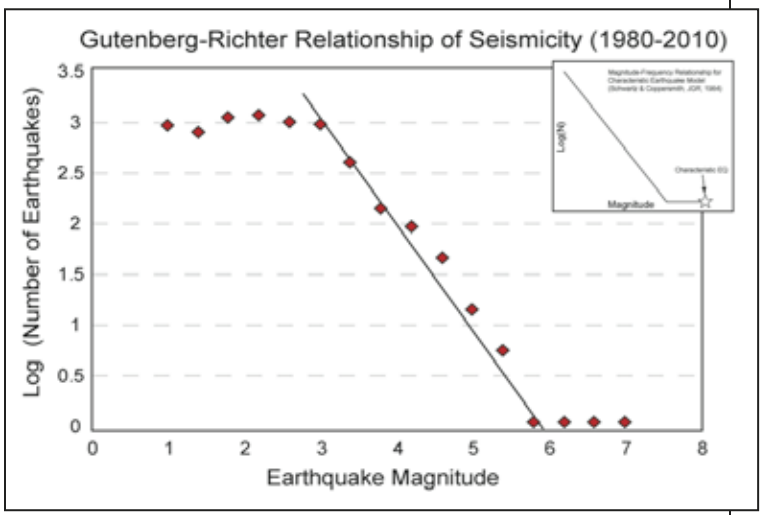


Figure 6 (Top left).
(a)-(c) show elastic modeling of the GPS velocities across the DSF through the Jordan Valley, Dead Sea Basin, and Wadi Araba. The zero y-axis is represented as the DSF. The range of slip rates and the associated locking depth is shown.

Figure 7 (Bottom left).
1-σ confidence elipses showing the distribution of possible slip rates and corresponding locking depths after Monte Carlo analysis. Points represent best-fit locking depth and slip rate for each profile. Dotted oval shows overlap between all three profiles, and is the most probable location for the absolute slip rate and locking depth.

Figure 8 (Bottom right).
Gutenberg-Richter relationship between earthquake magnitude and frequency of at-least that magnitude occurring. Seismic data obtained from the International Seismological Centre (ISC) from 1980-2010. Inset: Characteristic earthquake model by Schwartz and Coppersmith (1984) indicates that Characteristic earthquake occurs away from Gutenberg-Richter line. Integration under this line provides seismic moment release rate.





18 km provides accurate fitting of the data. This slip rate is provides a more accurate result than previous studies by increasing the spatial distribution and number of survey sites, a more robust analysis of these parameters was made possible in this campaign.

By comparing the moment accumulation rate with the amount of moment needed to produce an M = 7.2 earthquake, a recurrence period of 600-1300 years was found. The Gutenburg-Richter relationship only allowed integration to M ~6, which excludes some of the larger events in the region. By have a larger moment release, there would be a smaller deficit and thus a larger moment accumulation rate. This would reduce the return period and produce more robust results. Further studies may continue with this analysis.

CONCLUSIONS

The data shown above provided the evidence needed to conclude that present day deformation is occurring along the southern DSF. GPS velocities provide the left lateral motion of the Sinai plate relative to the Arabian plate. From these GPS velocities, other fault parameters, which include fault slip rate and locking depth, were found to have values of 4.1 mm/yr and 10-18 km, respectively. These values lie in the range of past studies along this section of the DSF, but also raise questions as to why these values vary from the southern DSF to the northern DSF.

A return rate of 600-1300 years for M =7.2 earthquakes was found for the entire length of the southern DSF. With large magnitude earthquakes present in the historical records, having a realistic idea of the recurrence rate is crucial for earthquake hazard assessment.

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Exploring Gender, Self-representation, and Communication in Second Life

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LITERATURE REVIEW

As interest in online interaction increases, so does the amount of research looking into how these interactions take place. Advancing technology has led to the popularity of virtual worlds in which users can communicate with others in 3-D visual, interactive spaces online. The popularity of these virtual environments, coupled with the way that they tend to mimic life offline and give users a sense of anonymity, make them incredibly useful for researchers who are studying human behavior.

Virtual Worlds and Online Identity

One of the most popular virtual worlds is Second Life (known as "SL"). Created by Linden Labs in 2003, Second Life has over 14 million registered users, known as "residents" (Rak, 2009, p. 148). In SL, residents are able to "buy and sell virtual land, start virtual businesses, attend or teach virtual classes, create objects...and participate in myriad activities limited only by their imagination" (Diehl & Prins, 2008, p.102). Upon registering in the virtual world, users are able to create and modify a virtual representation of themselves known as an avatar. These avatars are able to communicate with others in-world through text-and audio-based discussions, advertisements on virtual billboards, newspapers, blogs, or websites dedicated to SL (Diehl & Prins, 2008, p. 104).

Creating and clothing the avatar is one of the most important aspects of life in a virtual world. The outward appearance of the avatar communicates to others either who the user is or who they wish to be. Avatar creation is so important in Second Life that Julie Rak states in *The Electric Self: Doing Virtual Research for Real in Second Life* that "if Second Life has a gaming objective, it is the game of identity itself"(2009, p. 153). There are no predetermined goals in Second Life, such as levels to beat or missions to accomplish. Second Life is simply a virtual environment in which users participate in "social, economic, recreation and education activities with other avatars" (Diehl & Prins, 2008, p. 102).

Rak expresses that avatar appearance in-world is both a form of social currency and identity itself (2009, p. 154). Some users may create their avatars as near-identical representations of themselves, giving the avatar similar features and dressing the avatar as they would normally dress. Other users may create their avatar as completely different from themselves as a symbol of how they wish they appeared in first life or as a form of self-expression. Many users choose to model their avatars after socially accepted standards of beauty, often creating hyper-sexualized representations of gender.

An experiment by Yee and Bailenson (2007) found that

when respondents were represented by unattractive avatars, they were less likely to self-disclose and kept a greater distance when interacting with others than did respondents who were represented with more attractive avatars .Experiments such as this highlight the idea that online, just as in life offline, social interactions are guided by appearance. Stromer-Galley and Martey (2009) point out that the "more visually realistic avatars are more capable of effective social interaction" (p. 1051).

Anonymity Online

Residents may also create avatars that do not resemble themselves due to perceived anonymity tied to interaction in virtual worlds. Anonymity can generally be defined as the inability of an individual to be identified by others (Christopherson, 2007, pp. 3039-3040). Stromer-Galley and Martey discuss in their article *Visual Spaces, Norm Governed Places* that users of virtual worlds can still be anonymous because the avatar is not actually the physical self. (2009, p. 1055). While the avatar may be created as a direct representation of the user, it exists separately in an online space and allows the creator the freedom to remain unknown. Recently, researchers have placed great importance on the idea of anonymity in online communication.

In virtual worlds, anonymity plays an important role in social interactions as well as avatar creation. Because the actions of online representations do not generally come with automatic first life consequences, users are often able to keep those identities separate from their first life identities. For example, "one may type seductive and sexually inviting text...without typically having to worry about actually being physically touched in return (Roberts & Parks, 1999, p. 524). Users can be anonymous in virtual worlds while expressing thoughts and feelings without fear of being identified or sanctioned. Autonomy and anonymity give the user the chance to experiment with new behaviors or become completely different people without fear of social consequences (Christopherson, 2007). These factors may allow for users to experiment with gender roles and sexuality without being afraid of first-world repercussions such as harassment or physical harm.

Gender Identities Online

One of the ways that residents become different people in virtual worlds is the use of gender switching. Gender switching in virtual environments is the act of choosing an avatar which represents a gender different from the user's own biological sex (Roberts & Parks, 1999, p. 522).Gender switching is one of the most widely researched forms of gender play in online interaction. A common reason given for gender switching was the satisfaction of curiosities involving gender or the desire to experiment with gender, and most users who switched genders did so within traditional binary conventions (i.e. male to female or female to male) (Roberts & Parks, 1999). The ability to move beyond a gender binary has been regarded by some feminist commentators as an incredibly important political feature of virtual environments (Roberts & Parks, 1999, p. 525).

According to T.L. Taylor in her book Play Between Worlds: Exploring Online Game Culture (2006), identity exploration is a primary goal for women and girls who participate in virtual worlds. It has been shown that physical appearance plays an important role in social interaction and that gender performance can affect how residents are treated in virtual worlds (Christopherson, 2007). A study by Nowak and Rauh (2005) found that participants preferred gendered avatars (highly masculine or highly feminine) to more androgynous avatars (neither masculine nor feminine). Stromer-Galley and Martey (2009) found that "avatar bodies seem to shape how interaction unfolds and what the expected roles of men and women should be" and that "players chose avatar bodies that matched contemporary notions of attractiveness, especially for female avatars, including large lips, voluptuous flowing hair, and a curvy body" (p. 1052).

Feminist scholars have long been researching expectations of beauty placed on the female body. Anne Fausto-Sterling states in her book Sexing the Body (2000) that "...feminist theorists view the body not...as a bards scaffolding on which discourse and performance build a completely acculturated being...culture molds and effectively creates the body" (p. 6). This very well may be true for the creation of virtual bodies as well. Fausto-Sterling and other theorists suggest that culture places incredible pressure on people to be able to fit into strict categories of male and female. Susan Bordo describes the body as a "medium of culture", claiming that expectations are both inscribed on the body and reinforced through it at the same time (1993, p. 459).

The effects of cultural pressure on the female body is especially evident through the way that women are sexualized in the popular media and advertising. The sexual exploitation of women in advertising has increased dramatically in the last few decades, causing an onslaught of images of tall, thin, sexually suggestive women cropping up in magazines, on billboards, and on television and the internet (Renzetti, 2003, p. 157). Many of the avatars that can be seen in virtual worlds resemble the images described by Renzetti. Evans, Riley, and Shankar (2010) state that women "increasingly have come to live their sexualities through, and with the aid of, television, press, film, and most recently, cyberspace" (119). This may offer one explanation for why women may choose to represent themselves through hyper-sexualized avatars in virtual worlds.

Studies have shown a connection between the sexualization of women in our culture and how they present themselves in first life, but much research still needs to be done in relation to how women represent themselves in virtual worlds. There are a multitude of reasons that affect how people choose to build their avatars, and the fact that many women create sexualized avatars may have something to do with the sexualization of women in western culture.

THE PRESENT STUDY

The present study will shed light on how users of virtual worlds express gender identity and engage in gendered communication. It will also explore how anonymity affects how people interact and present themselves online. The research will increase understanding of whether or not current social constructions of gender are still catered to in virtual worlds when anonymity is a factor in social interaction and will expose the ways in which social ideals of beauty and body image carry over into life online. The study will question the ways in which

users represent their gender and sexuality in virtual worlds as well as how those representations affect social interactions in those worlds. It will also attempt to show that perceived anonymity in a virtual world is positively associated with feelings of freedom in regards to enacting gender roles while in virtual worlds.

METHOD

Data was collected through the administration of online surveys. Volunteers for this survey were recruited using both snowball sampling in the virtual worlds and through online social media sites. The roughly 15-minute survey contained both open- and closed-ended questions in order to gather both qualitative and quantitative information regarding participants lives in-world and in their first-lives. Participants were offered an incentive in the form of virtual money which was awarded through a random drawing of participants.

Participants

Participants were regular users of the virtual worlds Second Life and/or IMVU, although results from IMVU participants were inconclusive. Users of both virtual worlds were asked to answer the survey questions based on which virtual world they participated in most often, and participants were asked to answer the questions based on the avatar that they use most frequently. A total 302 users participated, with 58% *(n=174)* being women, 40% *(n=120)* men, and 3% *(n=8)* transgender.

Variables

Questions about the participant focused on basic demographic information, personal appearance and body image, level of media consumption and time spent in-world. Questions focusing on the user's avatar centered on the individual avatar's appearance, the dominant appearance of other avatar's in-world, and the reasons behind avatar creation.

Demographics

Questions about age, race, and sexuality were asked in order to get a clearer picture of the participants as well as gauge the ways in which they designed their avatars to match their first-life identities. Questions about the user's height, weight, and skin tone were asked so that the responses could be tied to responses to questions about the user's personal feelings about their own body. In regards to the participant's feelings about their own body, they were asked closed-ended questions, using a Likert scale, to rate their body image and satisfaction. They were then asked to rate their positive or negative feelings about their own body.

Avatar Sexualization

Participants were asked to rate certain characteristics of their avatar on scales from 1 to 5. For female avatars, scales were designed to rate the level of modesty of the avatar's clothing, the avatar's breast size, and the avatar's weight/body shape. For male avatars, scales were designed to rate the level of modesty of the avatar's clothing, the muscularity of the avatar, and the avatar's weight/body shape. Participants were also asked questions regarding average avatar appearance, the inspiration behind the styling/design of their avatars, and how the appearance of their avatar has affected their interactions in-world.

Anonymity

A section of the survey focused on anonymity and immersion in virtual worlds. Users were asked closed-ended questions regarding their use of virtual worlds, their online profiles, the amount of "real life" information that they supply to other residents in-world, and the quality/frequency of their relationships with others in-world. Users were also asked questions regarding the relationship between their lives online and offline.

Analysis of Data

Responses to open-ended questions were analyzed using thematic analysis with the assistance of a trained coder. Responses to closed-ended questions were analyzed using correlations, frequencies, and Chi-square tests. Quantitative analyses were primarily used to examine relationships between perceived anonymity and the gendering and sexualization of avatars in virtual worlds.

RESULTS

Thematic Analysis

Responses to open-ended questions were coded using thematic analysis. Common themes were identified in responses to each question, and then responses were categorized using those themes. In regards to the question "What inspired the styling/design of your avatar?", responses were coded for seven different themes. These themes were: Self Expression; Modeled after Real Life Self; Idealized Version; Influence of Others; To Fit a Role; Media Influence; and Other.

Responses to the prompt "Please explain in what way(s) you feel pressured to make your avatar look a certain way because of your avatar's gender" were coded into five main categories. These themes were: Pressure from Others; General Gender Ideals; Real Life Pressure to Conform; Second Life Pressure to Conform; and No Pressure to Conform to Gender Roles.

Participants' responses to the question "How has your avatar's appearance affected how people interact with you?" were coded into five categories of interaction: Generally Negative; Generally Positive; Experiences of Racism; Experiences of Sexism; and Neutral.

Finally, responses to the question "How would you describe your social interactions in-world?" were coded into four categories: Generally Positive; Generally Negative; Neutral; and Romantic or Sexual.

Avatar Design

Women were more likely than men to indicate that the inspiration for their avatar stemmed from an idealized version of the self, χ^2 (1, N = 257) = 5.24, p = .02, Cramer's V = .14. Participants who reported an idealized version of the self as inspiration for their avatar design stated that their avatar was designed to look like their real selves, but younger, thinner, taller, or more attractive. Approximately 30% (n = 55) of female participants responded in this way, compared to 16% (n = 12) of male participants.

Male participants were significantly more likely to indicate that the inspiration for their avatar's design came from the influence of others, χ_2 (1, N = 257) = 6.05, p = .01, Cramer's V = .15. Avatar design inspiration based on the influence of others was indicated by statements from participants that someone else had chosen the avatar's clothing or suggested ways that the user should modify the avatar, and/or that the user created their avatar in order to look attractive to someone else. Approximately 19% (n = *14*) of male participants responded this way, compared to 8% (n = *15*) of female participants.

Additionally, results cautiously suggest that participants who engaged in gender play (i.e. when a user creates an avatar of a gender different than that of their offline self) were disproportionately likely to report being influenced by the media for the design of their avatar in comparison to participants who did not engage in gender play, χ^2 (1, N = 258) = 4.42, p = .04, Cramer's V = .13. Of the participants who engaged in gender play, 10% (n = *5*) credited media influence as inspiration for their avatar's appearance, in comparison to only 3% (n = *7*) of those who did not engage in gender play. Modeling of an avatar after an actor, film, television, or book character, or some other celebrity was an indicator of the media as a source of avatar design inspiration.

Perceived Anonymity, Wishful Identification, and Gender Play

Of the participants who reported participating in gender play (n = *48*), male-to-female gender play was more common (n = *39*) than female-to-male gender play (n = *9*). It was predicted that higher levels of perceived anonymity would allow users to feel freer to engage in gender play. No support was found for this hypothesized relationship between gender play and perceived anonymity in the virtual world. Results show that there is no significant correlation between a user's perceived anonymity and their participation in gender play. There were, however, significant differences regarding wishful identification and gender play for participants who had female avatars, t = -2.40 (198), p = .02. Female participants who created female avatars indicated a higher level of wishful identification (M = *4.94*, SD = *1.80*), meaning that they desired to look more like their avatar in real life, than transgender male-to-female avatars (i.e. the phenomenon of male participants having a female avatar) (M = *4.13*, SD = *2.23*). No significant differences for gender play and wishful identification were found when examining participants who had male avatars.

Avatar Appearance

Participants were asked to rate the appearance of their own avatars on pictorial scales ranging from one to five on three appearance dimensions. The results of those scales can be seen in figures 1 through 6. The means for male avatar appearance were: 2.36 for avatar modesty (see figure 1), 2.85 for avatar muscularity (see figure 2), and 2.77 for avatar weight/body size (see figure 3). The means for female avatar appearance were: 2.61 for avatar modesty (see figure 4), 2.78 for avatar breast size (see figure 5), and 2.15 for avatar weight/body size (see figure 6). Female avatars were more provocatively dressed and slimmer than male avatars, which is consistent with U.S.-based cultural

Figure 1

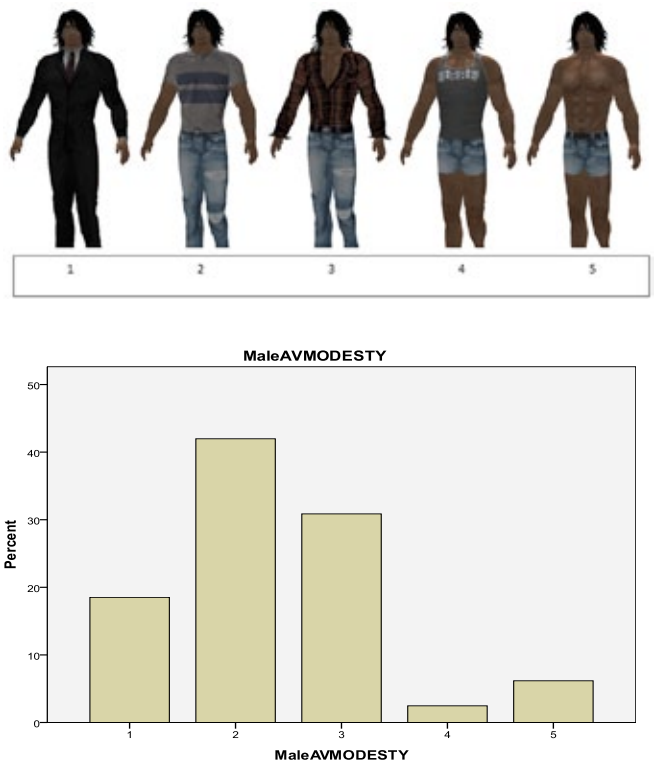
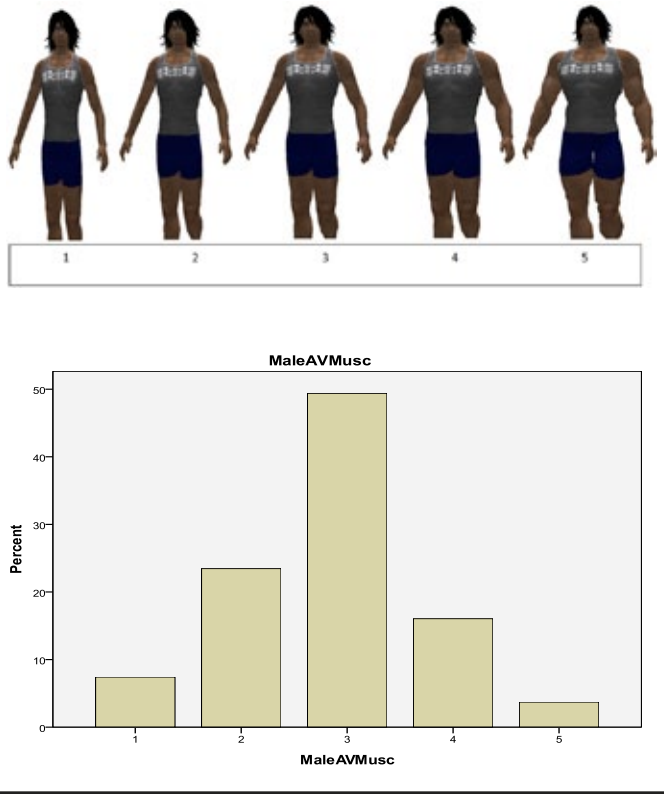


Figure 2



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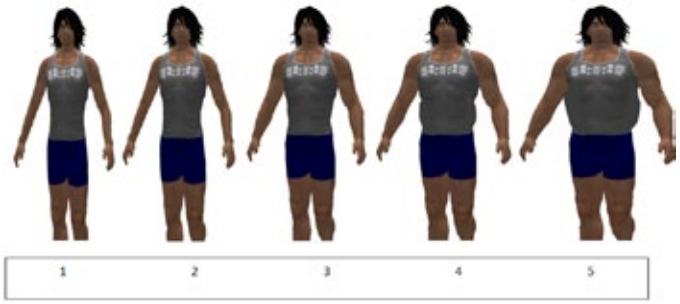

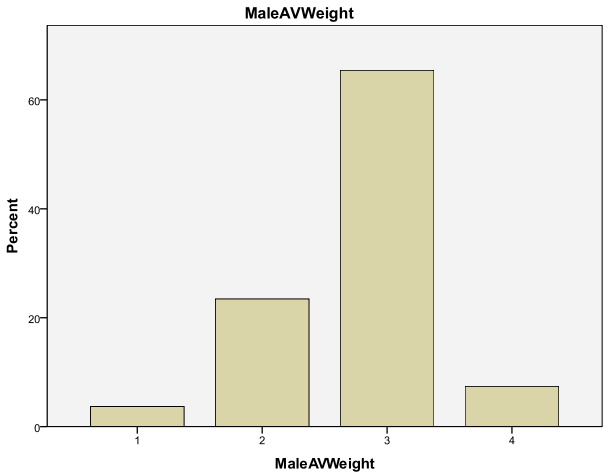

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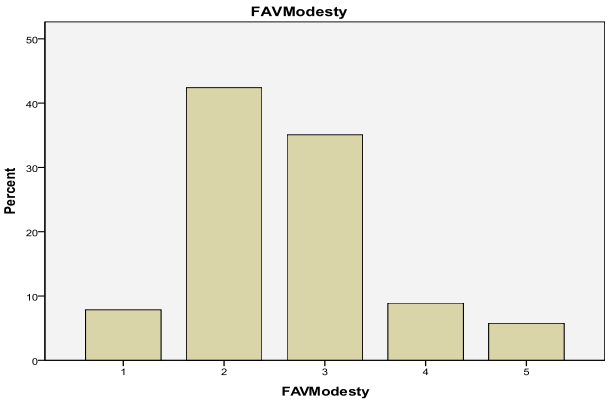

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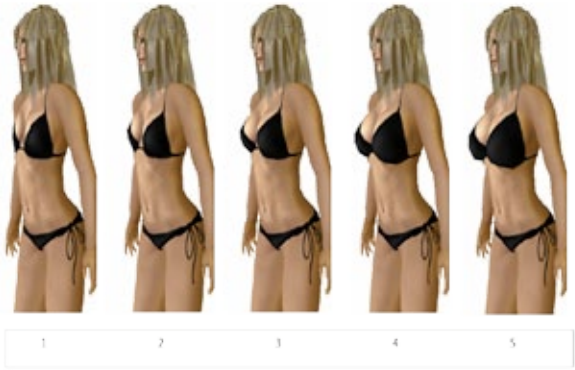

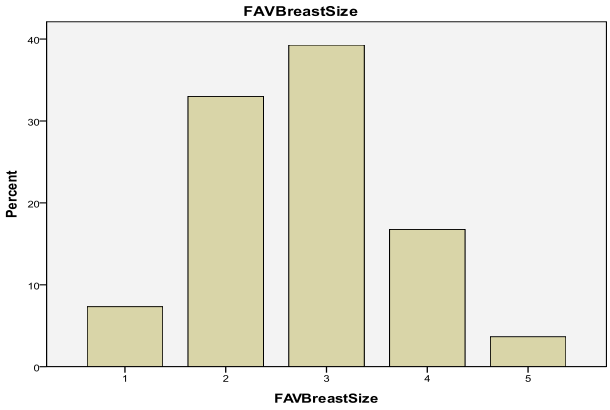

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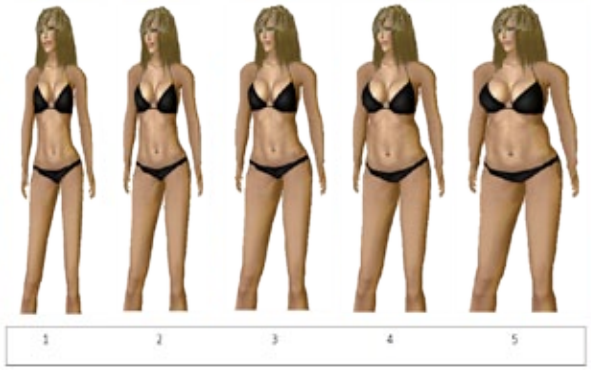

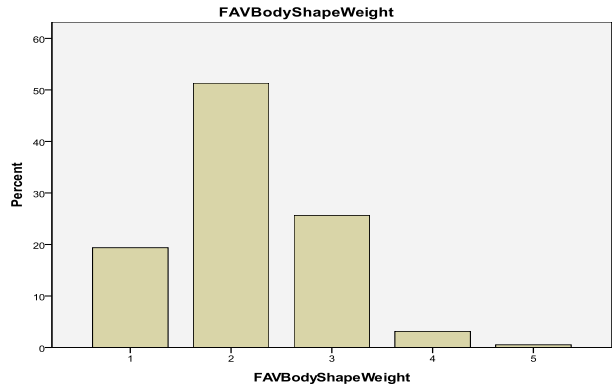

idealizations of female and male appearance. Additionally, when looking at figures 5 and 6, the data suggest that the body proportions of female avatars may be unrealistic, with somewhat larger breast sizes on smaller body frames.

Avatar Interaction and Communication

Analyses were conduced to test the relationship between avatar appearance and quality of in-world interaction. For female avatars, there was a significant link between breast size and positive interactions for female avatars ($r = -.27$, $p = .001$, $N = 152$). Those who indicated that their avatar had smaller breasts indicated more positive social interactions than those who indicated that their avatar had larger breasts. The results also indicate a significant link between modesty of dress and positive interactions for female avatars ($r = -.19$, $p = .02$, $N = 152$). Those who indicated that their avatar dressed more modestly indicated more positive social interactions that those who indicated that their avatar dressed more provocatively. Based on responses to an open-ended question inquiring about how their avatar appearance affected how others interact with them online, busty and provocatively dressed female avatars (i.e. sexualized female avatars) were often treated as sexual objects of desire by other virtual world users and received many unwanted sexual advances. Thus, female avatars with small breasts and modest clothing avoided unwanted attention, and therefore these participants reported having more positive social interactions in-world. So, in this case, lack of attention was constructed as positive interaction by participants, and unwanted sexual advances were avoided through the styling of a modest female avatar.

For male avatars, the results suggest a significant link between muscularity and negative interactions ($r = -.36$, $p = .005$, $N = 60$). Those who indicated that their avatar was more muscular were more likely to indicate that their social interactions were negative. Based on responses to open-ended questions, this may be because muscular avatars were perceived by others as being intimidating, thus limiting that avatar's social interactions. No other significant relationships were found between appearance dimensions and social interaction for male and female avatars.

When examining specific types of negative in-world communication, a significant relationship was found for avatar gender and experiences of sexual harassment. Of participants who had female avatars, 43% ($n = 91$) indicated that they have experienced sexual harassment in-world, compared to 16% ($n = 13$) of participants with male avatars. Male avatars were less likely than statistically expected to indicate experiencing sexual harassment, while female participants were more likely than statistically expected to indicate experiencing sexual harassment.

The results show a significant link between avatar gender and receiving unwanted flirtation or sexual advances. Fifty-two percent ($n = 43$) of participants with male avatars and 69% ($n = 147$) of participants with female avatars indicated that they have experienced unwanted flirtation or sexual advances. Male participants were less likely than statistically expected to indicate experiencing sexual harassment, while female participants were more likely than statistically expected to indicate experiencing sexual harassment. This indicates that sexual harassment in-world may be a gendered experience, with female avatars being more likely to experience this type of negative interaction.

DISCUSSION

The results of this study show that women and men have very different experiences in Second Life, both in their avatar creation and their interactions with others. Women's responses to questions about the creation of their avatar indicate concerns with body-image and self-esteem. These responses imply that women may be living vicariously through their avatars, or using their avatars as a way to feel better about themselves. Future studies should focus on the connection between women's self-esteem and body image and their relationships to their avatars.

This study also indicates that a female avatar's appearance is more likely than a male avatar's appearance to affect the ways that others interact with her. More specifically, participants who had more highly sexualized female avatars were more likely to receive unwanted attention from other users in-world. So, on the one hand, these avatars were clearly deemed to be highly attractive, but, on the other hand, these avatars garnered unwanted attention that was perceived as negative by the user. Additionally, simply being female – regardless of avatar styling – made one more vulnerable to sexual harassment in-world. Overall, results suggest that attitudes towards women's bodies and sexism that exist in life offline have carried over into life online, reinforcing prior research that claims that life in virtual worlds tend to mimic life in the regular world. This information is important for feminist and social science researchers, as virtual worlds become increasingly popular spaces to enact identity and interact with others.

While this study hypothesized that perceived anonymity in a virtual world would be positively associated with feelings of freedom in regards to enacting gender roles while in virtual worlds, the hypothesis was not supported by the results. Given the previous research into virtual worlds and perceived anonymity, this is surprising. While it would seem that increased anonymity would allow users to more openly express alternative notions of gender roles and gendered appearance, the current study found no connection between anonymity and gender play.

While there are many virtual worlds available to users, this study focused on only on two popular virtual worlds: Second Life and IMVU. The low number of participants from IMVU left results inconclusive for that virtual world, so results of this study came solely from Second Life users. Future research into gender and social interaction in virtual worlds should make it a point to recruit participants from multiple virtual worlds in order to expand the breadth of the study.

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An Investigative Analysis into Electrospinning for Collagen Regeneration

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INTRODUCTION

With the advent of different methods for controlling the production of materials on increasingly smaller scales, the field of nanotechnology has become ever more popular. One such method for the production of fibers that are on the nanometer scale has been electrospinning. With the basic parameters of electrospinning being highly modular, the permutations on the number of different materials that can be produced becomes increasingly large. One of the many parameters that can be manipulated is the solute that is being spun to produce the fibers on the base plate. As more than one polymer can be used in the solvent and subsequently electrospun, the combinations of different mixtures is staggering [2].

The history of electrospinning dates back to the early 1930's when a series of patents by an individual named Anton Formhals described a method for producing artificial filaments from electrostatic gradients [1]. These filaments were made from naturally occurring polymers but little attention was paid to them due to their lack of being able to be transformed into materials that had industrial applications. From this point, small advancements in technique and an increasing database of knowledge gradually increased the practicality and capabilities of this technology. The term electrospinning however did not appear until the early 1990's following a set of experiments when Reneker and Chun described the current mechanisms of electrospinning [2].

Since the early 1990s, the set-up has become increasingly refined and experimental data on various polymer mixtures, solvents and combinations has been growing exponentially each year. Particularly in the last decade, there has been a sudden interest in utilizing electrospinning in the field of tissue engineering. The primary constituent of extracellular matrices is proteins and carbohydrate polymers, which can be electrospun. Using this knowledge it may be possible to create electrospun biological scaffolds, which possess many different physicochemical properties and thus can be utilize in many biophysical and biomedical applications [2]. Such applications include the use of a topical spray consisting of a nanofiber mesh to wounds in order to aid recovery time, the use of a mesh of nanofibers to act as a microfiltration device, enabling the filtering of blood to detect biochemical phenomenon and the use of a mesh to act as a tissue replacement until growth and recovery can occur to the site of injury.

Apparatus Design

The basic apparatus of electrospinning consists of a set of electrodes that provide a potential difference across a known distance. These electrodes produce an electrostatic force that is

the driving method by which the electrospinning occurs. One end of the electrode is attached to a syringe tip while the other electrode is grounded on a collection plate as shown in Figure 1. Q is the flow rate of the solution that is being pumped, V is the potential difference between the needle and the ground (usually measured in kV) and d is the separation distance between the tip of the needle and grounding plate. The solution to be spun is contained in the syringe, which can be placed in a syringe pump and dispensed at varies pumping rates.

As the fluid is pumped, a droplet forms at the tip of the needle, with the size of the droplet varying with the solvent used (solutions will have different surface tensions), the pumping rates, and the magnitude of the electrostatic force [4]. As the fluid passes through the needle, it has an induced net charge, causing an attractive force to the other electrode. Once this force becomes large enough, the fluid essentially leaves the tip of needle and travels through the air to the ground plate.

As the fluid moves, the solvent, presumably one that is moderately volatile, evaporates leaving a polymer fiber that deposits on the ground plate. This area is described as the Taylor cone after the mathematician Sir Geoffrey Ingram Taylor who first described this phenomenon mathematically in 1964. The size and area of the Taylor cone is highly dependent on the separation distance of the electrodes as the electrostatic force decrease with the square of the distance. Once a sufficient quantity of material has been electrospun, the material can be removed from the electrospinning chamber [9].

Experimental Parameters

Of the different constraints that can be modified within the experimental scope of electrospinning, none is more expansive than the utilization of different polymers in producing a multitude of applications. The different polymers that can be electrospun range from Polyvinyl Chloride (the main component of PVC pipes) to Cellulose to various forms of Collagen. Each of the different polymers has different properties that range from being used as a strengthening agent (like Kevlar) to being used to make a material more biologically compatible (such as hyaluronic acid). Depending on the application, certain polymers may have target properties and consequently be a candidate for the electrospinning procedure. Typically a solution may only have one solute, but it is becomingly increasingly common for more than one polymer to exist in a solution. The purposes of this may be that one particular polymer has a desirable Young's Modulus while another may prevent fiber degradation when the material is subjected to an external environment [18, 19]. Tan et al discussed the methods in which single fibers were created and subjected to a nano-tensile tester in order to properly determine the tensile strengths of the material. Similarly, Kleinmeyer et al discussed the different morphological properties such as diameter size of the fibers and how those could impact the capabilities of the fibers in being used in the textile industry. Generally, they found that as diameter size increased, the tensile strength of the fibers increased.

A second and equally important factor in the experimental design process is the choice of a proper solvent with the correct properties. The most important criterion for electrospinning is that the polymers must exist in an aqueous state, consequently

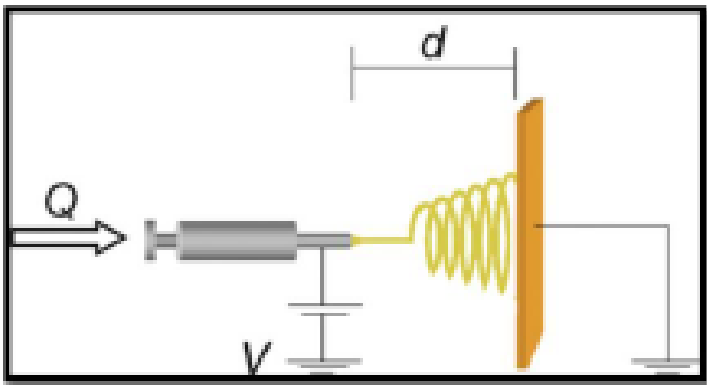

Figure 1. Schematic of an electrospinning apparatus. [2].

a proper solvent must be chosen. A second criterion is that the solvent-solute mixture must lay within a particular range for viscosity for electrospinning. The accepted range is between 1 and 20 centipoise. If the viscosity is too low then solution deposition occurs since the electrostatic force is too strong and thus causes beading of solvent on the fibers [5, 9]. If the viscosity is too high, then there is very little fiber deposition due to surface tension resisting the Coulombic force more vigorously.

If a solvent has an undesirable viscosity or surface tension, modifications can be performed to ensure that electrospinning can still occur. If the primary concern is that the solution viscosity is too high, one modification is to decrease the separation distance between the electrodes. As the distance become smaller, the electrostatic force increases and this can help ensure proper fiber formation. If the viscosity is too low, then decreasing the fluid flow rate can help counter beading on the fiber deposits. A third minor parameter that can be manipulated in order to achieve desirable results is the electric potential that spans the two electrodes, however it has been discovered on further experimentation that as the electric potential increases, so does the porous nature of the fibers making them rougher. It has been noted that as voltage increases, the number of fiber strands pulled from the droplet increases and thus increases the overall matrix density and deposition rate [5].

Material Characterization

Once fibers have been created, it is necessary to asses various characteristics of the fibers depending on the purposes of their application. One possible characteristic that may be assessed is the chemical composition of the mesh in order to verify that there are not any unwanted byproducts from the electrospinning process. An analysis for determining the chemical integrity can be done through scans using Fourier Transform Infrared Spectroscopy (FTIR). By matching the chemical signatures obtained through scans of different samples, it is possible to determine the chemical composition of the meshes. Additionally, by scanning several different samples, it becomes possible to compare the meshes against one another in order to determine the consistency of the process in creating identical meshes.

It may be desirable for the fibers to be of equal diameter, in order to have uniform tensile strength. The primary method for determining the average diameter of fibers has typically been through the use of imaging devices, such as a Scanning

Electron Microscope (SEM). This technique can also be used to determine whether or not there is a uniform fiber density within the mesh, which again is important for determining the tensile capacity of the material. One last characteristic that can be assessed with imaging is whether or not the fibers are porous, as the "roughness" of the fibers may provide practical limitations to their medical applicability [17]. One particular fact is that different cells adhere differently to substrates depending on the physical characteristics of the substrate. Generally, epithelial tissue prefers a smoother substrate while mesenchymal tissue will prefer a rougher substrate. Depending on the intended application of the mesh, it will be important to know which physical characteristics will need to be controlled.

Thermal stress is an additional physical parameter that can assess the capabilities of the fiber at hand, depending on what the platform is designed to function as. Many fibers will degrade above a particular temperature and will become saturated with moisture where as temperatures that are too cold may cause the fibers to become stiff and collapse the mesh altogether. This is known to occur in collagen based meshes as the protein will denature outside of a specific temperature range. A known phenomenon that occurs with the electrospun fibers is that often times their denaturing points and thermal degradation occurs at much lower temperatures due to the fact that the overall molecular weight of the "bulk" decreases, causing mechanical stress to become more apparent. Analysis of this is usually done through a differential scanning calorimetric analysis.

Another characteristic that may be necessary to consider is the biocompatibility of the electrospun fibers. Just because the bulk material is biocompatible, it does not guarantee that the electrospun fibers will be biocompatible. Only by performing biocompatibility testing (in vitro and in vivo studies) can the fibers be assessed [11, 15]. However, most materials do have established biocompatibility and using this knowledge, it becomes possible to determine particular polymeric mixtures that may be more biocompatible than others. It is important to note that current knowledge on nanofibers being incorporated into biological systems in growing but still limited.

Table 1

Displays hyaluronic acid and collagen mixtures between different solutions and volumes at 10% w/v and indicates the amount of solvent that was used.

Solution Volume (mL)	**1**	**2**	**3**	**4**	**5**
Solution Component					
NaOH (mL)	0.8	1.6	2.4	3.2	4.0
DMF (mL)	0.2	0.4	0.6	0.8	1.0
10% w/v (g)	0.1	0.2	0.3	0.4	0.5
Hyaluronic Acid (95%) (g)	.095	0.19	0.285	0.38	0.475
Collagen (5%) (g)	.005	0.01	0.015	0.02	0.025
Hyaluronic Acid (80%) (g)	.08 g	0.16	0.24	0.32	0.4
Collagen (20%) (g)	.02 g	0.04	0.06	0.08	0.1

Table 2

Displays hyaluronic acid and collagen mixtures between different solutions and volumes at 5% w/v and indicates the amount of solvent that was used.

Solution Volume (mL)	**1**	**2**	**3**	**4**	**5**
Solute Component					
NaOH (mL)	0.8	1.6	2.4	3.2	4.0
DMF (mL)	0.2	0.4	0.6	0.8	1.0
5% w/v (g)	0.05	0.1	0.15	0.2	0.25
Hyaluronic Acid (95%) (g)	.0475	0.095	0.1425	0.190	0.2375
Collagen (5%) (g)	.0025	0.005	0.0075	0.01	0.0125
Hyaluronic Acid (80%) (g)	.04 g	0.08	0.12	0.16	0.2
Collagen (20%) (g)	.01 g	0.02	0.03	0.04	0.05

APPLICATION

In recent years, electrospinning has been utilized in tissue engineering to graft tissue and/or vasculature, to develop drug delivery systems, and to produce sophisticated filtration devices. One of the main advantages of using electrospinning is the ability to create synthetic extra cellular matrices (ECM). ECM is composed of mostly of collagen. Collagen is a protein that can make up between 25% and 35% of the whole body protein content. Current research is being conducting on the viability of collagen as a method to heal wounds that may be too large to manage by traditional methods or to provide some sort of structural rigidity to large areas of injury [11, 14]. If small fibers could potentially be applied as a topical spray, this would provide the potential to accelerate the healing process. Other applications involve utilizing electrospun scaffolds for tissue culturing; with the proper design it could be possible for the scaffolds to provide a framework on which cells can grow and differentiate [3, 10]. Organ and tissue malfunction such as hernias, ulcers, burns and large lacerations continue to plague many individuals and with no real alternative aside from medication, surgery, or even transplantation. A platform that can be tailored for a specific function would be beneficial for anyone suffering from these ailments, but more research must be conducted on how systems will react to these materials [7, 9].

Drug delivery is also an area of research and possible application of electrospinning technology. Meshes have been observed to decay in accordance to zero-order kinetics, indicating that a drug could be released a constant and known rate. Liang et al discussed the different natural and synthetic polymers that could be employed (such as collagen or Poly(3-hydroxybutyrate-co-3-hydroxyvalerate) (PHBV)) and decay at known rates. Because the meshes produced are porous, they have great capability of being loaded with a particular drug and as the mesh decays internally, the drug could be released to localized areas [12]. It would be possible to apply a mesh to a wound, allowing for a timed delivery to only the target tissue [6].

Another platform on which electrospinning has applicability is in the field of sensing and filtration. Current research has been conducted on the viability of a non-woven mesh in detecting trace compounds in a solution that is passed over the membrane. As the nanofibers can be functionalized with various proteins and provide different signals for the presence (or absence) of a particular substrate, they bring with them the ability to detect

toxins or possible enzymatic activities [13]. Consequently, it is also possible to use the mesh as a filtration device giving it the ability to remove toxins from a liquid or air. The high surface area to volume ratio of the mesh makes it ideal as a possible filtration device.

It is within the scope of my research to find a suitable combination of hyaluronic acid and collagen that most effectively promotes fibroblast growth. In addition to this, I will test the chemical properties of the mesh and characterize it. The overall project goal is to construct a mesh that retains its chemical integrity so that when the mesh is applied to a wound, it will have the strength to resist degradation while having the biological capabilities of promoting growth. By trying varying combinations of different concentrations, it may be possible to produce a mesh that has these capabilities and allows for the treatment of various wounds.

CONCLUSION

Although the technology of electrospinning was created and described approximately 80 years ago, it has only been in recent years with the advancements in medical technology and an ever increasing database of knowledge that electrospinning has begun to make a mark on the medical community and in particular, the field of tissue engineering. The size of the fibers produced in electrospinning as well as the ease with which the process of electrospinning takes place make this technology ideal for a wide array of biomedical applications. Using different materials and determining properties of both single polymer and composite electrospun meshes, it can become possible to tailor scaffolds that are ideal for particular applications. Control over biocompatibility and fiber properties are important however if the technology is going to be successful. More research will be needed on tissue and cellular responses to such fibers before their incorporation into medical technology is possible.

METHODS

The process of electrospinning is controlled by the many parameters that can be manipulated independently and consequently can have dramatic effects on the mesh that is produced. Additionally, parameters that may be independent of the actual electrospinning include the solution that is to be electrospun and all of the properties that can be changed with respect to the particular polymers that are to be used. There are two main variable areas that were manipulated in order to obtain the nanofiber meshes that were desired for the scope of the project: the solution parameters and electrospinning parameters. After the nanofiber meshes were fabricated, they were characterized using SEM, FTIR, and DSC. The protocol developed was closely modeled after Kim et al with a few modifications to the methodologies due to different experimental conditions. [14]

Solution Parameters

The solution parameters were altered in very specific ways, which mainly concerned the concentration of hyaluronic acid (HA) and collagen (from calf skin) within the solution and the ratios with which these particular proteins were dissolved. Two main categories of solutions were created, those that contained a 10% w/v solution and those that contained a 5% w/v solution. Within each of these solutions, there were different ratios between HA and collagen that were mixed for electrospinning. A 95/5 and 80/20 HA to collagen set of solutions were created for electrospinning; each polymer was dissolved in a 4:1 ratio of 0.5M NaOH and dimethylformamide (DMF). It was necessary to dissolve the collagen in the NaOH solution prior to adding the DMF and HA, this is because the DMF is volatile and will evaporate if exposed to the air for lengthy periods of time. Additionally, there is a narrow time window with which the HA can be added to the solution and be electrospun before it congeals, after which electrospinning becomes virtually impossible. The time window has been observed to be between 30 minutes and 1 hour, depending on the mixed solution where higher concentrations of HA congealed more quickly. Adding heat to the solution also causes the solution to solidify more rapidly. For a complete list of tested solutions, see Tables 1 and 2.

Electrospinning Parameters

The electrospinning parameters that were manipulated within the context of this experiment were the separation distance between the needle and the electrode, the needle gauge, the flow rate of the fluid and the applied voltage. The separation distance of the needle and plate was the first parameter that was optimized, using a solution of 10% w/v HA solution for electrospinning. If the separation distance was more than 5 cm, deposition of the solution directly onto the plate became an issue as the electrostatic force became too large or too small. The second variable that was altered was the needle gauge; larger needle bores allow for a larger Taylor cone formation, which allows for more material to be electrospun at one time. However, if the drop became too large, the surface tension of the droplet would break under the physical weight of the solution. The optimal bore size was determined to be .514 millimeters, allowing for the largest electrospinning capabilities in light of the viscosity of the material as well as the density of the solution.

The flow rate of the solution was a parameter that was modified slightly depending on how the system was reacting to the electrospinning. This is due to the fact that solidification of the solution was dependent on many variables and as a solution became more viscous, the flow rate was lessened to give the material more time to electrospin. Overall, the best starting flow was determined best to be 0.6 mL/hr. Following the protocol developed by Kim et al, the applied voltage that was initially used was 9 kV; however this was quickly determined to be too small due to the high density and viscosity of the solution. 16 kV was more optimal in promoting electrospinning of the solution with a current of approximately 0.01 mAmp. If the current or applied voltage is raised above this level, fiber formation and deposition becomes inconsistent.

Characterization of the Polymers

Several different characterization methods were used on the different solutions that were spun in order to gain an understanding of the various properties of the electrospun polymers. Using scanning electron microscopy (SEM), it was possible to see the fibers and the mesh on a micrometer and nanometer scale and to determine the diameters of the individual nanofibers. Additionally, characteristics such as beading and

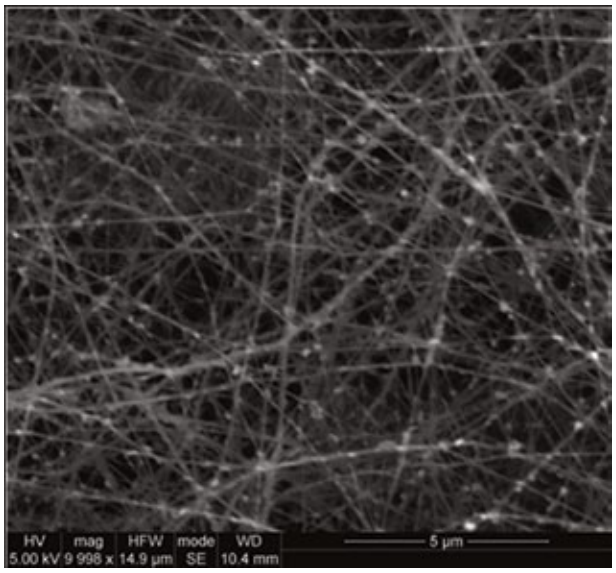

Figure 2. 5% solution, 10000x.

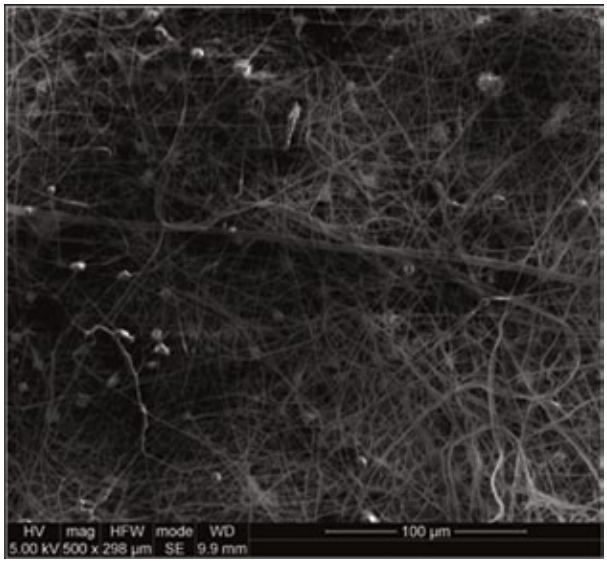

Figure 4. 10% solution, 500x.

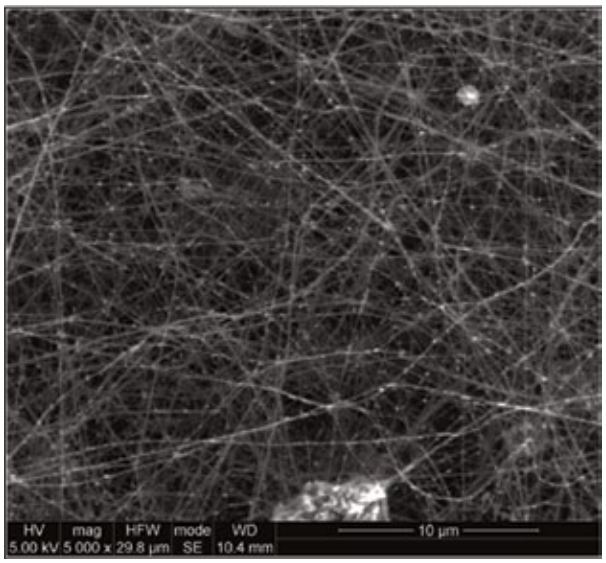

Figure 3. 5% solution, 5000x.

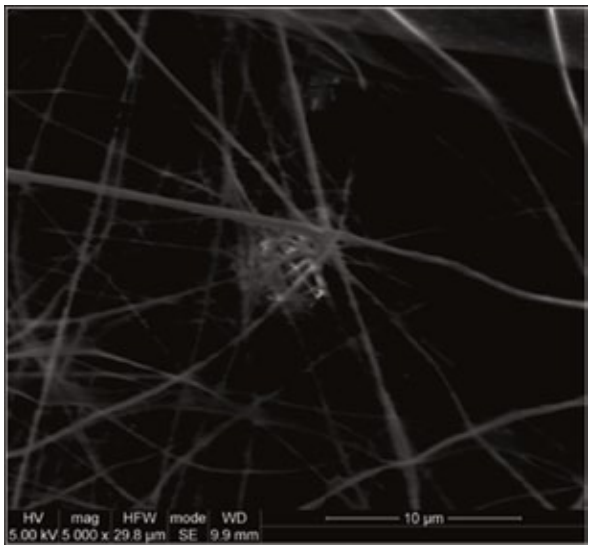

Figure 5. 10% solution, 5000x.

bulk fiber deposition, as well as the density and porosity of mesh were able to be addressed and evaluated through the use of this technique. A second characterization technique that was used in order to compare samples was Fourier Transform Infrared Spectroscopy, or FTIR. Through the use of FTIR, it was possible to not only search for the sample signal and compare it to a standard, but it was also possible to compare the samples to one another in order to see how or if different solution concentrations changed the FTIR data and altered the integrity of the meshes. This was also used to ensure that the nanofibers did not have
impurities that might interfere with their eventual application. The third technique that was used to characterize the fibers was a differential scanning calorimetric analysis (DSC). This particular technique was used to determine the thermal properties of the different meshes such as denaturation temperature and heat of enthalpy. The main purpose of the test was to compare the different mixture ratios to one another as the mesh needs to have the structural integrity to withstand enzymatic degradation. All of the above techniques were used and taken into account when determining which polymer mixture was best for performing the overall function of the proposed design.

RESULTS

The images obtained from the SEM allowed for primary assessments of the physical properties of the mesh as shown in Figures 2-5. Analysis of the fiber diameter for the different solution concentrations indicated that the 5% solution had an average fiber diameter of 13.685 nm and the 10% solution had a fiber diameter of 47.171 nm. Additionally, the variance for the fiber diameter from the 5% and 10% solutions were 1.84 and 9.12, respectively. Mesh density and porosity were also assessed through the SEM images, revealing that the 5% solution had a more uniform fiber placement as well as a denser structure when compared to images of the 10% solutions. Relatedly, the

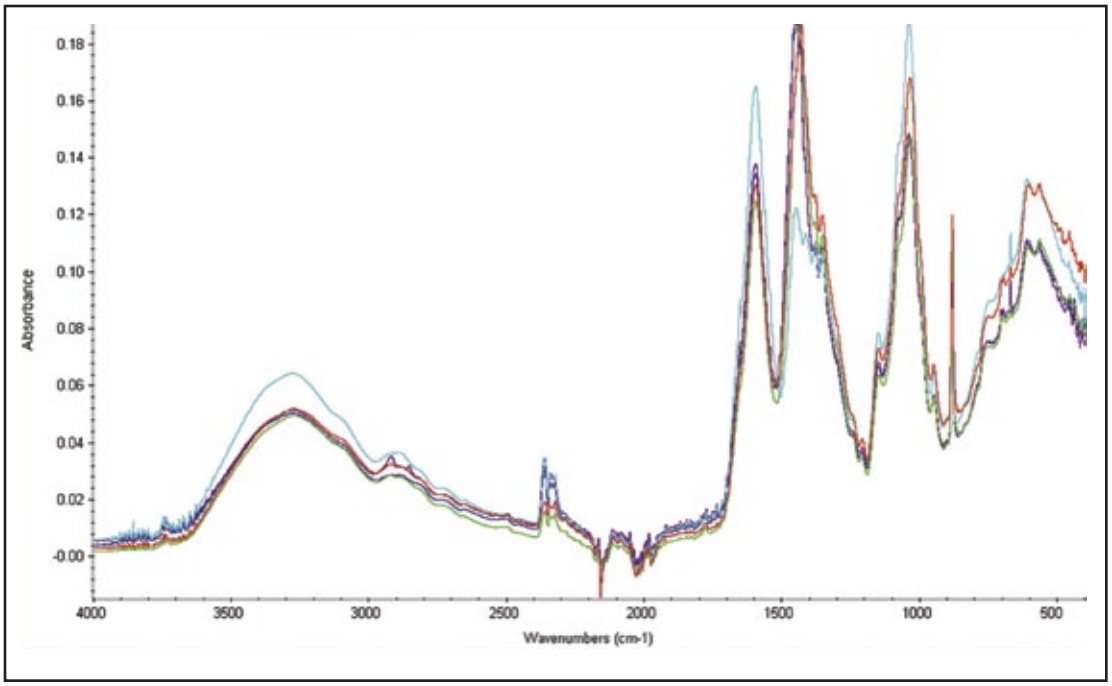

Figure 6: The FTIR scan of several different samples. Peaks at 1600 cm-1 and O-H stretching above 3000 cm-1 are indicative of specified proteins.

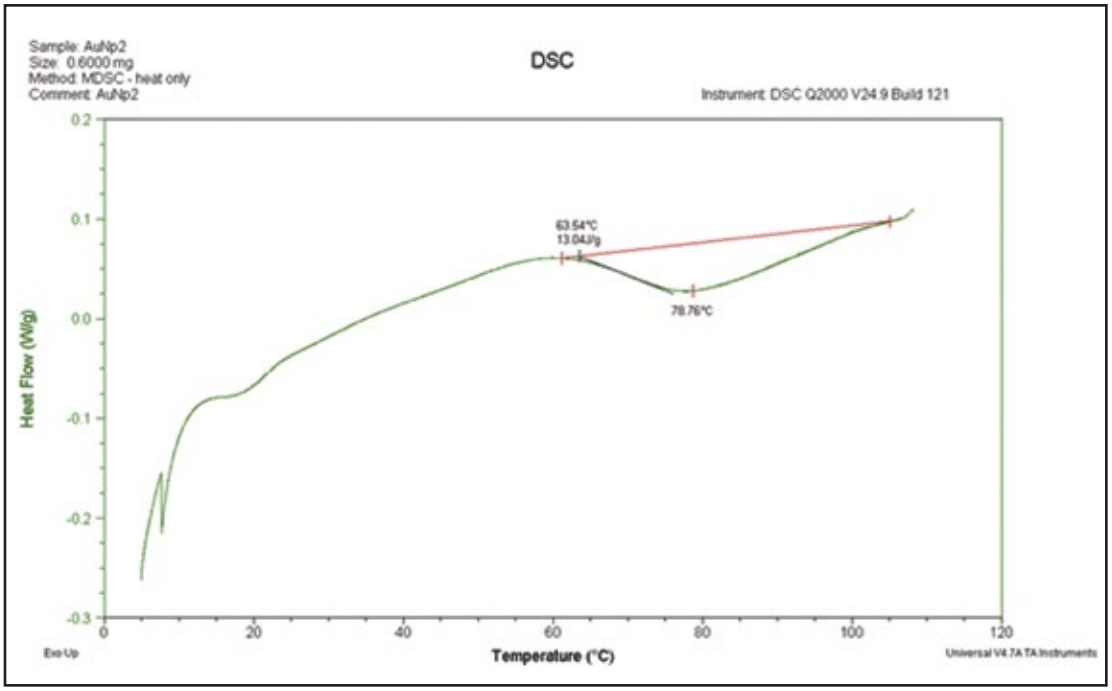

Figure 7: DSC analysis indicating the onset melting temperature and denaturing point.

images offer insight into the nature of fiber deposition during the electrospinning procedure, i.e., the random deposition of the fibers to form a mesh structure.

As shown in Figure 6, FTIR spectroscopy was performed on the fibers. The results showed that the chemical signatures were indicative of collagen and hyaluronic acid. It can also be seen that all of the scans are consistent with one another, with an increase in concentration matching a higher absorption peak. Typical bond absorption patterns occurring around 1450, 1600 and 3000-3250 cm-1 indicate that there was no polymer degradation in the electrospinning procedure and that solvents used were not found in the mesh. DSC analysis is ongoing and so far, has provided only preliminary results, but initial analysis indicates that cross linking of collagen and HA was successful as shown in Figure 7. The measured onset temperature was 63.54 °C and the observed denaturation point was 78.76 °C. This temperature falls within the normal range of collagen denaturation temperatures [20]. The initial data collection during the DSC sampling was inconclusive as there may have been data collection issues due to the mass of the mesh that was analyzed so more studies are in progress.

DISCUSSION

Initial analysis indicates that the consistent construction of a mesh using collagen and hyaluronic acid through electrospinning is feasible and the mesh that is constructed has properties that can be compared against known standards, such as Type I

collagen. SEM images indicate that the diameters of the fibers were uniform and that the lower concentrations of collagen produced smaller diameter fibers. This is useful as biological systems seem to prefer consistency in their external environment as well as small nanostructures. This is also why uniform porosity of the mesh is desirable when differentiating between the different solution concentrations. The potentiality of the nanofiber mesh to be used as a scaffold for collagen regeneration is practicable as the mesh exhibits properties that would promote the growth of fibroblasts. Since the mesh has chemical properties desirable in an ECM, as indicated by the FTIR scans and comparison to known standards, it is a candidate for use as a collagen scaffold. Additionally, each of the different scaffold samples exhibited the same chemical signatures with slight variations in absorbance. These variations can be attributed to slight concentration differences of each mesh due to the electrospinning process. Lastly, the preliminary DSC scans are promising as the mesh exhibits characteristics that are indicative of thermal stability. Further analysis of the meshes would require more characterization of the material using larger samples and therefore providing more consistent data in determining the thermal effusivity.

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The Lived Realities of Middle-class African American Men: From a College Perspective

CAMERON WILLIAMS

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Department of Sociology

Cameron comes to us from St. Louis, MO and is a senior Sociology major with a minor in Black Studies.In addition to being a Diversity Scholarship receipient, Cameron has received the Fisher House Foundation Scholarship for military children.He is an active member of the Impact Movement Christian Ministry and serves as a Peer Advisor in Lathrop Resident Hall. Over the summer, Cameron studied abroad in Rwanda and researched the history of the genocides. His future plans include obtaining a PhD in Sociology and becoming a professor with an emphasis in race, class, and gender.

INTRODUCTION

Studies of African Americans in urban and suburban contexts are very significant in the scope of sociology. People become aware of the daily routines and struggles African Americans face through these works. Current literature focuses heavily on "deviant" aspects of African American identity and experience. For instance, research of urban areas explores African American men in the inner-city as they navigate in roles such as gangstas, drug dealers, and thugs (Anderson 1999, Kelley 1998). Displaying inner-city life that some men live is of great significance because insight is drawn into the issues particular to that demographic group. However, less of an emphasis has been placed on the less "deviant" aspects of African American identity in America. The purpose of this study is to explore the complexities in identity construction in middle-class African American men by gaining insight into their lived realities. Additionally, exploring the impact stereotypes might pose to men from middle-class backgrounds is a factor that will be observed in this study.

LITERATURE REVIEW

Urban:

Research concerning the life of African Americans in the inner-city produces important knowledge regarding identity formation conducive to that environment (Anderson 2000, Majors and Billson 1993). Urban African American men strategically engage in distinct rituals to establish their manhood and retain respect within the inner-city. Utilization of physical space by some men is endemic to their location because of the dangerous contexts of these areas. Physical techniques such as sitting with legs wide open, walking slowly, and posture are used to show strength. Gang activity is another reality for some in the inner-city. Initiation into gangs may serve some men as a means to gain respect from others or to signify entry into manhood. Rituals used to initiate men into gangs can be precarious in nature for the potential inductee, often in their teenage years, and people caught in the mist of the event. Committing a criminal act with a handgun or being jumped by future gang mates are just some forms of initiation (Shakur 2004).

Further augmenting the issue can be the difficulty for inner-city men to avoid these lifestyles. Men within inner-city borders might be expected to join a gang when they become adolescents. Avoidance of gang activity is achieved by some young African American men by taking alternative routes when walking around the city. In addition, independence from a gang might cost these young men socially because they are perceived as "weak" (Anderson 2000).

Mitchell Duneier (1994) conducted ethnographic research on African American men in the inner-city in a nontraditional way. Duneier analyzed the life of urban African American men with strong work ethic, valuing strong friendships, and disapproving deviant behavior within the context of a Chicago diner. Capturing the identity and beliefs of an often overlooked population of African American men was a major focal point of Duneier's research. Karyn Lacy (2007) conducted a study of middle-class African Americans living in two different types of suburbs, one exclusively white and the other entirely African American. Lacy's findings help demonstrate that African American middle-class experience cannot be assumed to correspond to that of white people of the same economic status.

Social Cost

Research completed on common representations of African American men in the media and aligning perceptions people develop because of the communicated images are revealed by numerous studies (Collins 2005, Slater, Peterson, Kaufman, Bjornstrom 2010, Entman 1994, Chiricos and Escholz 2002). Studies illustrate how African Americans are disproportionately displayed as criminal suspects in television news stories. Crime stories regarding African Americans portray them as the perpetrators and 77 percent are drug or violence related. Media sources overrepresentation of certain groups as perpetrators, can lead to racial or gender stereotypes or reinforce public hostility toward such groups.

Stereotypical images of Africans Americans have negative implications for them. Richeson and Pollydore (2002) explored the impact of this in a study of the reactions of African American students to stereotypical and counterstereotypical images of group members in the media. Students were exposed to short clips of situation comedy played by African American characters. Many African American comedy shows emphasize stereotypical images of African American people such as "fun-loving," "poor," and "clownish." In other cases, African American characters act out counterstereotypical images of African Americans such as speaking British English because it thought to be more formal than standard American English. The study found that students had negative reactions to the stereotypical images regardless of the two extreme representations.

African American students at predominantly white colleges can feel caught between two cultures; that of school and the practices of home. African American students must remain aware of the potential negative stereotypes because they are visible minority group on campus. Failure to monitor the impressions held by white faculty members could lead to serious costs, such as depressed grades and performance evaluations. Further research suggests that managing ones behavior can come with a psychological cost (Leary, Nezlek, Downs, & Radford-Davenport). Impression management has been linked to affective reactions such as heightened anxiety and expression, particularly when the cost of failure is high, as in the case of African American students at predominately white colleges. A study of Latinos experience with perceived discrimination can be related to this study. Stereotype threat, or fear of conforming to stereotypes, regardless of discrimination experiences, negatively affected the well-being in Latinos (Steele and Aronson 1995, French and Chavez 2010). Findings of this nature are significant because they are applicable to African American students at predominantly white colleges as well.

Middle-class African Americans combating discrimination

Middle-class African American people utilize their economic status to help minimize the risk of discrimination in certain situations. Some use public identities to convey their status to others in certain situations. For instance, when shopping middle-class African American people dress nicely in efforts to avoid the stigma of being shoplifters. Standard English is used at work to avoid any challenges to their intelligence. Middle-class African Americans may have to navigate in white settings more often because of their economic status. Cultural straddling may also be used which is when African American youth move between minority and mainstream culture (Lacy 2007).

Research has found that a middle-class status does not shield African Americans from racial discrimination (Lacy 2007). Middle-class African American people may experience an increased risk of encountering racial discrimination because of more interactions in white settings. Several accounts of discrimination towards middle-class African American people are discussed in this reference. Personal accounts have been revealed through interviews of African Americans having to wait excessive amounts of time to be served or even acknowledged, while whites were served with immediacy. While shopping, middle-class African American people are often victims of over surveillance by white employees. Harassment by white police officers is also commonplace among middle-class African American people. Middle-class African American people are not immune to racial profiling by police even if they possess a more mainstream appearance (Sikes 1994).

Studies have found that some African Americans living in white neighborhoods and working in predominantly white spaces have to assimilate to the dominant culture. Impression management or front-stage performances are used to aid in assimilation to white settings. After exiting white settings they are able to be display their true personalities or what Erving Goffman terms "backstage identities" (1959). Identity maintenance becomes a concern to some middle-class African Americans because they want to remain connected to their culture. Interacting in African American settings is important because it enables them to keep this connection and additionally may protect them from racial discrimination (Lacy 2007).

METHODS

Participants for this study were recruited from an organization that helps build the character of African American male college students at the University of Missouri. Other participants were referred for the study by men in the organization. All participants are second semester freshmen students ages 18-21. Several factors guided the decision to recruit young men from this organization. As second semester freshmen, these men are not too far removed from their home environments. In addition, participants are still adjusting to their role as a college students and being away from family and traditional support networks. The ability to find men in

a wide range of majors was also taken into consideration for utilizing this organization for recruitment. Participants come from predominantly white suburbs or very diverse suburbs near metropolitan areas. In-depth interviews with open ended questions were used for this study, each lasting between 30 and 60 minutes. The criteria for inclusion was a family income of $50,000 plus or parents working in professional occupations, communicated to prospective participants as fields like teaching or social work that typically require a college education. Nine men participated in the study and six interviews were transcribed for the purposes of this study. While transcribing the interviews, themes were found to analyze the parallels in participant responses.

ANALYSIS AND DISCUSSION

Stereotypes and Labels

Stereotypes of African American men are still grounded in society and permeate social perceptions beliefs of them. Collins (2005) writes about common social perceptions in American society about African American men. African American men are often portrayed as hypersexual, athletes, and criminally deviant. Analysis of participant responses reveals corresponding beliefs that stereotypical images about African American men pervade the media today. Several participants' shared similar views regarding this when asked how they feel African American men are portrayed in the media.

Vince: I am not entirely fond of how they are portrayed in the media. I feel as if in the media they're usually portrayed in a negative light. For instance, on the news if like a crime has occurred in Maryland then they would mention oh it was on Castle Boulevard and that was like a generally black area and they would say that like they were African American or like it's usually crime would be linked to African Americans and I didn't really like that.

Mike: In the news, and actual real-life stories they promote a lot of crime by black people, black males in general. Cause you don't really see too much of, you don't really see all the kids who on honor roll in public schools in black communities, you don't see the successful things black people have done in their communities, such as community service or Boys and Girls Clubs.

Vince and Mike's comments emphasize their belief that the media focuses heavily on crime while neglecting to emphasize more positive aspects of the African American community. Mike displays his concern over the biases he sees in the media's reporting of African Americans. A common theme emerged with every participant stating that the media portrays people of their race in a negative light. Statements revolving around this issue demonstrate a disappointment in these men because of what they perceive as biased representations of them in the media. Men in this study are conscious that the media has a significant influence over people's perception of African American men which might have negative implications for them and the well-being of their race. Wayne Brekhus (1998) might help illustrate why inner-city or deviant aspects of African American culture persist in the media. His article discusses aspects of social life in terms of marked and unmarked. Unmarked groups are viewed as normal or ordinary, examples include men, heterosexuals, and caucasians. Marked characteristics of groups tend to be extraordinary or more highlighted in society. Examples include minorities, women, and gays. Brehkus' argues that such a heavy emphasis on these aspects of life unintentionally reproduces and reinforces cultural stereotypes by overemphasizing morally critical or factually exotic social phenomena. African American men can become subject to stereotyping because of the media's prominent focus on criminally deviant phenomenon in the inner-city. Another participant Sean says, "I feel like there is a really successful African American man, like we can say for example Denzel Washington like he is widely accepted as a person of high stature, him and let's say Morgan Freemen." In general, participants feel there are two pervasive views of African American men in the media, one being criminally deviant and the other being a highly successful entertainer such as an actor or rapper. Upon further probing, the men take issue with these representations because African American men as professionals, blue-collar workers, and college students are discredited in the process.

Another negative implication of these representations is the categorization of these men as deviant because they do not fit into those communicated images. For example Vince says, "I feel as if when I work hard enough, I feel like more people are impressed by it, then say if an Asian person works as hard it like oh it's been done, but when I work as hard it is like oh look at him." Vince's statements might look like something to be taken as a compliment, but there is some resignation in his statement. Within his statement, he is communicating an awareness that work ethic is often measured by ethnicity. African American men have often been defined as lazy in the realm of work and education while people of Asian descent are viewed as more industrious. Generalizations of African American men as lazy may be the reason Vince questions peoples motives when they comment about his work ethic. Vince's remark demonstrates the reality of African American men having acquired internal uncertainties in reference to particular comments made because they are members of a heavily stereotyped group.

Identity Challenges

Many of the participants in this study have been ostracized because of their middle-class status. Observation of this appeared when participants responded to questions in relation to how they feel the African American and white communities perceive them. Common patterns of negative labels or teasing materialized mostly because of their middle-class status and being independent of stereotypical behavior.

Sean: People ask me why don't you cuss, why don't you drink, why don't you smoke, you're Black? You know like all of these things are a question and I'm like why do I have to... like is that a definition me? Is that the type of person I am supposed to be?

Jeffrey: I feel that when people don't get to know me at first they automatically have an idea in the back of their mind on what kind of person I will be based on my mannerisms or just based on how I look.

Essentially, Sean is asking why stereotypical images are seen as the default definition of African American men. This young man's authenticity as being "truly" African American is challenged because he does not engage in certain behaviors. Sean also displays his belief that his African American identity does not rest in behaviors often generalized as being specific to males in his race. His statement highlights the perception that middle-class African Americans are "uppity" or "arrogant" which are labels other participants alluded to in their comments, although Jeffrey does not outright say it that Sean exposes the reality that his behavior is constantly compared to stereotypical images of African American men. Jeffrey's statement shows that people might make judgments about him as a person just based on his demeanor. Stating this is significant because it shows that middle-class African American men have struggles that are exclusive to them as a group. However, African American men from lower economic backgrounds can relate to Sean's comment. Both men expose the reality that there is cost to being middle-class and African American which is that they standout even more because of their "triple status" as African American, middle-class, and educated which leaves them more susceptible to ostracism. Generalizations of African American men may be leading to race playing a greater role in social perception in opposition to economic status, education, and other demographics.

Students raised in predominantly white environments responses indicated more occurrences of teasing. Participants Sean and Vince are from predominantly white suburbs and both attended majority white schools. The men made these statements in regards to how some people view their speech and style of dress.

Vince: Yes, because oh, because it was joked about back home, but it is also joked about a little over here. Like why I speak this the way? I was raised to speak [this way] by both my mom and my dad.

Sean: I'm myself and I guess I don't dress the stereotypical way that a black male these days would dress... Like my mom always raised me to be somebody who is presentable, it wasn't like I did not have black culture."

The comments from Sean and Vince reveal how their speech and dress come is questioned by their peers. Even though they are middle-class they are still expected to conform to stereotypes by people in mainstream society. Vince and Sean bring to light an oxymoron in society in that African American men are stereotyped for being deviant, yet when they possess more mainstream characteristics they are still being questioned by their white peers. Several participants have been told by their white peers they are not "African American" because they speak proper English. The belief that speaking proper English is a quality specific to white people is exposed when comments like this are made to African American men. Both men mentioned how their parents were strict in monitoring their speech and style of dress while being raised. Environment probably also played a significant role in the formation of their speech and dress. Living in more mainstream settings influenced their style of dress, dialect, and demeanors. The development of more mainstream characteristics brought additional challenges their authenticity as being truly "African American" as evidenced by Sean and John below.

Sean: Oh, you don't know anything about the streets, you're soft, you know all of these things, you don't know what's going on in the world, you don't know how to fight.

John: I feel you should not stereotype someone for who they are I don't think there is a such thing as acting black or acting white or acting Asian for that matter. It's just more of the environment where you grew up because once again I grew up in the suburbs, but I feel as if I am just black as somebody who grew up in a lower-class family.

Here we see that true African American identity is said to take place exclusively in the inner-city. Location has become an indicator of African American authenticity. Participants are often told they do not have a true racial identity by their African American peers because they grew up in the suburbs. Essentially, their African American peers are telling them they have taken on a white identity because they are middle-class and from the suburbs. Sean's comment brings to light the way African American men are defined in physical terms. African American men from the inner-city are often viewed as violent and aggressive when it comes to their physicality. Middle-class counterparts are viewed as "inauthentic" because they decided to conform to mainstream values and culture. Further labeling centers on them as buddies to white men because they are friendly, deferential, and nonthreatening (Collins 2005). Possessing these characteristics has caused them to become seen by some African American as "sellouts" and an anomaly to white people.

Navigation Rituals

Observation of participant responses revealed that some collaborators in the experiment engage in the behavior of code-switching. Anderson (2000) and Lacy (2007) explain the concept of code-switching in their works regarding African Americans. In the field of sociology this behavior refers to the modification of physical demeanor and dress or the change of dialect in particular environments. Mike Sanders illustrates this behavior when he talked about his experience while attending a predominantly white high school. Mike says, "I would have to change my presentation; I didn't want to wear my earrings to class because I did not want to look intimidating or just like that other black kid from the hood." Mike's comment demonstrates his awareness that he might be perceived negatively if he displays characteristics counter to the dominant society. Mike's statement resembles others in which they are aware of the settings that will require them to code-switch which include class, predominantly white organizations, and their future careers. Participants who engage in this behavior feel it is necessary to ensure they are not viewed as unintelligent and to keep them from being viewed in stereotypical ways. Based on comments made in class and in the media, these men also fear that their white peers and instructors might believe they are in college because of affirmative action and not their intellectual abilities. Behaving in ways that are too "ethnic" around the dominant society might reinforce the misconceptions that people already have about the African American race.

However, not all participants in the study engage in code-switching. Analysis of the work of Mary Patillo-McCoy (2000) might help explain this behavior only being imitated by some middle-class African American men. McCoy conducted a three-year ethnographic study of Groveland, a African American middle-class neighborhood on Chicago's South Side. McCoy found that the children raised in middle-class environments near lower-income cities often developed characteristics similar to the inner-city inhabitants. Both participants above who mentioned engaging in code-switching are from suburbs in St. Louis near lower-class environments. The close proximity to the inner-city might have lead to these men to taking on the dialects and dress similar to their inner-city peers.

Participants were asked what organizations they are involved in on-campus. Every participant mentioned being involved in at least one African American organization. A common theme emerged regarding the reason for them joining these organizations. A participant's response when asked why he joined an African American organization is as follows.

Jeffrey: I felt that it would be a great opportunity to find people that have similar interests that I do that are aspiring black journalists so I can hear from the experiences that they have had that are currently in the area right now.... I feel more comfortable and I feel like they're going through the same thing that I am going through, so we can all help each other make it through it.

These men feel empowered to be around other African Americans who are working diligently toward similar goals as them. Joining these African American organizations also helps them cope with being on a predominantly white campus. African Americans at predominantly white colleges join all African American clubs, organizations, and networks, primarily to "turn off" their impression management as well as to reinforce their racial identity (Lacy 2007). Jeffrey's comment also reveals that he has a sense of security when around his African American peers.

Participants were asked about their experiences with discrimination. Discussing this topic was compulsory to the study since past literature cited evidence of discrimination from African American middle-class individuals (Lacy 2007, Feagin and Sikes 1994). Analysis of participant responses revealed that the way these men define their African American identity often determined how they responded to questions regarding their experiences with discrimination or improper racially motivated comments.

Jeffrey: Personally, I feel that being Black is something that I would be identified as, I try not to focus on race too much because I want to be identified as the person I am.

Devon: I feel like being Black shapes my identity because I couldn't see myself as anything else because... Two there is a history that comes along with it and there's a struggle that comes with it and that's one of the things that has fueled my drive and fueled my passion for things that I want because it's like our people as a whole have went through so much to get to the resources and opportunities that we have now.

Men in this study have different reactions in regards to their acknowledgment of negative racial encounters. Jeffrey deemphasized his racially identity as being African American. He does not want to focus on race and mentioned the desire to be identified as an individual. Throughout the interview, Jeffrey was less likely to mention incidents of negative racial experiences. When asked directly, he did not give any accounts of experiencing discrimination. However, he would give some accounts he described as minor experiences of discrimination through other questions that were asked. Comments from Devon demonstrate that he identifies strongly with his African American identity because he believes there is a unique history behind it that shapes who he is today. Men who identified more strongly with their African American identity or emphasized race shared their experiences they perceived as discriminatory in nature more readily. When Devon states "and there's a struggle that comes with it [being African American]" he is acknowledging his knowledge of the oppression that African American race has experienced. Erica Childs (2005) interviewed African American-white interracial couples to study their social experiences and how those realities influence their private lives. Childs found that African American partners who deemphasized their identity were less likely to report experiencing incidents of white racism. Conversely, Childs found that African American partners emphasized their racial identity were more likely to share experiences of racism. Jeffrey did give accounts of experiencing discrimination, which may mean that he avoided talking about negative experiences directly was way to cope with his past experiences.

FUTURE RESEARCH

Participants felt, that stereotypes do have a negative impact on them. The main challenge of this reality is that maintaining an African American identity has essentially become another responsibility in their everyday lives. Future research will be aimed at exploring the implications stereotypes have on the well-being of African American men from all demographics. An emphasis will be placed on the social development, mental health, and educational attainment of African American men. Additionally, more research needs to explore the potentially negative influence stereotypes and inequalities have on the everyday experiences of African Americans, Hispanics, Asians, Native Americans, and religious minorities.

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Featured Scholar

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As a 19 year old college student who was met with varying financial challenges, the most appealing aspect of the McNair Program upon first introduction was the benefit of receiving a stipend. My limited understanding of higher education at that time failed to provide me with full understanding of the immense level of professional growth and development that was soon to embark upon.

It has been nearly 15 years and I can still recall the seminars on constructing a curriculum vita versus a resume, having my first business card being provided by the McNair program, and being permitted to stay in the McNair office after hours on Friday to study for the GRE.

The first graduate program that I entered was a Master's program in Community Counseling at the University of Georgia. I remember having various conversations with my cohort about research endeavors and their limited participation in such scholarly efforts. Such a trend was not specific to the Master's program that I attended. Upon enter the Doctoral program at Indiana University, I had also found that several of these students had limited access to research activity and conference participation in undergrad. While I continued to have so much to learn, I believe that for the first time in my academic career I had a true feeling of preparedness, understanding, and belonging that I had previously questioned.

There were various efforts that were engaged upon by the McNair staff, for my benefit, that are countless to name. For me, the McNair program aided my movement beyond that of "disadvantaged". I felt fully supported and encouraged by the McNair staff to obtain my bachelor's degree and fervently pursue a doctorate.

Currently my career focuses on direct clinical service. In my spare time I continue to read articles and scholarly literature specific to my field. I have maintained partnerships with some of my graduate research mentors and have continued to stay engaged in scholarly writing. At the present time I am pursing publication of a journal article specific to my clinical practice with women who experience domestic violence.

My first exposure to research was as a result of my participation in the McNair program. With an earnest heart and an endearing smile I can honestly say that the McNair program's investment and belief in future has continued to impact my love for research and my desire for lifelong learning; challenging myself to continually reach for the stars.

2010-2011 Research Topics

Scholar	Major	Title	Mentor
Joshua Brinkley	Psychology	Positive Mood, Intuition, and the Effects of Approach-Avoidance Primes	Laura A. King
Marcone Cangussu	Economics	Where Has the Money Gone? A look at the Spending Habits in Haiti	Peter Mueser
Annoff "Nick" Cobblah	Physics and English	Preparation of an Ultra-high Vacuum System for Heteroepitaxial Film Growth	Paul F. Miceli
William Joseph Cochran	Geology	Global Positioning System Analysis of Fault Motion Along the Southern Portion of the Dead Sea Fault, Jordan	Francisco Gomez
Nicole Hams	Biochemistry	Identification of Roles of Catechol 1,2-dioxygenase and Beta-betoadipyl-CoA Thiolase During Nodulation and Symbiotic Nitrogen Fixation	David W. Emerich
Shane Hoffman	Journalism	How 'Fair and Balanced' is Fox News?	Mike Dunn
Kimberly Johnson-Anderson	Business Administration - Management	Character Strengths and Outcomes: The Significance of Gratitude	Daniel Turban
Darrell "DJ" Jordan	Music	The Effectiveness of Vocal Function Exercises on Collegiate Singers	Ann Harrell
Calvin Lewis	Medicinal Chemistry	Molecular Descriptors of Polyhedral Boranes and Carboranes: Curical Parameters for Building Better Drugs	Mark W. Lee
Brittany Long	Anthropology	Caste, Marriage Costs, and Education Among Hindu Daughters	Mary Shenk
Michael McCoy	Biological Engineering	An Investigative Analysis into Electrospinning for Collagen Regeneration	Sheila Grant
Shannon Montañez	Parks, Recreation & Tourism	Understanding Children's Perceptions of Places for Physical Activity through Cognitive Mapping	Sonja Wilhelm Stanis
Fiona Odu	Biology	Development of a 30D08 Polyclonal Antibody to Investigate Interactions Between Host Plant Proteins and the Cyst Nematode 30D08 Effector Protein	Melissa Mitchum
Long Pei	Economics	Ethnic Chinese Networks, International Trade and Statistics and Exchange Rate	Vitor Trindade
Sydney Pursel	Art	The Representation of Native Americans in Contemporary Society	William Hawk Jessica Thronton
Shannon Schipper	Women & Gender Studies	Exploring Gender, Self-Representation, and Communication in Second Life	Elizabeth Behm-Morawitz
Jerry Steward	Biology	Characterization of mTTC 13	Michael Garcia
Diliana Stoimenova	Biology	Development of In Vitro Model of Quail Vasculogenesis	George E. Davis
Michelle Tang	Biology	Surveying Chloroplast Gene Loss in the Plant Order Brassicales for Evidence of Horizontal Gene Transfer	J. Chris Pires
Cameron Williams	Sociology and Communication	The Lived Realities of Middle-class African American Men: From a College Perspective	Wayne Brekhus
See Yang	Agribusiness Management	A Multi-framework Analysis of Factors Contributing to the Economic Success or Failure of Hmong Poultry Farmers in Southwest Missouri	Seth Meyer

2010-2011 McNair Scholars

Back row: Brittany Smotherson (Graduate Student Intern), Jeremy Bloss (Student Services Advisor), Calvin Lewis, Cameron Williams, Anoff "Nick" Cobblah, Shane Hoffman, Darrel "DJ" Jordan, Marcone Cangussu

Third Row: Darlene Dixon (Program Assistant), Jerry Steward, Kimberly Johnson Anderson, Long Pei, Michael McCoy, Joshua Brinkley, William Joseph Cochran (2009-2010 Scholar), NaTashua Davis (Director)

Second Row: Nicole Hams, Michelle Tang, Shannon Schipper, Shannon Montañez, Denean Brady, Brittany Long

First Row: See Yang, Fiona Odu, Sydney Pursel (2009-2010 Scholar)

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