

FALL = 2018





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The **MU McNair Journal** is the official journal of the McNair Scholars Program (Ronald E. McNair Post-Baccalaureate Achievement Program) at the University of Missouri. Full funding is through a grant from the U. S. Department of Education (Grant. No. P217A070148) at the amount of \$252,000.

The **MU McNair Journal** is published annually. Manuscripts are accepted from McNair Scholars participating in the program at the University of Missouri, Columbia Missouri 65211, (573) 882-1962.

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On the Cover:

Phong H. Nguyen attaches alligator clips to terminals of a solar cell to measure solar conversion efficiency.

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Message from the Director

t is with great pride that I introduce this outstanding collection of articles from the 2017-2018 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. Six 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 Universitywide 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.

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 twenty-fifth 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, PhD Director MU McNair Scholars Program

The McNair Scholars Program

BACKGROUND

College students who are conside ring 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 ten 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.

Exploring the Associations Between Sexual Intensity, Skin Tone, and Relationship Outcomes

JAYLA HEAD

Antoinette M. Landor, PhD, Mentor Department of Human Development and Family Science



Jayla Head is a psychology major from Chicago and received the 2017 Hummel Family Scholarship and the 2016 Mary McLeod Bethune Leading Educator Award. She is a member of Epsilon Psi Chapter of Delta Sigma Theta Sorority, Inc. and Big Brothers Big Sisters of Central Missouri.

This fall, Jayla started a doctoral degree in Human Development and Family Studies at Texas Tech University. Her ultimate goal is to become a professor at a research one institution and to study the black family and marriage.

Abstract

This study seeks to examine the association between sexual intensity and five relationship components - intimacy, love, trust, commitment, and relationship satisfaction while also investigating the moderating effect of skin tone. African American participants (N= 89) were recruited from a Midwestern University where they completed a questionnaire regarding romantic relationships, sexual behaviors, and academic experiences. Results show a positive significant association between sexual intensity and intimacy as well as sexual intensity and trust. Participants who reported more sexual intensity in their relationships reported more intimacy and trust. In addition, there was a positive significant association between sexual intensity and intimacy when skin tone was a moderator. Determining these associations can help understand what may lead to healthier intimate relationships. By looking at an African American sample, these questions can be answered in order to tailor counseling programs for underrepresented groups in relationship and marital therapy. This can result in more African Americans having and maintaining healthy relationships.

Introduction

Within the Black community, there is constant conversation on Black relationships and why they are unsuccessful. The perceived dysfunction among the union of Black men and women has been researched for decades. The Moynihan Report (1965) was a popular piece of analysis that concluded that Black women's domination in romantic relationships deprived men of their identity (Burton & Tucker, 2009). The Moynihan Report (1965) used inaccurate measures of assessing Black and white families, leading to overgeneralizations and inaccurate conclusions regarding African American families (Pitner et. al, 2011). For example, it was believed that the domination of the Black woman led to unsuccessful relationships and a never-ending cycle of poverty in Black families. I chose to only analyze African Americans in the sample because the importance of African American romantic relationships is evident in the functionality of the Black family. I also think it is interesting to present a new idea about sexual intensity and its impact on the functionality of these intimate relationships.

It is important to understand what specifically impacts relationship quality among variables such as intimacy, love, trust, commitment, and relationship satisfaction because these components have been found to make up a healthy relationship (Fletcher, & Simpson, 2000).Which variable is highly correlated with sexual intensity? Does sexual intensity and skin tone have any impact on relationships quality? Answering these questions can lead to healthier intimate relationships. By looking at an African American sample, these questions can be answered in order to tailor counseling programs for underrepresented groups in relationship and marital therapy. This can result in more African Americans having healthy relationships and maintaining healthy relationships.

Sexual Intensity in Romantic Relationships

Sexual intensity is a passion measure and may be used interchangeably with sexual passion. Sexual passion is the state of intense longing for union with another (Phillipe et. al, 2017). It is the drive that leads to romance, physical attraction, sexual consummate, and related phenomena (Phillipe et. al, 2017). In other words, sexual intensity does not have to include sexual acts, but it can.

African Americans continue to have an interesting experience self-proclaiming their sexual identities. Stereotyped versions of African Americans' sexuality have been plastered all over the media. African American men's sexuality has been stereotyped as dangerous, predatory, and violent (Helm & Carlson, 2013; Landor & Barr, 2018). Emotion suppression is true for all men, but especially for African American men because there is a thin line of masculinity in the Black community, and a big fear of being labeled as feminine or gay if you are transparent about your emotions (Helm & Carlson, 2013). Black men in particular have represented masculine ideologies that applaud sexual prowl and the objectification of women, especially those belonging to lower socioeconomic status (Kohan et. al, 2017). These masculinity rules are very rigid because as we see, sexual assertiveness in the only type of masculinity that all Black men are able to attain.

The four main stereotypes for Black women are the jezebel, the mammie, the welfare mother, and the matriarch. The jezebel is promiscuous, while the mammie is usually darker skinned, asexual, and always putting others' needs before her own. The welfare mother places a financial strain on society because she bears excessive amounts of children, and is in need of government assistance, while the matriarch is controlling and condescending, usually for the benefit of money (Helm & Carlson, 2013). These stereotypes have been used in politics deeming the Black family as deviant and an example of what the absence of marriage can do to society (Landor & Barr, 2018). To counter these negative stereotypes, African Americans tend to be more conservative in their sexual behavior than their white peers. Women are pressured into picking the right partner because it is believed that there are more costs than benefits when comparing them to men (Ackerman et. al, 2011). In other words, women have more to lose than men if they choose a poor mate, such as bearing his child. Therefore, there is an added pressure for black women to choose the right mate. This may be because of the portrayals of their sexuality in the media are not consistent with the way they feel about themselves. Based on the literature, we hypothesize that sexual intensity will have a positive association with the relationship components.

Relationship Quality Among African Americans

Current literature examines relationship quality through intimacy, love, trust, commitment, and relationship satisfaction. There are many negative perceptions placed on Black relationships and marriages by Blacks themselves and by the dominant white culture. The Moynihan report was a popular piece of analysis that deemed African American relationships as dysfunctional because it often did not reflect the Western standard of a family structure, which is the male breadwinner, and the homemaker wife. In this report, it was expressed that African American families were at risk because the men cannot be husbands or fathers because the dominance of the woman. The Moynihan report excluded the contextual factors that contributed to the disadvantages of African American families such as poverty, lack of resources, and discrimination. These exact same stressors effect African American relationships and marriages today. For example, Black males are expected to be the breadwinners in their families but when we account for mass incarceration and reduced employment opportunities, it is difficult for them to fill this role (Jones et. al, 2018; Kogan et. al, 2018). Poverty and uncertainty often contribute to the failure of these unions (Burton & Tucker, 2009). With the uncertainties of job security and having enough resources to care for yourself, and possibly your offspring, there is not enough time to "nurture a romantic relationship" (Burton & Tucker, 2009 p.139). You have to have time, resources, and even financial stability to sustain one. Black couples also report that having to attend to one's own racial hardship as well as carrying their partner's racial wounds can negatively impact relationships (Awosan & Hardy, 2017).

Within the Black union, we examine this constant internal and external conflict. Gender roles are often ambiguous in these relationships (Helm & Carlson, 2013). Unfortunately, today some Black women do not see the benefits of marriage (or romantic relationships) because Black women and men experience similar stressors and discriminations, so they are left pondering, what is there to actually gain from marriage, especially because marriage is no longer for the sake of children, but for the sake of marriage itself (Burton & Tucker, 2009). Black women have generally been apart of the labor force (Landor & Barr, 2018). Therefore, there isn't much financial gain for Black women in marriage. Black women are even happy to stay single because of the uncertainties that come with marriage. It is more desirable for them to focus on their personal and professional lives (Hurt et. al, 2014). Therefore one may find it difficult to examine themselves and determine who they are, and their contributions to the relationship. The external conflict consists of balancing the wants and needs of a romantic relationship while balancing contextual stressors such as economic instability. In this study, rather than focus only on African American marriage, we focus on the romantic relationships of young African Americans to explore how sexual intensity in a relationship is associated with relationship quality such as intimacy, love, trust, commitment, and relationship satisfaction. We hypothesize that African Americans who report more sexual intensity will report more intimacy, love, trust, commitment and relationship satisfaction. In the following sections, we detail each component of relationship quality.

RELATIONSHIP QUALITY

Intimacy

Before examining intimacy in relationships, it is important to clarify a few things. There are multiple types of intimacy. Physical intimacy is the sharing of one's body with another person and also being attracted to the physical features of another person. Mental intimacy is the sharing of thoughts and values. Emotional intimacy is the sharing of feelings. This is highly allured in Western cultures. Spiritual intimacy is the sharing of religious beliefs. This entails, studying and practicing religion together. This is highly allured in African American culture (Helm & Carlson, 2013). Black men even advise Black women to focus on their spiritual growth to find a good partner (Hurt et. al, 2013).

We also have to examine when and how we learn intimacy. Emerging adulthood is a period when young people try different experiences, making choices in love and work (Arnett, 2007). It is a period where we try to establish our own identities away from our parents, and also become more dependent on peers for support and influence. This is also a stage where we start to experiment in crushes, dating, and interdependent friendships.

Romantic relationship scripts are cognitive representations of romantic relationships. They are usually learned through various cultural means. Within scripts are the expectations about the behavior of others, and guidelines to these behaviors. It also provides an understanding of social situations and their outcomes (Eyre, et. all, 2012). Sexual scripts are how we view and interpret sex and relationships. Culture, family, environments and society, influence your sexual scripts as well (Helm & Carlson, 2013). The media also has a lot of influence in what we learn about intimacy especially among Black adolescents. There is a constant battle of defining yourself when you are trying to account for your self-perception, stereotypes that are portrayed in the media, and the morals you uphold through your familial influences. The portrayal of female sexuality especially in hip hop culture is an example of how young girls may think this is what physical intimacy should look like. In fact, African American adolescents who watch shows that display the risk of sex are less likely to engage, but the opposite is also true (Helm & Carlson, 2013). Those who are exposed to sex and other risky behaviors in media are also likely to partake in those behaviors.

African American adolescents also start dating and having sex earlier than their white counterparts. These romantic relationships look different to African American adolescent women when compared to White adolescent women. African American adolescent women describe these relationships as less intimate with less disclosure, but more sexually intimate (Fortenberry & Hensel 2014). Many factors can contribute to earlier dating and sex such as personal, familial, and extra-familial influences (Helm & Carlson, 2013). Personal influences include your own personal choices. For example, your choice to consume alcohol may influence looser attitude towards premarital sex. Familial influences include parental monitoring. Some researchers believe this contributes to African American adolescents partaking in risky behaviors before other groups. They contribute it to the fact that there are a lot of single-parent households in African American communities, which lead to less parental monitoring, and a more likely chance to have the freedom to partake in risky behavior. Some African American youth use sexual experience to mark their independence as young adults. They also may rebel against parents' advice about safe sex (Sidibe et. al, 2018). Extra-familial influences include socioeconomic status. Adolescents with lower socioeconomic statuses may have sex sooner because they may not have access to knowledge or resources that may contribute to sex related prevention (Helm & Carlson, 2013). Negative relationship portrayal in the media may contribute to negative attitudes and beliefs towards dating and intimacy. As discussed previously, there are negative stereotypes regarding Black romantic relationships. This may lead to adolescents having negative beliefs as well and engaging in risky behavior to avoid emotional intimacy, or it may lead to overall emotion withdrawal. Lack of emotional intimacy is what brings couples into treatment (Helm & Carlson, 2013). Knowing this, it is important that adolescents, especially African American adolescents are socialized by caregivers so that they do not rely on the media to teach them about intimacy because it can be a fragile part of one's identity. Based on this literature, we hypothesize that there would be a positive association between sexual intensity and intimacy.

Love

Love is a state of deep attachment and care for your partner based on long-term intimacy and knowing the person. It is seen as the goal of a relationship, rather than the premise (Eyre et. al, 2012). Ideal love is what one thinks their relationship should encompass (Soloski et. al, 2013). It is hard to discuss the love between an African American male and female without discussion of gender role conflicts. The Eurocentric definition of what it means to be the "head of the household" does not include egalitarian gender roles, which are more reflective of the Black family (Lawrence-Webb et. al, 2004). In many instances both Black men and women are unable to fuse the two together, because they may have different expectations of the responsibilities of each person in a romantic relationship. Therefore, Black women can be seen as unfeminine and overbearing because of the economic help they bring to a family (Lawrence-Webb et. al, 2004). In fact, the definition of love varies by each individual because it is a social construct that we place a lot of pressure on because it is necessary for marriage (Soloski et. al, 2013). Therefore, we hypothesize that there would be an association between sexual intensity and love.

Trust and Commitment

Interpersonal trust is defined as one's expectations to predict and depend on the actions and words of their partner (Hurt et. al, 2013). In Dr. Chalandra M. Bryant's expert interview, she expressed that trust is a challenge for Black couples, and yet there is not a lot of research on how it is gained or maintained throughout marriage. This trust factor makes sense considering that African Americans report higher rates of infidelity, even more specifically, African American men (Helm & Carlson, 2013). Among low-income African American young adults, trust is viewed as more profound than sex and love, because

you cannot love someone without truly trusting them (Eyre et. al, 2012). There are many theories to explain infidelity in Black relationships including sex ratio theory and the pervasiveness of the hypersexual stereotype (Helm & Carlson, 2013). This creates an intentional or unintentional cycle of infidelity, with the absence of trust inhibiting healthy relationships amongst Black couples. High relationship commitment is a product of being heavily invested in your relationship as well as having few attractive alternatives (Sanderson & Kurdek, 1993). Therefore if there is not a strong focus on your relationship as well as the presence of alternatives, high commitment is unlikely. Relationship commitment is also correlated with relationship satisfaction. It is higher with women than in men (Sanderson & Kurdek, 1993) To this end, we hypothesize that there will be a positive association between sexual intensity and trust as well as commitment.

Relationship Satisfaction

The interdependence model predicts what factors contribute to relationship satisfaction (Sanderson & Kurdek, 1993). A satisfied relationship is one that has more rewards than costs. Also, the relationship at least meets the standards of what the person considers to be an ideal relationship; this is referred to as the comparison level (Sanderson & Kurdek, 1993; Landor & Barr, 2018). Therefore a person who is satisfied in their relationship sees more benefits, few extraneous sacrifices as well as feeling that their relationship is an example of what a relationships should be like. The interdependence model is so important because it cuts across diversity markers, such as race, gender, and sexual orientation (Sanderson & Kurdek, 1993). An important aspect of relationship satisfaction is that it can change in response to accumulated experiences (Byers, 2005). High relationship satisfaction is also correlated with constructive problem solving skills such as compromise, and negotiation. It is also inversely correlated with negative problem solving skills such as coercion, withdrawal, and avoidance (Sanderson & Kurdek, 1993). This means that communication skills have a major impact on relationship satisfaction, considering that conflict resolution involves a lot of communication. High relationship satisfaction and high relationship commitment seem to resemble the "perfect relationship". This consists of high rewards, few costs, high comparison level, few attractive alternatives, and high investment. Is this the complete and final formula to a perfect relationship or are there other factors that need to be considered?

The idea of interdependence versus independence in ones personal needs while in a romantic relationship contributes to relationship satisfaction. Growing up, Black women receive contradictory messages about romantic relationships from elders in their communities and families. In the messages on independence it is expressed that Black men cannot be trusted, therefore it is important that a Black woman be able to love and provide for herself. Compared to whites, Black partners were expected to show less dependence on their relationships (Kurdek, 2008). Experiencing discrimination and deviance in communities can lead to individuals becoming defensive and guarded because they expect others to treat them bad. This can inhibit the formation of healthy relationships (Kogan et. al, 2013). The second message of interdepence expresses that a Black woman's priority is to find Black love. This leads women to have a hard time forming relationships with the internal struggle of whether she desires to be independent or interdependent (Hurt et. al, 2013). In result, Black men feel as though it is hard to form and maintain relationships with Black women that are "too independent", meaning these women "don't need a man". Being too independent in a relationship can affect living arrangements and household activities. Some Black men express that Black women do not know how to manage a household with a mate because they have spent so much time alone or have never had a positive model of this type of household (Hurt et. al, 2013). With all of the confusion on gender roles, some individuals do not have energy, time, or will power to exist together in their relationships (Charleston, 2014). Relationship dissatisfaction can also occur when there are incongruences in intimacy, passion, and commitment in romantic relationships (Soloski et. al, 2013). We hypothesize that there will be a positive association between sexual intensity and relationship satisfaction.

Impact of Skin Tone on Relationships and Marriage Among African Americans

Research shows that within the African American community there is discrimination based on skin tone. Darker skin individuals are treated more negatively because they closely represent negative stereotypes that are associated with people of color (Landor & Halpern, 2016). Darker skin individuals are associated with being less attractive, less intelligent, and more aggressive. Also, darker skin children are more likely to receive negative socializations in relationship to their skin tone (Yancey, 2004; Landor et. al, 2011). A study of college students was conducted to determine whether skin color was significant in mate selection. The results show that lighter skin is contributed to beauty among African Americans. Sixteen percent of women preferred dating lighter skinned males, while seventeen percent preferred to marry them. Thirty-three percent of African American males preferred dating lighter skinned women, while thirty-eight percent preferred marrying them (Yancey, 2004). With darker skinned individuals receiving more discrimination, parents may treat their lighter skinned children more preferentially or provide more support to their darker child, to offset discrimination they will face (Landor et. al, 2013).

On average African American men and women had the lowest expectation of getting married (Landor & Halpern, 2016; Landor, 2017). Among gender of this sample, African American women report having higher expectations of getting married compared to African American males. When skin tone is a moderator, darker skinned women have less expectation to get married, whereas lighter skin individuals view marriage as an option they were less likely to partake in risky behaviors (Landor & Halpern, 2016). This shows an unconscious privilege that lighter skin individuals may posses because they make decisions knowing that marriage could be a choice. Together, we hypothesize that there will be a negative association between sexual intensity and relationship components when skin tone is the moderator.

METHOD

Participants

The present study is part of a larger study in the Health and Relationships During College (HRDC) Lab at a midwestern university that investigates the discrimination and relationships experiences that African American and Latino students have in a college setting. Ninety-one African American students were sampled in a Health and Relationships During College (HRDC) study. These participants reported the sexual intensity and relationship quality of their current relationships.

Procedure

Participants were recruited via email to participate in the HRDC study. After given informed consent, they completed the questionnaire, while a research assistant was present, which took approximately 1.5 hours to complete. The questionnaire included a wide range of topics, including demographics, relationship questions, attitudes about marriage, cohabiting and casual sex, academic aspirations, and discrimination. The responses received from the questionnaire were then added to a larger data file. From there, I extracted the data from only African American students who were discussing their current relationships.

Initially, I ran linear regressions using SPSS to determine if sexual intensity (IV) would be associated with the relationship quality (DV), which included intimacy, love, trust, commitment, and relationship satisfaction. Next, I ran linear regression analysis to determine how skin tone (IV) is related to relationship components (DV) examining three skin tone variables. Skin tone variable 1 examined the skin tone of participants based on their own perceptions. Skin tone variable 2 examined the skin tone of participant based on rater perceptions. Skin tone variable 3 examined skin tone of participant based on the their own perceptions while having a picture to refer to with five skin tones present that range from light to dark. I created three interaction variables that included the sexual intensity variable and each of the three skin tone variables mentioned above.

Measures

Skin Tone. **Skin Tone Variable 1** Reports of skin tone were indexed from Landor et. al (2013) and Robinson &Ward (1995). Participants rated their skin tone, 1(*very light skin*), 5(*very dark skin*). **Skin Tone Variable 2** Raters determined the skin tone of the participants 1(*very light*), 5(*dark*). **Skin Tone Variable 3** examined skin tone of participant based on the their own perceptions while having a picture to refer to with five skin tones present that range from light to dark 1(picture of a very light person), 5(picture of a very dark person).

Sexual Intensity. Sexual intensity was adapted from the Perceived Relationship Quality Component Measure, Fletcher & Simpson (2000). Response items ranged from 1(not at all) to 5 (extremely).

Intimacy. Reports of intimacy were indexed from Fletcher &Simpson's (2000) five point scale. For example, "How intimate is your relationship". Items were rated from 1(not at all), 2(very little), 3(moderately), 4(a good deal), 5(extremely). *Love*. Reports of love were indexed from Fletcher &Simpson's (2000) five point scale. For example, "How much do you love your partner?". Items were rated from 1(not at all), 2(very little), 3(moderately), 4(a good deal), 5(extremely).

Trust. Reports of trust were indexed from Fletcher &Simpson's (2000) five point scale. For example, "How much can you count on your partner?". Items were rated from 1(not at all), 2(very little), 3(moderately), 4(a good deal), 5(extremely).

Commitment. Reports of commitment were indexed from Fletcher &Simpson's (2000) five point scale. For example, "How devoted are you to your relationship?". Items were rated from 1(not at all), 2(very little), 3(moderately), 4(a good deal), 5(extremely).

Relationship Satisfaction. Reports of relationship satisfaction were indexed from Fletcher &Simpson's (2000) five point scale. For example, "How content are you are you with your relationship?". Items were rated from 1(not at all), 2(very little), 3(moderately), 4(a good deal), 5(extremely).

RESULTS

Multiple linear regressions were run to determine the association between sexual intensity and relationship components, which included intimacy, love, trust, commitment, and relationship satisfaction. There was a significant positive correlation between sexual intensity and intimacy in which B=.231, p<.01, and sexual intensity and trust had a significant positive correlation where B= .002, p<.05. Three skin tone variables were also used to perform regressions to determine if there was a significant association between sexual intimacy, skin tone, and relationship components listed above. Skin tone variable 1 examines the perception of the participants own skin tone. Skin tone variable 2 examines skin tones of participants based on rater perceptions. Skin tone variable 3 examines the perception of the participants' skin tone based on pictures that include a skin tone range from light to dark (1-5). There were no significant relations between the three skin tone variables and the relationship components, which include intimacy, love, trust, commitment, and relationship satisfaction. When these three skin tone variables were separately run as interaction variables with sexual intensity, there was a significant association between intimacy and the interaction variable where B=.036, p<.05 (See Figure 1). That is, the association between sexual intensity and intimacy was stronger among darker skin participants. There were no significant interactions between any of the relationship components and the interaction variable that included skin tone variables 1 and skin tone variable 2.

DISCUSSION AND CONCLUSION

I chose to examine the association between sexual intensity and relationship components to understand what factors of a relationship may contribute to its success. There is an abundance of literature explaining why Black unions are dysfunctional; explaining the higher divorces rates among African American couples. I also chose to use skin tone as a moderator to determine if this would impact the relationship between study variables because the literature does support that darker skinned African Americans have a more negative

Table 1

Association Between Sexual Intensity and Relationship Components (Skin Tone Variable 1)

		Intimacy						Love						Trust						
	Ν	/lodel 1		I	Model 2	2		Model :	1		Model 2	2		Model	1		Mode	2		
Variable	В	SEB	β	В	SEB	β	В	SEB	β	В	SEB	β	В	SEB	β	В	SEB	β		
Sexual Intensit	0.231** y	0.084	0.287	.036*	0.017	0.219	0.153	0.109	0.151	0.041	0.022	0.2	.002*	0.091	0.003	007	0.018	-0.041		

			Commit	ment		Relationship Status							
		Model 1			Model 2			Model	1	Model 2			
Variable	В	SEB	β	В	SEB	β	В	SEB	β	В	SEB	β	
Sexual	0.192	0.009	0.206	0.025	0.02	0.135	0.063	0.075	0.091	0.001	0.015	0.005	
Intensity													
Note: *p<.05, **<.01													

Table 2

Association Between Sexual Intensity and Relationship Components (Skin Tone Variable 2)

		Intimacy					Love					Trust						
		Model 1			Model	2		Model 1			Model	2		Model	1		Model	2
Variable	В	SEB	β	В	SEB	β	В	SEB	β	В	SEB	β	В	SEB	β	В	SEB	β
Sexual	0.231**	0.084	0.287	0.018	0.015	0.134	0.153	0.109	0.151	0.018	0.018	0.109	.002*	0.091	0.003	013	0.015	-0.092
Intensity																		

			Comr	nitment	:	Relationship Status								
	I	Model	1	Model 2			ſ	Nodel	1	Model 2				
Variable	В	SEB	β	В	SEB	β	В	SEB	β	В	SEB	β		
Sexual	0.192	0.099	0.206	0.015	0.017	0.099	0.063	0.075	0.091	-0.008	-0.074	-0.008		
Intensity														
Note: *p< 05_**< 01														

Table 3

Association Between Sexual Intensity and Relationship Components (Skin Tone Variable 3)

		Intimacy						Love						Trust					
		Model 1			Model 2	2	I	Model 1			Model	2		Model	1	ī	Nodel	2	
Variable	В	SEB	β	В	SEB	β	В	SEB	β	В	SEB	β	В	SEB	β	В	SEB	β	
Sexual Intensity	0.231**	0.084	0.287	0.017	0.019	0.1	0.153	0.109	0.151	0.02	0.024	0.091	.002*	0.091	0.003	-0.018	0.02	-0.098	



Note: *p<.05, **<.01

Figure 1.

Sexual Intensity and Intimacy and Skin Tone as a Moderator



relationship experiences than lighter skinned African Americans (Landor & Halpern, 2016). Can these experiences impact romantic relationships? I did find that there is a positive significant association between sexual intensity and intimacy. That is, those who reported a more sexual intense relationship also reported more intimacy in their relationship. There was a positive significant association between sexual intensity and trust. When participants reported a more sexual intense relationship they reported to have more trust as well. When skin tone was used as a moderator, there was a positive significant association between sexual intensity and intimacy. Those who reported themselves to be darker on the skin tone scale also reported to have a more sexually intense relationship as well as more intimacy. Sexual intensity is described as an intense longing for union with another person (Phillipe, 2017). Intimacy includes but is not limited to the sharing of one's body, thoughts, emotions, and

values (Helm & Carlson, 2013). It can be implied that when this union is granted sharing oneself and exchanging emotions also take place. In a sexually intense relationship a strong emotional connection is present, leading to romance and physical attraction. It can be concluded that sexual intensity would have a positive association with trust because these passionate experiences and feelings are exerted in private settings, whether sexual acts occur or not. It can be implied that one is more likely to long for someone that they trust rather than mistrust. Among African Americans, trust is profound in a relationship. It is believed that you cannot love someone without truly trusting them (Eyre, 2012). Study participants were in committed relationships, meaning they most likely have trust in their relationships. It can be implied that one would be more likely to long for someone that they trust rather than mistrusted.

Darker skin individuals who rated their own skin tone as dark reported a more sexually intense relationship as well as reported more intimacy in their relationships. Our findings are consistent with past research. Darker skin males are more likely to engage in risky sexual behaviors (Landor & Halpern, 2016). For example, darker skinned males report having more sexual partners (Landor & Halpern, 2016). It can be implied that the more partners you have the less likely you are to be intimate with those partners. But in fact, these individuals who are in sexually intense relationships also report more intimacy.

In this study, we utilized a small sample of African American college students. Future research should expand on the sample size. The participants in this study were also recruited from a midwestern university. It would be interesting to see how responses to the questionnaire may differ or remain depending on the geographic location of the study participants. Future research should examine gender differences and differences in those who are talking about their current relationships versus talking about past relationships.

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Using Asian Carp for Humanitarian Aid in Haiti

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Abstract

The spread of Asian carp throughout the Mississippi River Basin, including its tributaries, has resulted in numerous problems to aquatic ecosystems. Relatively few strategies are in place to reduce their growing population. One overlooked solution is use of carp for humanitarian aid. Inexpensive sources of protein are in high demand at many charitable organizations. However, the product would need a long shelf-life, without the need for canning, refrigeration, or freezing. Our study focused on salting and smoking the fish. To minimize hypertension, a portion of potassium chloride (KCL) was substituted for table salt (NaCl). Each mixture contained some sugar to improve taste. Tests to determine water activity, mold, and yeast were conducted to ensure product safety. With logistical support from Glory House Services in Kansas City, Missouri, a sample of Asian carp was delivered to Haiti in March, 2018. The project was successful since villagers ate the product and wanted more of it.

Background

Silver carp (Hypophthalmicthys molitrix) and Bighead carp (Hypophthalmicthys nobilis), collectively known as Asian carp, were imported from China into the U.S. during the 1970s as a biological control mechanism to improve water quality (Kelly et al. 2011). Subsequent flooding allowed both species to escape confinement, resulting in unusually large concentrations in the Mississippi River and its tributaries, especially in the Illinois River downstream of Chicago (Chick and Pegg 2001). Invasive species are nearly impossible to eradicate after occupying a new environment (Trexler et al. 2000).

High densities of invasive carp can pose numerous problems for aquatic ecosystems since they consume planktonic organisms and therefore compete with native species for available food sources (Irons et al. 2007). Asian carp are subject to massive die-offs due to oxygen depletion, resulting in a putrid odor that prevents recreational enjoyment of affected waterways. Moreover, Silver carp tend to leap from the water when startled, causing personal injury and property damage to boats (Stokstad 2010). If boaters seek Midwest waters that are free of Asian carp, then local tourism economies will suffer (Leung 2011).

Asian carp threaten to enter Lake Michigan from the Illinois River via the Chicago Sanitary and Ship Canal (Moy et al. 2011). In 2002-2010, the U.S. Army Corps of Engineers built three "invisible fences" using hundreds of electrodes to pulse electricity continuously into the water at Lockport, Illinois (Chick and Pegg 2001). If Asian carp enter the Laurentian Great Lakes, they will likely disrupt a multi-billion-dollar fishing industry (Tsehaye et al. 2013). Although electric current is an effective deterrent for Asian carp (Hinterthuer 2012), it does nothing to reduce their existing population. Asian carp are not caught using conventional fishing methods. Commercial harvest is a viable option, but the supply of fish is larger than current demand (Conover et al. 2007). Some uses of carp include fertilizer, fish oil, and pet food (Charlebois et al. 2010). Human consumption is a possible solution (Morgan 2018), but the domestic market is weak (Varble and Secchi 2013).

Use of Asian carp as a potential food source for hunger relief is a promising, but overlooked strategy. According to the Food and Agriculture Organization, nearly 800 million people worldwide suffered from chronic undernourishment in 2014-2016. Most of them live in developing countries. The first and most important deficiency is protein-energy malnutrition.

Haiti is the poorest country in the Western hemisphere and about 30% of the population lives in extreme poverty. Nearly half of Haiti's population (about 5.35 million) are undernourished. About 30% of Haitian children are chronically malnourished, often stunting their growth. Sources of protein are always in demand. Convoy of Hope, a nonprofit organization located in Springfield, Missouri feeds 90,704 children at 1,108 centers across Haiti. This group has agreed to ship our product, free-of-charge.

The salting and smoking of fish is a time-honored strategy that has two benefits: 1) it reduces the population of Asian carp in Midwestern rivers; and 2) it preserves them for easy transport to individuals living in poverty. Table salt is a tasty food additive. However, the high intake of salt (NaCl) can increase the risk of hypertension – a growing concern in developing nations (Seedat 2005). To combat this issue, a portion of potassium chloride (KCl) will be used as a substitute for sodium chloride (NaCl). As compared with NaCl, KCl is an effective preservative for meats (Desmond 2006) and has been shown to reduce the risk of hypertension (Houston 2011). This study was designed to create an inexpensive food product using Asian carp for people living in developing countries that is safe to eat and easy to transport.

Hypotheses

H1: When controlling for other factors, potassium chloride (KCl) will preserve Asian carp as well as sodium chloride (NaCl) as measured by water activity, mold, and yeast tests.

H2: Study participants will prefer the taste of NaCl over KCl as measured by a pencil-and-paper taste to determine overall likeability.

Methods

For the initial testing, 10 lb batches of four different mixtures of NaCl and KCl were used to compare their preservation abilities and flavor. All four batches contained 10% sugar. Utilizing sugar is a common strategy in the food science industry to improve the taste of meat without affecting preservation quality. Several tests were conducted to determine the amount of preservative needed, based on total fish weight. The initial concentrations were 2%, 5%, 10%, 15%, and 20%.

- Mixture A: 90% NaCl, 10% sugar (No KCl)
- Mixture B: 60% NaCl, 30% KCl, 10% sugar
- Mixture C: 30% NaCl, 60% KCl, 10% sugar
- Mixture D: 90% KCl, 10% sugar (No NaCl)

Results

Smoking Outcomes

Three different time frames were tested to determine the duration of smoking. We smoked two pieces of fish for each mixture, one at 2% of the total body weight and the other at 20%, for 6-hours. This process was repeated for a 12-hour time frame and a 24-hour time frame, also using two pieces for each mixture with the same percentages as the 6-hour time frame. We also smoked two pieces of fish, one thin and the other thick, without any mixture during the two longer time frames to serve as a control. None of the 6-hour samples were considered safe. Some of the 12-hour samples were safe, but only when the pieces were thin and a high percentage of mixture was used. We chose to smoke the fish for 24 hours to ensure the best preservation.

Water Activity Tests

Water activity tests were performed on all the smoked samples from each time frame to determine if they were safe for human consumption. This was done by placing a small, handshredded sample of fish on a plate in the tester and recording the results. This procedure was replicated three times for each sample. Water activity needed to be below 0.85 to ensure safety. We ran a Pearson r correlation analysis on thickness and water content. The 13-hour smoking resulted in r=.505 and the 24-hour smoking was r=.636. Longer smoking times explained about 40% of the variance.

Mold and Yeast Tests

Mold and yeast tests were conducted on the 10% and 15% samples to determine if they were safe for consumption after the samples were stored for four months. All of the 2% samples and some of the 5% samples had visible mold colonies, so neither of these percentages received further testing. The higher mixtures had no visible mold so we conducted additional tests to determine if there were safe. All the samples tested were safe for human consumption.

Sample	Total Aerobic Plate Count (CFU/G)	Mold and Yeast Count (CFU/g)
B 1	<10	<10
B 2	<10	<10
B 3	<10	<10
B 20%	<10	<10
D	<10	<10
D 20%	6,800	<10 mold; 30 yeast

Table 1. Microbiological Analyses¹ of Smoked/Dried Vacuum Packed

 High Temperature Stored Asian Carp.

¹Two dilutions (10⁻¹, 10⁻²) of each sample were plated in duplicate.

Taste Test

We conducted a taste test at the Haitian First Baptist Church in Kansas City, Missouri through connections with Glory House Services. Glory House is a non-profit, charitable organization that serves Haitian immigrants in Kansas City and provides humanitarian aid to Northwest Haiti. Over 100 Haitian subjects participated in the taste test. We brought the 15% samples from all four mixtures that had been smoked for 24 hours. The Haitians enjoyed tasting each of the fish samples. Although participants preferred mixture A (90% NaCl / 10% sugar), each of the samples were acceptable as a food source.

Incubation Test

We conducted further testing on the 15% and 20% samples of the B and D mixtures. These samples were placed in an incubator that kept them at 100°F for a 21-day period. This was done because the final product would be on a cargo ship for about that length of time and kept at approximately that temperature for that time frame while being transported to Haiti. We found that the 15% and 20% samples of mixture B (15% concentration) were safe, as well as the 15% sample of mixture D.

Discussion and Conclusions

Every sample that had been coated with a mixture equal to at least 10% of the total weight of fish and smoked for 24 hours was safe to eat, according to our results from the water activity, mold, and yeast tests. Based on a variety of indicators and our desire to limit the amount of salt, we selected mixture B (15% concentration) because it could withstand high temperatures for a long period of time without showing any adverse effects.

The hypothesis regarding the effectiveness of KCl compared to NaCl was supported through our incubation, mold, and yeast tests as outlined above. Small amounts of KCL was shown to be a viable alternative. For hypothesis two, study participants preferred the taste of salt as a preservative, however, each of the samples gained public acceptance. Taste is secondary in importance to food safety.

Successful development of this product served a variety of purposes. Asian carp removal is beneficial to aquatic ecosystems, especially to rivers which are infested. Population reduction, whether large or small, can result in some positive outcomes for native species since they compete poorly against invasive species. Asian carp can become an important food source in areas that need humanitarian aid, such as Haiti. These fish are high in protein, a nutrient that is lacking in developing nations due to poverty and poor diets. The fish product is dry and easily transportable, even to remote areas. It does not require refrigeration, making the product accessible to many people who have no other sources of meat. Our solution is a simple and healthy option. Replacing table salt (NaCl) with 30% potassium chloride (KCl) lowers the risk of hypertension for those who eat it without jeopardizing cost or food safety.

Limitations

• Relatively small sample sizes of fish products limited our ability to repeat certain tests.

• The taste test should be conducted in a controlled setting with at least one data collector who is fluent in Haitian-Creole.

Future Research

Future research could focus on replications of this study, perhaps extending the length of time by using other means of preservation. The ultimate goal of this additional research would be food safety. Placing the fish in bags after salting and smoking is another area that warrants additional study.

Other studies should be conducted on the effectiveness of potassium chloride as a preservation agent on other kinds of meat, instead of fish. For example, invasive species that have red meat could be preserved and distributed to people living in impoverished areas worldwide.

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Do Peers Know That Their Friends Have Dark Personalities?

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Abstract

Authenticity is a robust correlate of well-being. The purpose of this study was to examine the role of authenticity in the well-being of individuals who possess "dark" personalities. The Dark Tetrad (Machiavellianism, narcissism, psychopathy, and sadism) is a constellation of traits reflecting aversive personalities. Two prior studies demonstrated that the Dark Tetrad moderated the association between authenticity and well-being, such that among those high on dark traits, inauthenticity predicted higher well-being. The present study examined this issue incorporating peer reports to address the following question: do peer reports of target personality accurately reflect their dark traits and does this association matter to target well-being? Authenticity moderated the relationship between Dark Tetrad traits and well-being, such that a positive correlation existed only at low levels of authenticity. Peer report showed significant convergence with target personality ratings for dark traits. In addition, results showed that being known by one's peers improves well-being, even if peers know the target to be manipulative, self-centered, and immoral.

Introduction

The idea that it is best for people to be themselves is well represented in psychological research and theory. Authenticity is defined as being aware of one's own characteristics and genuinely expressing these in behavior. Many psychological approaches to optimal functioning incorporate authenticity as a central theme (see Robinson, Lopez, Ramos, & Nartova-Bochaver, 2012). Humanistic conceptions of personality, especially, present authenticity as a key to adjustment and personal growth. Yet, in a sense, the value of authenticity, of genuinely expressing one's innermost desires and impulses, rests on another humanistic assumption, namely, that these innermost impulses are generally for the betterment of the self and others. Does authenticity relate unproblematically to well-being even among individuals whose innermost impulses involve potential harm to the social world? Before presenting a study addressing this question, we briefly review the meaning of authenticity and its role in human functioning. We then describe the dark traits that were the center of this investigation and suggest predictions about the ways that Dark Tetrad traits might moderate the association between authenticity and psychological well-being.

Authenticity & Well-being

Authenticity has long been embraced by philosophers and psychologists as an optimal strategy toward psycho-

logical functioning. Following on Kierkegaard's famous quote (1983), "To be that self which one truly is, is indeed the opposite of despair," Rogers (1961) traced the central role of becoming one's genuine self in the process of therapeutic healing. Rogers observed that as his clients developed toward optimal functioning, they showed a pattern of moving away from various externally oriented behavioral controls.

Similarly, the contemporary humanistic approach to motivation, Self Determination Theory (SDT), maintains that authentically following one's innate desires is a pathway to better functioning (Ryan & Deci, 2001, 2004). Within SDT, following one's innate tendency toward the satisfaction of organismic needs leads naturally to well-being and growth (Deci & Ryan, 2000; Ryan & Deci, 2001). Not unlike Rogers' portrayal of movement away from reliance on external social controls to reliance on internal personally congruent impulses, SDT presents autonomy as a central aspect of healthy human motivation, particularly as the person is increasingly motivated by intrinsic rather than extrinsic ends (e.g., Deci & Ryan, 2000).

Research supports these humanistic ideals. Self-reported authenticity relates to numerous aspects of well-being (Kernis & Goldman, 2006) and does so across cultures (Robinson, Lopez, Ramos, & Nartova-Bochaver, 2012). Following one's innate values (Sheldon, Arndt, & Houser-Marko, 2003) toward greater concordance between one's goals and intrinsic, organismic needs predicts ever greater well-being (Sheldon, 2014; Sheldon & Kasser, 1995; Sheldon & Houser-Marko, 2001). Research has further shown that individuals high in "self-presentational congruence" (presenting oneself as one truly is across a variety of social relationships) show higher social and psychological wellbeing (Gohar, Leary, & Costanzo, 2016). Moreover, those who present themselves as they really are in everyday life experience higher relationship satisfaction (Gosnell, Britt, & McKibben, 2011). Certainly, there is ample evidence that "being who you really are" and following your innermost impulses predicts heightened well-being.

Similarly, research on the "true self" has demonstrated that reminders of one's essential nature lead to higher levels of meaning in life (Schlegel, Hicks, Arndt, & King, 2009). In addition, feeling like one is "in touch" with one's true self, is associated with higher meaning in life (Schlegel, Hicks, King, & Arndt, 2010). Such findings lend support to the humanistic idea that authenticity is an essential part of optimal human functioning.

Yet, the humanistic perspective assumes that the content of a person's innermost, genuine feelings and impulses are toward self-growth and compassion toward others. In contrast, we might question whether it is optimal for someone who possesses traits that predispose him or her to negative actions, such as aggression or self-harm, "to be that self which one truly is."

Interestingly, Rogers anticipated this concern. He (1961, p. 177) noted that for some his advocacy for being true to oneself might involve "releasing the beast within." In answer to the possibility that clients might view their innermost feelings and desires as problematic or dangerous, Rogers (1961) drew an analogy to a lion, attacking and devouring its prey. For the lion, such behavior is an expression of his innermost natural impulses as a member of its species. Rogers maintained that

human behavior could be viewed similarly: Increasing trust in a person's "organism" was a good: "...when one is truly and deeply a unique member of the human species, this is not something which should excite horror" (Rogers, 1961, p. 178). Impulses that are feared by the person are likely to emerge as natural and innately beneficial. Of course, from Rogers' perspective, this emergence of feared behaviors as expressions of true human nature

would involve the undoing of the socialization that has led to a chasm between the person's current self and his or her true nature. Similarly, addressing the "darker side" of human functioning, SDT scholars maintain that truly heinous behavior can be traced to "serious thwarting of psychological needs during development" (Ryan & Deci, 2000 p. 321). From a humanistic perspective, there are those who have not received the proper nutriments of self-development (for Rogers, unconditional positive regard; for SDT, autonomy support) and may have impulses that are twisted accordingly. For such individuals, authenticity may be a complicated matter, involving first the uncovering of long suppressed impulses (Kernis & Hepner, 2008).

Dark Personality Traits

Paulhus and Williams (2002) identified the Dark Triad (including, Machiavellianism, narcissism, and psychopathy) as a constellation of traits reflecting aversive personality characteristics. The Dark Triad traits are considered to be subclinical reflections of a shared core of callousness and manipulativeness towards others. The traits are conceptually distinct from each other, but empirical overlap has been identified (Furnham, Richards, & Paulhus, 2013). Machiavellianism is characterized by the belief that manipulating other people is vital to one's success and a willingness to engage in such manipulation (Christie & Geis, 1970; Jones & Paulhus, 2009). Machiavellians are cynical and unprincipled (Furnham, Richards, & Paulhus, 2013). Narcissism is reflected in grandiose self-views, dominance, and a strong sense of entitlement and superiority (Corry, Merritt, Merug, & Pamp, 2008). Psychopathy refers to impulsive, antisocial, and lacking in empathy (Miller, Lynam, Widiger, & Leukefeld, 2001). Considered together with sadism, which is the enjoyment of cruelty and the suffering of others (Buckels, Jones, & Paulhus, 2013), these traits comprise the Dark Tetrad which may be considered contemporary personality psychology's approach to evil (Book et al., 2016).

Do these characteristics represent the core selves of those who endorse these scales or are they superficial qualities, laid over true, good human nature? Research and theory on the Dark Triad considers these traits as nature: they share substantial genetic components (e.g., Onley, et al., 2013, Petrides et al., 2011) and evolutionary approaches to these dark traits consider them under the umbrella of fast life history strategies (e.g., Jonason, Koenig, & Tost, 2010; McDonald, Donnellan, & Navarrete, 2012). Clearly, as noted above, the humanistic perspective would posit that such characteristics likely emerge from problematic socialization.

Whatever their origins, how do these traits relate to wellbeing? Although typically studied in the context of negative behaviors (such as deception, Jones & Paulhus, in press), the correlations between these traits and well-being have begun to attract scholarly attention. Given its relatively recent addition to the Dark Tetrad, research has not examined sadism and wellbeing. Associations for the other three traits vary and, at times, depend on the specific measure used. Overall, narcissism tends to relate positively to well-being (e.g., Aghababaei, & Błachnio, 2015; Egan, Chan, & Shorter, 2014). Particularly as measured by the Narcissistic Personality Inventory, narcissism predicts greater daily levels of life satisfaction and positive mood but also hostility (Giacomin & Jordan, 2016). Psychopathy relates to depressive symptoms and lowered well-being (Aghababaei, & Błachnio, 2015; Love & Holder, 2014), though some facets of psychopathy might relate positively to well-being (Durand, 2016). A negative correlation between Machiavellianism and well-being has been reported (Egan, Chan, & Shorter, 2014) but other studies have found no association (Aghababaei, & Błachnio, 2015).

The Content of the Authentic Self

How might the content of a person's character affect the association between authentic self-expression and well-being? Little research has addressed this question. Schlegel, Hicks, Arndt and King (2009) showed that even exposure to negative true self aspects led to higher levels of meaning in life, suggesting that reminders of the true self are beneficial even if these do not represent one's "best" self. Thus, it may be that authenticity is associated with well-being, regardless of the qualities a person possesses. Thus, one might hypothesize main effects, such that authenticity and the Dark Tetrad traits relate to wellbeing in a straightforward way with no interaction. Indeed, Gohar Leary and Costanzo (2016) found that self-presentational congruence predicted higher well-being and social adjustment controlling for Machiavellianism. However, these authors did not test for moderation.

The question of whether negative traits might alter the association between authenticity and well-being is complicated by the fact that authenticity and positivity share a strong association. Although authenticity is often thought of as being oneself "warts and all," research suggests that when people feel that they are being themselves they are rarely showing their warts: Positive, socially desirable behaviors are more likely to feel like authentic expressions of the self, even if they are not. For example, Jongman-Sereno and Leary (2016) found that people find positive behaviors as more authentic expressions than negative behaviors, regardless of whether these were actually behaviors they had performed. Similarly, Sheldon and colleagues (1997) found that people feel more authentic when they are enacting socially desirable traits. Strohminger, Knobe, and Newman (2017) propose that the true self is inherently moral. Certainly, such findings suggest that, even apart from the inherent dishonesty implied in Machiavellianism, the Dark Tetrad are likely to be negatively related to authenticity.

We suggest that for those who possess traits that are socially problematic, inauthentic behavior could be functional, at least in terms of personal well-being. That is, if one knows that s/he is prone to manipulative or callous behavior towards others, hiding that fact might be lead to better outcomes. Such outcomes might occur for at least three reasons. First, it might be that individuals who possess Dark Tetrad traits would engage in strategic inauthenticity. The traits are generally associated with dishonesty (Lee & Ashton, 2014) and for these individuals to get what they want (i.e., to successfully manipulate others), inauthenticity might be a superior strategy to putting all of one's impulses on display. Well-being might be higher among those who are successful at this manipulation.

Another, quite different possibility warrants consideration, however. It might be that for such individuals hiding who "they really are" is an attempt, simply, to be a good person. Rather than following their innermost impulses toward goodness, for such individuals, personal well-being, growth, and positive social relationship may require them to deny those impulses (which the person may have no intention of actually enacting). Successfully making and keeping friends and carrying out warm relations with others may require those high in Dark Tetrad traits to hide these tendencies. Being good, even if it is not an expression of the person's "true self," may lead to well-being benefits.

Finally, it might be that for those who report themselves as cold and calculating, being inauthentic is, itself, authentic. That is, if a person experiences his or her "core self" as deceitful and manipulative, being inauthentic may be the most genuine expression of the self. To the extent that being true to oneself is associated with well-being, we might expect inauthenticity to be associated with well-being for those for whom being inauthentic is true to their core sense of self. Essentially, we propose that the context of the Dark Tetrad will flip the meaning of (in)authenticity. This idea is akin to a recent set of studies showing that narcissism is associated with finding higher meaning in extrinsic goals and that among those high in narcissism, relatively more extrinsic than intrinsic values predicts higher meaning in life (Abeyta, Routledge, & Sedikides, 2017). Perhaps, in the context of potentially evil impulses, being inauthentic is more likely to predict well-being.

Overview of Current Study

Two studies have been completed. These demonstrated a consistent pattern of moderation such that among those high in Dark Tetrad traits, inauthenticity is associated with higher levels of well-being. The present study builds on these results, seeking to illuminate the meaning of inauthenticity among those high in so-called "dark traits." In this study, participants completed the same measures as in the first two studies, including measures of the Dark Tetrad (i.e., narcissism, Machiavellianism, psychopathy, and sadism), an array of well-being measures, and established measures of authenticity. In addition, participants were asked to provide the emails of 5 people who know them well. These individuals were sent a link to a survey about the participants. These data were used to examine whether peers are aware of the "dark" traits the participants possess, whether authenticity on the part of participants relates to whether peers know "who they really are", and whether being known is associated with participant well-being.

Methods

Participants and Procedure

We recruited students from the University of Missouri to complete self-report questionnaires. The sample of "targets" consisted of 364 participants (61% female). Participants were awarded research credit in General Psychology for their participation. The study was conducted entirely online.

Measures

Unless otherwise noted, all ratings were made on a scale from 1 to 7, with 7 meaning higher endorsement. The Authenticity Scale (AS; Kernis & Goldman, 2006) contained 45 items measuring authenticity. Example questions include "I often find I am overly critical of myself" and "I prefer to ignore my darkest thoughts and feelings." This scale is divided into 4 components determining Awareness, Unbiased Processing, Behavior, and Relational Orientation. The Satisfaction with Life Scale (SWLS; Diener, 1985) is composed of 5 items assessing life satisfaction measures (e.g., "I am satisfied with my life").

Participants were asked a single question to gauge selfesteem measurement (e.g., "I have very high self-esteem"). For this scale, a 7-point Likert scale was employed with responses ranging from "not very true" to "very true." An 8-point section on affect was used to determine current feelings at the time of the questionnaire. Individuals were asked to rate how they currently felt on a 7-point Likert scale with response ranging from "not at all" to "very much" (e.g., "frustrated", "sad", etc.).

The Meaning in Life Questionnaire 5-item Presence of meaning subscale (Steger, Frazier, Oishi, & Kaler, 2006) was used to measure meaning in life (e.g., "My life has a clear sense of purpose"). A 9-item inauthenticity analysis was performed to measure true self (e.g., "When I hide my true self from others, I do it so they will like me").

Dark Tetrad traits were measured using a 7-point Likert scale with responses ranging from "Strongly Disagree" to "Strongly Agree". Machiavellianism and narcissism involved using 9-item subscales to measure manipulative tendencies and narcissistic behavior (e.g., "It's not wise to tell your secrets" and "People see me as a natural leader"). The Levenson Self Report Psychopathy (LSRP; Levenson, Kiehl, Fitzpatrick, 1995) was administered as a 7-point Likert scale and consisted of a 16-item analysis that calculated psychopathy. Assessment of Sadistic Personality (ASP; Plouffe, Sklafske & Smith, 2017) was also presented as a 7-point Likert scale consisting of a 9-item analysis. A final 7-point Likert scale was used to determine intrinsic religiosity (e.g., "My whole approach to life is based on my religion"). The religiosity scale also contained responses ranging from "Strongly Disagree" to "Strongly Agree".

Next, participants completed demographic items and then were asked to provide the names and email addresses of 5 close friends. Participants were instructed to exclude parents from their list of names. Peers were contacted and invited to complete a brief survey about the original participants. The peers were offered a chance to win one of four \$50 Amazon gift cards in return for participation.

Peer Rating Measures

Peers were asked to complete a series of questionnaires as if they were the target. These included The Satisfaction with Life Scale (SWLS; Diener, 1985) (e.g., "I am satisfied with my life"); measures of positive and negative affect (e.g., "anxious", "frustrated", "angry"); the MLQP, (e.g., "I understand my life's meaning"), and a single item self-esteem measure: "[peer name] has high self-esteem."

Because participants might have been hesitant to rate their friends on negative traits, indicators of the dark tetrad and dishonesty more generally were embedded in a list of characteristics. In addition, for each, we used a sliding scale and the following instructions: "For the following items, we are going to present you with a list of characteristics. We would like you to think about a person you know that most represents each characteristic. This should be someone you know personally, and not a celebrity, historical figure, or fictional character. The person you know that most embodies each quality will represent the highest score on the scale. For example, if we listed the trait outgoing, you would think of the most outgoing person you know. On a scale from 0 to 100 for outgoingness, this person would rank at 100 on the scale." Then participants were asked to think about the target and place them on the scale with respect to the person that most represents each characteristic. The characteristics rated include: Arrogant, Dependable, Honest, Compassionate, Authentic, Self-centered, Caring, Intelligent, Manipulative, Charming, Sympathetic, Gentle, Mean, Trustworthy, Impulsive, Cynical, Moral, Kind/Caring. Finally, peers rated their relationship with the target. A 7-point Likert scale was used with responses ranging from "Disagree Strongly" to "Agree Strongly" (e.g., "I know [peer name] very well").

Results

Preliminary Analyses

To assess peer agreement, we examined the relationships among the peers ratings. Because the number of peers for each person varied from 1 to 5, we examined these associations only among those who had more than one peer reporter. Further, because few people had more than 2 or 3 peers, we limited our assessment to the first 3 peers reporting. Within the wellbeing variables, relations were modest, but this was likely due to a lack of variance. Most peers rated targets' lives as quite satisfying, happy, and meaningful. In addition, recall that these items were rated using single items. For life satisfaction, for the first three peers, *r*(115)= .22, *p*=.022; *r*(42) = .15, *p*=.33; r(42)=.29, p=.059. For happiness, r(113)=.15, p=.10; r(42)=.13, *p*=.43; *r*(42)=.19, *p*=.23. For meaning in life, *r*(112)=-.02, *p*=.82; r(42)=.18, p=.27; r(42)=.06, p=.71. For self-esteem, r(113)=.25, *p*=.008; *r*(42)=.21, *p*=.19; *r*(42)=.28, *p*=.08. For the dark personality traits, there was considerably more agreement, r(100)=.46, p < .001; r(38) = .47, p = .003; r(37) = .30, p = .07. Recall that these correlations are based on multiple items aggregated. In any case, to examine our main hypotheses, we aggregated over the available peers for each target.

Targets (N=364)	Mean (SD)
Well-being	
Meaning in Life	4.86 (1.43)
Satisfaction With Life Scale	4.81 (1.19)
Positivie Affect	4.33 (1.46)
Negative Affect	2.56 (1.31)
Self-esteem	4.35 (1.70)
Authenticity	
Authentic Processing	3.94 (0.80)
Authentic Awareness	4.90 (0.79)
Authentic Behavior	4.44 (0.83)
Authentic Relational Orientation	4.90 (0.74)
Total Authenticity	4.58 (0.62)
Dark Tetrad Traits	
Narcissism	4.20 (0.81)
Machiavellianism	4.00 (0.98)
Psychopathy	3.02 (0.93)
Sadism	2.50 (1.22)
Peers (<i>N</i> =364)	
Target Well-Being (composite)	5.69 (0.82)
Target Dark Traits (composite)	29.57 (17.00)
Quality of Relationships	6.13 (0.88)

dark-traits which were rated on a scale from 1-100.

Table 1 shows descriptive statistics regarding student reported levels of well-being, authenticity, dark tetrad traits and peer reports of targets' well-being, dark traits, and relationship quality. Although peer reports of dark traits were low (~30 on a 100 point scale), there appeared to be sufficient variability in these to warrant analyses.

Table 2 shows the correlations among all measures. Among Dark Tetrad (DT) traits, narcissism was positively related to all the well-being measures and the rest were generally negatively related to these. Within the peer reports, peer-rated well-being was negatively related to peer estimates of dark traits. In addition, peer ratings of relationship quality were positively related to well-being and negatively related to the dark trait ratings.

The bottom rows of Table 2 show the cross correlations between targets and peers. Generally, peer ratings of wellbeing were positively related to self-reports of well-being. In addition, self-reported well-being was negatively related to peer assessments of dark traits. In addition, peer ratings of dark traits were generally positively related to self-reports of these. This convergence indicates that friends do know if their peers have dark personalities. Self-reported authenticity was positively related to peer reports of well-being. Peer reports of relationship quality were positively correlated with target life satisfaction and authentic awareness, and negatively related to psychoticism, sadism, and the dark tetrad composite.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Targets																			
1.MIL	.92																		
2.SWLS	.65**	.85								/ 1 1 1									
3.pa	.43**	.49**	.92																
4.na	32**	43**	31**	.81						1									
5.se	.44**	.53**	.46**	31**								***********							
6.owb	.77**	.83**	.73**	64**	.74**	.80		1											
7.aut	.61**	.58**	.40**	48**	.46**	.69**	.90												
8.aaw	.66**	.58**	.38**	38**	.43**	.66**	.85**	.79											
9.abh	.49**	.51**	.33**	47**	.42**	.60**	.85**	.62**	.77										
10.aup	.28**	.26**	.28**	34**	.36**	.41**	.62**	.31**	.49**	.66									
11.aro	.50**	.49**	.28**	35**	.24**	.50**	.80**	.70**	.54**	.24**	.72								
12.nar	.34**	.29**	.27**	13*	.53**	.42**	.32**	.29**	.28**	.28**	.17**	.68							
13.mach	20**	-20**	18**	.13*	09	21**	40**	23**	37**	29**	39**	.13**	.81						
14.psy	23**	18**	04	.17**	.06	15*	43**	39**	30**	15**	51**	.15**	.53**	.89					
15.sad	26**	18**	10	.22**	.06	19**	42**	37**	31**	18**	46**	.07**	.41**	.69**	.90				
16.odt	12*	09**	02	.14*	.20**	04	33**	25**	25**	12**	42**	.48**	.73**	.84**	.77**	.68			
Peers																			
17.pwb	.30**	.28**	.19**	11	.31**	.32**	.22*	.24**	.19*	.15*	.12	.14*	11	11	09	05	.84		
18.pdt	18*	07	15**	.14	04	16*	12	17	07	07	10	.02	.14	.22*	.17*	.19*	26**	.84	
19.gpr	.10	.15*	.06	04	.03	.10	.14	20*	.04	.11	.12	06	14	16*	13	17*	.31**	34**	.88

Table 2. Correlations Among All Measures

Note: MIL = Meaning in Life, SWLS = Satisfaction with Life Scale, PA = Positive Affect, NA= Negative Affect, SE = Self-esteem, OWB = Overall Well-Being, AUT = Authenticity, AAW = Authentic Awareness, ABH = Authentic Behavior, AUP = Authentic Processing, ARO = Authentic Relational Orientation, NAR = Narcissism, MACH = Machiavellianism, PSY = Psychopathy, SAD = Sadism, ODT = Overall Dark Tetrad, PWB = Peer Well-Being, PDT = Peer Dark Tetrad, QPR = Quality of Peer Relationship Student N's range from 362-364 due to missing data. Peer N's range from 178-188 due to missing data. For each target, the number of peers ranged from 2 to 5. **p<.001, *p<.05. Coefficients on the diagonal are Cronbach's α

Primary Analyses

Focusing only on the self-report data, to examine whether the relationship between self-reported authenticity and well-being was moderated by the Dark Tetrad, we computed the correlations between the well-being variables and the DT composite at low and high levels of authenticity. Results are shown in Table 3. As can be seen, the DT composite was more positively related to well-being at low levels of authenticity and unrelated to well-being at high levels of authenticity. Differences in correlations were significant for positive affect, self-esteem, and the well-being composite. No relationships emerged for peer-rated well-being. These results indicate that (only) at low levels of authenticity, DT traits are positively related to well-being.

Table 3. Correlations between well-being and Dark TetradComposite, for those low/high in Authenticity

	Low Authenticity (1 SD below the mean)	High Authenticity (1 SD above the mean)	Z (difference)
Meaning in Life	.32	.05	1.42
Life Satisfaction	.44	.11	1.83
Positive Affect	.33	10	2.23*
Negative Affect	17	02	08
Self-Esteem	.61	.22	2.45*
Well-being Composite	.48	.09	2.19*
Peer Rated Well-being	11	.13	79

Note. For low authenticity, *n*=364; for high authenticity, *n*=364. ***p*<.001; **p*<.05.

We also computed multiple regression equations testing the interaction of authenticity and the dark tetrad in predicting well-being. Only one equation produced significant results, unbiased processing, and it is shown in Table 4. As can be seen in Table 4, unbiased processing (i.e., a person's ability to view and assess one's own positive and negative traits without bias) positively predicted well-being. However, this main effect was qualified by a significant interaction. To probe this interaction, we computed simple regression lines for individuals +/- 1 SD from the mean on unbiased processing and the dark tetrad composite. Results are shown in Figure 1. As can be seen, unbiased processing was strongly related to well-being for those low on the Dark Tetrad but was unrelated to well-being for those high on these traits. To insure these generated lines represent the raw data, we calculated correlations between unbiased processing and well-being for those low and high on dark tetrad traits. Among those 1 SD below the mean on DT (*n*=44), unbiased processing was positively related to wellbeing, *r*=.50, *p*=.001; in contrast for those 1 SD above the mean on DT, r=.045, p=.77

Table 4. Moderation Analyses Regressing Well-being on

 Authenticity Components X Dark Tetrad

y 1		
Predictors		β
Main Effects	$\Delta R^2 = .17^{**}$	
Unbiased Processing		.40**
Dark Tetrad		01
Interaction	$\Delta R^{2}=.01^{*}$	
Unbiased Processing X Dark Tetrad	_	11*

Note. **p<.001; *p<.03. For the equation, R²=.18; F(3,36)=26.21, p<.001.

Does it matter if friends are aware of a person's dark traits, for well-being? To address this question, we first standardized the self and peer reports for the dark traits. Then we calculated two difference scores. For the raw score, high scores indicated that peers view the target worse than he or she reported themselves. Absolute values of these scores indicated the degree of match between the reports (with no indication of the direction of the difference). Correlations between these scores and selfreported authenticity and well-being and peer reported wellbeing and relationship quality are shown in Table 5.

The signed difference scores were negatively correlated with peer ratings of target well-being and relationships quality but were unrelated to self-reports of authenticity or well-being. The absolute difference scores were negatively related to both self and peer rated well-being. These results indicate that not being known—even about one's dark traits—is associated with lower well-being.

Figure 1. Dark Tetrad and Authentic Unbiased Processing Predicting Well-Being



Standardized well-being for individuals +/- 1 SD on Dark Tetrad Composite and Unbiased Processing.

General Discussion

The present study examined two key questions. First, we sought to identify whether peers were aware of their friends "dark" personality traits. Results showed that there was some convergence between targets and peers – peers do seem to know if their friends have dark personalities. Second, we examined whether the relationship between authenticity and well-being was moderated by dark traits. We tested this idea in three ways. First, we examined the association between dark traits and well-being at high and low levels of authenticity. Results showed that, as predicted, at low levels of authenticity, dark traits were positively related to well-being, compared to at high levels of authenticity. Second, we tested whether self-reported authenticity interacted with dark traits to predict well-being. Results showed that only the relationship between "unbiased processing" and well-being was moderated by the dark traits. In addition, the pattern of this result did not conform to predictions. Rather than showing a boost in wellbeing at low levels of authenticity for those high in the Dark Tetrad, results showed only that one aspect of authenticity was less strongly associated with well-being among those high on the Dark Tetrad. Finally, we tested whether the "match" between targets and peers on target dark personality ratings had implications for well-being. The distance between targets and peers in their estimates of even these negative personality traits was related to poorer well-being, suggesting that being known, even for one's dark sides, is associated with higher well-being. Although these results do not support the prediction that being inauthentic is associated with higher well-being for those high in the dark traits, they do have implications for our understanding of well-being and role of being known in human functioning.

Table 5. Peer ratings of Dark Personality Traits, Self-ratings,

 Authenticity and Well-being

	Difference Score (Raw)	Difference Score (AV)
S- Authenticity	.08	11
S-WB	09	20**
P-Well-Being	21**	15*
P-Relationship Quality	20**	14

Note. N=178; Difference Scores were calculated using standard scores, subtracting target from peer ratings. For raw scores, higher scores indicate peers view the target as "darker" than they reported themselves. Absolute value scores indicate inaccuracy (with 0 indicating perfect accuracy). **p<.008; *p<.05.

Agreement Between Targets and Peers

Peer reports of dark traits indicated high correspondence with self-reported dark traits. Additionally, peer reports for target well-being were positively related to self-reported wellbeing. This agreement between peers and targets suggests that at both low and high levels of the Dark Tetrad, peers accurately assessed their friend's traits. Furthermore, peer reports of target well-being were negatively correlated with peer reports of dark traits. This suggests that peers perceive a negative relationship between dark traits and well-being, as expected. We found that self-reported well-being was also negatively related to peer assessment of dark traits. This further strengthens the idea that peers accurately assessed the target's personality, and also provides evidence that peers understood the targets well-being levels. For targets who had inaccurate peers, not being known was negatively associated with well-being. This occurred even if targets were not known for having a dark personality. The agreement between peers and targets extends further still, as data showed that self-reports of quality of relationship were positively related to peer reports of quality of relationship. Taken together, the present study suggests that peers are aware of not only target levels of Dark Tetrad traits and well-being, but that the better targets were known by their peers the higher their well-being.

We now propose several possible explanations for peer accuracy in reporting the target's levels of well-being, Dark Tetrad traits, and the quality of relationship. Conceptually, authenticity refers to being one's true self. We also know that each of the individual Dark Tetrad traits involves over inflated self-evaluations, callousness, and manipulation. It may be possible that being one's true self for someone high on Dark Tetrad is to be inauthentic. If it is being one's true self that promotes higher well-being, this may explain why we observed a positive relationship between Dark Tetrad and well-being at low levels of authenticity.

Another possibility is that people high on the Dark Tetrad that report low authenticity are truly attempting to be kind in an effort to sustain personal relationships. Our findings provide support for this explanation. Specifically, we found that when peers know the targets are high on Dark Tetrad traits, the targets reported higher well-being. It may be that targets are attempting to preserve social relationships by compensating for relatively dark personality traits by being kind to their peers and presenting inauthentic versions of their true, dark selves.

High vs. Low Authenticity Levels

At low levels of authenticity, well-being did correlate positively with Dark Tetrad traits, providing evidence that those with dark personalities increase their well-being by being inauthentic. At high levels of authenticity, dark tetrad traits (except for narcissism) were generally unrelated to wellbeing. These findings would suggest the relationship between Dark Tetrad traits and well-being differs as a function of authenticity. However, evidence for moderation of the relationship between the Dark Tetrad and well-being by authenticity was weak. It is unclear why regression models testing for moderation failed to support predictions. One possibility may be that authenticity and well-being were so strongly related. We expected authenticity and well-being to be positively related, however, the magnitude of the relationship between authenticity and well-being was unexpected. The strength of the correlation between these variables may have resulted from socially desirable responding. It may be that students generally rated themselves highly on positive traits, which spurred the very strong association between authenticity and well-being.

Authentic Unbiased Processing

We found very little support for the prediction that authenticity would moderate the relationship between dark tetrad personality traits and well-being. We tested this prediction in models with overall authenticity as well as for each of the four sub-components of authenticity, and only one result stood out. Authentic unbiased processing has been previously defined as assessing one's positive and negative traits without bias. This sub-component moderated the relationship between Dark Tetrad personality traits and well-being, however, the pattern of moderation did not match our predictions. Still, we found that at low levels of authentic unbiased processing, Dark Tetrad traits were positively related to well-being, while at high levels of authentic unbiased processing, they were unrelated.

These results may imply that authentic self-reflection might be more important to the relationship between the Dark Tetrad and well-being than other components of authenticity. The moderating effect of unbiased processing on well-being and the Dark Tetrad might mean that those with dark personalities exhibit higher well-being when they assess themselves with bias. Although data do not suggest that it is better to be inauthentic for those high on the Dark Tetrad, it does fit with the idea that for them, authenticity is less strongly related to well-being. However, because the evidence for moderation was fairly weak, we urge caution in the interpretation of these findings. Future research should attempt to replicate these findings.

As noted in Table 5, peers rated overall relationship quality and target well-being as worse than the students did. Additionally, self-reported well-being was negatively related to peer assessments of dark traits.

Limitations & Future Directions

This study relied on a student sample, and their peers. As a result, targets were mostly college freshman who may not have been representative of the general public, especially in terms of Dark Tetrad traits. Furthermore, students not only may be lower on Dark Tetrad than the general public but may also have been more likely to engage in socially desirable responding, thereby artificially deflating their Dark Tetrad scores. Future research should be conducted using more representative samples.

Another limitation was that many of the students provided no peers. Future studies may find it beneficial to incentivize peer participation to increase response rates. Having more peers for each student may have allowed us to gather more accurate peer assessments.

Future studies may wish to implore a different design to replace or accompany using self-report questionnaires. For instance, an in-lab study would allow researchers to actually observe interactions between targets and peers, and code for variables such as authentic self-expression.

Another limitation was that, due to time constraints, almost all peer measures were limited to single-items, potentially leading to concerns with measurement error. Future research should also collect data from peers using more comprehensive measures.

Conclusion

The present study examined the role of authenticity in the relationship between Dark Tetrad personality traits and well-being. We did not find strong evidence for the predicted moderation, but we did find that dark tetrad personality traits were positively associated with well-being, only at low levels of authenticity. Additionally, we found that peers do know if their friends have dark personalities, and peer accuracy was associated with target well-being, even when it was about dark tetrad traits. These results of this research suggest that being known by one's peers, even if it means peers know that one is manipulative, self-centered, and immoral, is better for one's well-being than not being known.

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Teachers Interactions with Students in their Classroom: Differences by Race, Gender and SES?

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Abstract

Students who have more negative interactions with teachers are more likely to have negative academic, behavioral, and social-emotional outcomes. African-American boys, especially those who come from low SES families, tend to have more negative interactions with teachers. The purpose of this study was to determine if students gender, race, and SES were predictive of observed disruptive behavior. In this study we evaluated whether teacher reported disruptive behavior was consistent with what was seen in classroom observations and if teachers interacted more or less negatively with students who they perceived to be more disruptive, have more concentration problems and lower self-regulation. Students were predominantly Black students (73%), 51% were boys, and 61% of the sample received free or reduced lunch with a total of 679 students. Teachers were from nine elementary schools teaching in first thru fourth grade. Direct observations of student-teacher classroom interactions were gathered as well as teacher reports of student's social behavior Regression analyses was conducted to determine associations between classroom observations, teacher reports, and demographics of students. When looking at race, gender, and SES, gender was the only predictor of observed disruptive behavior. Despite boys being the only group observed as having more disruptive behavior, teachers reported Black students, boys, and lower SES students as having more disruptive behaviors, concentration problems, emotional dysregulation, and less prosocial behaviors. Thus, Black students, students from low SES backgrounds, and boys may have fewer positive teacher interactions which could result in negative outcomes.

Key Words: Student-Teacher Interactions, Bias, Culturally Responsive Teaching

Introduction

How do interactions between a teacher and a student impact the student's outcomes? For school-aged children, teachers are individuals with whom they interact with a great deal. When these interactions are more often negative than they are positive, this can have negative outcomes for the child. Specifically, the way a teacher interacts with students and visa-versa, is a strong predictor of the child's behavioral and academic outcomes (Reinke, Herman, & Newcomer, 2016). More specifically, when teachers give more negative attention to positive attention these interactions are related to increased disruptive behavior over time (Reinke et al., 2016).

According to Skinner & Belmont (1993), the way a teacher interacts with a student is a predictor for a child's social emotional and behavioral engagement in the classroom. Individual interactions with teachers have a significant impact on how children perceive the teachers' involvement with them (Skinner & Belmont, 1993). Specifically, in children in grades 3-5, eacher involvement was a strong predictor of their emotional engagement (Skinner & Belmont, 1993).

Interactions between teachers and students are often reciprocal and in response to the students' behavior. Children with externalizing issues who experience more negative interactions with teachers (conflicted and angry) reported less positive self-perceptions when compared to students who did not experience these negative interactions (Henricsson & Rydell, 2004). Students that teachers perceive as having externalizing and prosocial behaviors have a more positive relationship with their teacher (Fowler, Banks, Anhalt, Der, & Kalis, 2008). More positive, quality interactions ith teachers has been found to have a positive impact on students' academic outcomes. Highquality interactions with teachers in kindergarten are beneficial for students at the start of their schooling regardless of the amount of formal teaching received (Pakarinen et al., 2017). Emotional support from teachers is important for children's literacy skills (Pakarinen et al., 2017; Burchinal et al., 2010; Curby et al., 2009). For example, Pakarinen et al. examined the extent to which quality teacher-student interactions in kindergarten, are associated with student's reading and math development during the rest of their elementary school years. They found that high-quality teacher-student interactions in kindergarten were positively associated with more advanced academic skills four years later (Pakarinen et al., 2017).

Teacher-Student Interactions in Regards to Race

Teachers, like everyone else, have implicit biases that effect how they interact with students. This can be seen in things like Office Disciplinary Referrals, in which Black students are significantly more likely to be sent to the office for disciplinary reasons than White students (Bradshaw, Mitchell, O'Brennan & Leaf, 2010). Factors such as race, gender, and ethnicity have also been found to correlate with how teachers rate students' classroom adjustment (Saft & Pianta, 2001; Alexander & Entwisle, 1988; Pianta & McCoy, 1997). Additionally, Black students are given more severe punishments for committing the same act as a White student (Horner, Fireman, & Wang, 2010). Teachers are also more likely to perceive Black students as needing psychological assessments, special education services, and hyperactivity diagnosis (Horner, Fireman, & Wang, 2010). In fact, this same study found that a child's race was the best predictor for serious disciplinary action even when controlling for overt aggression (Horner, Fireman, & Wang, 2010).

Student-Teacher Interactions in Regards to Gender and Socioeconomic Status

Similarly to race, a child's gender can predict how teachers will rate them for conduct problems and their academic achievement (Saft & Pianta; Patterson, Kupersmidt, & Vaden, 1990). While girls receive less attention from teachers when compared to boys, they are also less likely to be criticized by teachers than their male peers (Saft & Pianta, 2001; Brophy, 1985; Eccles & Blumenfeld, 1985; Morgan & Dunn, 1988). Males, regardless of race and ethnic background, were more likely to receive discipline referrals (Gregory, Skiba, &

Noguera, 2010).

In addition to race and gender, the socioeconomic status (SES) background from which a student comes from has been found to impact students' outcomes (Jones, 2004; Jussim & Eccles, 1992; Lupart, Cannon, & Telfer, 2004; Ma, 2000; Palardy, 1998; Zaher, 1996). Studies have shown that children from high-SES backgrounds are treated more favorably by teachers than students who perform similarly academically, but are from low-SES backgrounds (Auwarter & Aruguete, 2008). For example, Auwarter & Aruguete found that teachers perceived low SES-students as having less promising futures than high-SES students and rated low-SES students as needing more academic support (Auwarter & Aruguete, 2008).

The Present Study

The present study aims to examine the way teachers interact with their students and if those interactions are different based on the student's race, gender, and socioeconomic status (SES). This was done by examining teacher's ratings of student's behavior and comparing that to observations of student's behavior to determine if teacher's perceptions of students in their classroom were being impacted by the demographic of the student. This study was guided by the following research questions:

- 1. Does student gender, SES, or race predict observed disruptive behavior in the classroom? We did not expect student demographic to predict observed disruptive behaviors
- 2. Do teachers report higher disruptive behavior based on gender, SES, or race? We expected teachers to report male students, student from low SES backgrounds, and Black students as having more disruptive behaviors, concentration problems, and emotional dysregulation.
- 3. Do teachers interact more negatively with students they perceive to be more disruptive, have more concentration problems and lower self-regulation when controlling for student demographics? We expected teachers to have more negative interactions with students they perceived to be more disruptive, have more concentration problems and have lower emotion regulation when controlling for student demographics.
- 4. Do teachers interact more positively with students they perceive to have more prosocial behaviors. We expected teachers to interact more positively with students they perceived to have more prosocial behaviors when controlling for student demographics.

Methods

Participants and Setting The study was conducted across K to Grade 4 classrooms in nine elementary schools in a low-income urban Midwestern school district. The teachers in these classrooms were part of a larger randomized trial evaluating the efficacy of a universal classroom management intervention. Participants in this study were 107 teachers. Of the 107 teacher participants, 93% were female. Forty percent of teachers reported earning a bachelor's degree as their highest degree, 51% earned a master's degree, and 9% reported earning a post master's certificate. On average, teachers in the study had been teaching for 12 years.

The racial demographics of the teachers were 22% Black, 75% White, 1% Asian, 1% Hispanic and 1% listed themselves as Other. Seventy-six percent of the teachers were between the ages of 20 and 40, whereas 24% were above the age of 41. Student participants were those whose parents con-sented for their participation in the larger randomized trial. Students were predominantly Black students (73%), 51% were boys, and 61% of the sample received free or reduced lunch. A total of 174 students (25%) were in first grade, 188 (27%) were in second grade, and 216 (31%) were in third grade, and 110 (16%) were in fourth grade.

Measures

Direct Observation of Student-Teacher Classroom Interactions. Independent observers conducted direct observations of teacher and student behaviors using the Brief Student-Teacher Classroom Interaction Observation code (ST-CIO; Reinke & Newcomer, 2010). A frequency count was conducted of teacher use of behavior specific praise, general praise, explicit reprimands and harsh reprimands directed toward the individual student being observed. In addition, the frequency of student disruptive behaviors of the observed individual student were gathered at the same time. Each student was observed for 5 minutes during academic instruction times (reading or math). For the purpose of this study, each student with consent to participate in the classroom was observed for five minutes. Observation of each student were conducted in spring of the school year (April). All data were converted to rate per minute. To determine the amount of positive to negative interactions the individual student received from the classroom teacher, the total number of reprimands (explicit + harsh) was subtracted from the total number of praise statement (behavior specific + general). Thus, students receiving more positive than negative attention had a positive score on this variable and those receiving more negative than positive attention had a negative score.

Student demographics. Free and reduced lunch status (FRL), race, and gender were obtained from the school district for all participating students. Students were coded as 1 if they received FRL and 0 if not. Student gender was coded as 0 for boys and 1 for girls. For the purposes of this study student race was coded as Black, White, or Other Race.

Teacher report of child social behavior. The Teacher Observation of Classroom Adaptation-Checklist (TOCA-C; Koth, Bradshaw, & Leaf, 2009) is a 54-item measure of child behavior. It was completed by the classroom teachers for each child. Teachers were asked to rate each child on the items referencing the past three weeks. The four subscales of the TOCA-C included in the present study were Disruptive Behaviors, Concentration Problems, Emotional Dysregulation, and Prosocial Behavior. The item responses ranged from 1 (never) to 6 (almost always). Prior studies support the factor structure of the TOCA-C (Koth et al., 2009) as well as strong evidence of subscale predictive validity. Prosocial behaviors, concentration problems, and disruptive behaviors also all significantly predict office discipline referrals (Pas et al., 2011). Previous research of the TOCA-C has found internal consistency estimates ranging from .86 to .96. For the current study,

the internal consistency (computed using Cronbach's alpha) for each subscale ranged from .77 to .96. For the purposes of this study, data were gathered in spring.

Results

Analytic Approach

Regression analyses were conducted to determine the associations between direct observation of disruptive behavior and demographic characteristics, and separately to determine the association between teacher report of disruptive behavior and demographics of students. Gender, race, and lunch status were regressed on observed disruptive behavior. Gender, race, and lunch status were also regressed on teacher reported disruptive behavior. Teachers interactions with students (positive to negative), gender, race, and lunch status were all regressed on teacher reported disruptive behavior, concentration problems, emotional dysregulation and prosocial behavior.

Table 1. The Association between Student Gender, Race, andLunch Status and Observed Disruptive Behavior

Variables	Observed Disru N=	uptive Behavior 679
	β	SE
Gender	-0.10*	0.01
Race	0.06	0.01
Lunch	0.04	0.01

Note: Student sex 0=male 1= female; Race = 0 White and other 1= Black * p < 0.05, ** p < 0.01, *** p < 0.001

As indicated in Table 1, results indicate that only male students were actually observed to be more disruptive in the classroom (β =-0.10, p<.05). The results also indicate that teachers in general, perceive male students (β =-0.12, p<.001), Black students ($\beta = 0.06$, p< .001), and student receiving FRL ($\beta = 0.04$, p <.001), as more disruptive (see Table 2). More importantly, findings indicated that teachers have more negative interactions with students with higher teacher reported disruptive behavior, concentration problems and emotion dysregulation (see Table 3). Boys, Black students, and student receiving FRL were reported by teachers to display these problems despite the fact that observations only indicate that boys were more disruptive, whereas teachers interact more positively with students they report as being prosocial, and are female and do not receive FRL. Teachers perceiving White students are more prosocial was marginally significant.

Table 2. The Association between Student Gender, Race, andLunch Status and Teacher Reported Disruptive Behavior

TOCA Disruptive Behavior N=679			
β	SE		
-0.12***	0.06		
0.14***	0.07		
0.17***	0.07		
	TOCA Disrup N=6 -0.12*** 0.14*** 0.17***		

Note: Student sex 0=male 1= female; Race = 0 White and other 1= Black * *p* < 0.05, ** *p* < 0.01, *** *p* < 0.001

Table 3. Teacher Interactions Associated with Teacher Reported Disruptive Behavior, Concentration Problems, Emotion Dysregulation and Prosocial Behavior Controlling for Student Gender, Race, and Lunch Status.

Variables	TOCA Disruptive Behavior N=679		TOCA Concentration Problems N=679		TOCA Emotion Dysregulation N=679		TOCA Prosocial Behavior N=679	
	β	SE	β	SE	β	SE	β	SE
Teacher	-0.09**	0.23	-0.12***	0.34	-0.15***	0.29	0.11***	0.29
Positive to Negative								
Gender	-0.12**	0.06	-0.26***	0.09	-0.19***	0.08	0.15***	0.08
Race	0.26***	0.07	0.13***	0.11	0.12***	0.10	-0.07†	0.09
Lunch	0.16***	0.07	0.14***	0.10	0.15***	0.09	-0.13***	0.08

Note: Student sex 0=male 1= female; Race = 0 White and other 1= Black

* p < 0.05, ** p < 0.01, *** p < 0.001

Discussion

The purpose of this study was to determine if teachers interact differently with students based of demographics. We know that both negative and positive teacher-student interactions influence student outcomes (Reinke, et al., 2016), since these interactions are so critical, this study aimed to find out if certain students are experiencing more negative interactions. When looking at race, gender, and SES, gender was the only predictor of observed disruptive behavior. Despite only boys being observed as having more disruptive behavior, teachers reported Black students, boys, and low SES students as having more disruptive behaviors, concentration problems, emotional dysregulation, and less prosocial behaviors. We know that teachers tend to interact more negatively with students who are reported as having these behavior issues and previous research shows negative behavioral, social-emotional and academic outcomes for students who have more negative interactions with teachers. This means that Black students, low SES, and boys may have fewer positive teacher interactions which could result in negative outcomes for these students.

The findings in this study can be used to make teachers aware of the implicit biases they may hold that are likely the cause of these findings. Since teachers are not likely intending to rate and interact with students differently based on demo raphic, the current study allows teachers to be aware that their implicit biases may be influencing the way they interact with students.

This study raises questions to be looked at in further research. Based on these findings, preventive interventions can be developed to support teachers in becoming aware of their biases and improving interactions with all students. Future research can evaluate the impact of interventions that will help teachers become aware of how they interact with students of color and from low SES backgrounds.

This study also raises the question as to why boys were the only demographic to actually be observed to have more disruptive behaviors when compared to their peers who are girls. This study should be replicated in order to see if the results hold true with a different sample, if so, are we seeing differences in the disruptive behaviors of boys and girls because of the way we socialize boys to behave? investigate teacher interactions with students in middle and secondary schools.

Teacher interactions with students can impact academic, social, and behavioral outcomes of students, both positively and negatively. Students spend almost every day interacting with teachers so teachers play a major role in their development, making understanding these interactions even more critical. The present findings suggest that teachers perceive the behaviors of certain students to be more negative than others. Being able to see these differences in perceived disruptive behavior and sharing this information with teachers could be the first step in making teachers more aware of how their own biases and these biases impact their interactions with their students. Teaching is a challenging and important profession. Finding ways to support teachers in being more culturally responsive and having more positive interactions with students regardless of demographic is an important area of research. This study is first step toward understanding how to provide these supports and increasing positive outcomes for future students.

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While this study was successful in showing the different ways teachers perceive students and how they interact with these student, there were some limitations. The study was conducted in a school district with a primarily Black student population, so the results are not able to be generalized to other less homogenous districts and to the broader populations. In addition, the sample is only of elementary students and teachers. Future research should

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Novel 3D Semiconductor Nanostructure Applications as Charge Transport Materials in Dye-Sensitized Solar Cells

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Abstract

The efficiency with which dye-sensitized solar cells (DSS-Cs) convert sunlight into useful energy is low compared to solar conversion efficiencies of conventional silicon solar cells; however, DSSCs have proven to be more cost-efficient to produce while maintaining exceptional stability. To make harvesting of solar energy more reliable, safer, and more sustainable through DSSCs, solar conversion efficiencies of DSSCs must be improved. The current models applied to the understanding and improvement of DSSCs direct research focus to increasing photoanode surface area, increasing dye-loading capabilities, optimizing electron transport pathways, and implementation of solid-state electrolyte materials. In our research, we investigate the potential of two novel three-dimensional semiconductor nanostructures: zinc oxide-coated zinc nanoparticles and titanium dioxide nanoforests. Furthermore, we present results of experiments performed to deposit platinum nanoparticles on conductive glass substrates, to form cathodes, using an entirely solution-based method as well as solar conversion efficiencies of a P25 titanium dioxide photoanode-based DSSCs.

Introduction

Zinc Oxide-Coated Zinc Nanoparticles

Zinc oxide-coated zinc nanoparticles are being investigated for their potential to increase electron mean free paths in DSSC photoanodes. Semiconductors have the desirable property of a "Goldilocks" band gap: conductive materials have too little of a band gap and insulators have too high of a band gap. The result is that electron mobility is significantly hindered in both conductive and insulating materials. This leaves semiconductors as the ideal in the spectrum of conductivity for use in photovoltaic devices. However, ideal conductors have the benefit of naturally negating electric fields within themselves by being able to rearrange internal electrons freely to counteract any external electric field, such that the potential across the terminals of an ideal conductor is approximately non-existent. Zinc oxide-coated metal nanoparticles can potentially take advantage of the desirable traits of high electron mobility in semiconductors as well as lack of potential in ideal conductors, enabling photoexcited electrons traveling through this proposed material to travel more efficiently than they would through conventional photoanode semiconductor materials.

In the literature, there are a multitude of examples of coating a semiconductor core with another semiconductor material that possesses a higher conduction band edge, effectively exploring the ideas put forth here.¹⁻⁹ Hamadanian et al. neatly summarizes the shared conclusions of relevant literature by

stating, "The coating allows the electrons generated upon photoexcitation of the sensitizer dye to tunnel through the shell to the semiconductor core and, subsequently, into the TCO whilst simultaneously creating an energy barrier for recombination processes." Wang et al. discuss the benefits of passivation layers in the prevention of recombination and mediation of lattice mismatch between materials.¹⁰ Based on their results in mediation of lattice mismatch using a semiconductor interface between metals, it is expected that zinc oxidecoated zinc nanoparticles can take advantage of significant lattice matching at the metal-semiconductor interface to avoid recombination at the interface. Ding et al. makes an interesting comment by introducing the topic of surface plasmon resonance which is variable based on the relative concentrations of metal and semiconductor components of core-shell type nanoparticles.¹¹ Further, the Ding et al. demonstrated that core-shell nanoparticles can increase the electromagnetic absorption range of the photoanode via different mechanisms.

In general, the literature lends support to the application of zinc oxide-coated zinc nanoparticles whose fabrication we seek to understand, such that particles can be robustly modified based on specific application and experimental needs.



Figure 1: A zinc oxide-coated zinc particle with a thin zinc oxide shell (left), and a zinc oxide-coated zinc particle with a thick zinc oxide shell (right).

Preliminary efforts to develop a suitable material has exposed a method of synthesizing zinc oxide-coated zinc nanoparticles of varying coating thickness. Optimization and control of factors affecting core- and shell-diameters promises robust control over properties of this unique material, such as the material's permittivity, surface area, reflectivity, porosity, and absorption peaks. Implications could include optimization of light scattering through a gradient of small-to large-sized particles with different absorption band edges. At the time of writing, the synthesis process is still being investigated; the synthesis protocols have not been finalized and thus, will be reported on in the future.

Titanium Dioxide Nanoforests

Titanium dioxide nanoforests are proposed as a natureinspired solution to DSSC issues in light harvesting and electron transport. Trees have evolved over millennia to survive and thrive primarily by converting sunlight, water, and carbon dioxide into carbohydrates and oxygen. They boast leaves, designed to have immense specific surface area to sufficiently expose chlorophyll to sunlight, and have sturdy, efficient pathways through their trunks to transport key nutrients needed to survive through a variety of seasons and temperatures. In proposing the implementation of titanium dioxide nanoforests, we seek to implement the natural design of contemporary foliage to the nanoscale to propagate these desirable traits, substituting chlorophyll with sensitizing dye and nutrients traveling through tree trunks with electrons migrating towards photoanodes.

Unique semiconductor nanostructures and their derivatives have been studied intensely over the course of the past two decades as a possible source of solar conversion efficiency improvement.¹²⁻²³ Nanorods, nanowires, nanotubes, nanospheres, etc. often produce a higher solar conversion efficiency than that produced by standard polycrystalline titanium dioxide. These unique nanostructure solutions frequently provided more discrete and direct pathways for photoexcited electrons to travel to the photoanode; however, one-dimensional structures, such as nanorods, nanowires, and nanotubes, often suffered from low specific surface area resulting in poor dye-loading and relatively low current density. A proposed solution that retains the direct electron transport characteristics of one-dimensional nanostructures but improves upon the limited specific surface area is nanoforests.

In 2011, Ko et al. reported on high density tree-like ZnO nanoforests applied as a DSSC photoanode and demonstrated an efficiency that exceeded 4 times that of plain ZnO nanowires, leading the way for other studies to investigate hierarchical nanostructures as the path forward in attaining more efficient DSSCs.²⁴ In 2012, Herman et al. investigated the branching effects by synthesizing "weeping willow nano-trees with very long branches," giving further proof that increasing surface area generally improves solar conversion efficiencies; however, the group also reported that there is an apparent limit to how much branching can increase solar conversion efficiencies, as longer electron transport pathways (through branches) allows for more opportunities for recombination to occur as electrons travel towards the photoanode.²⁵ In 2014, Roh et al. reported on pine tree-like titanium dioxide nanoforest structures in conjunction to employing a solid-state electrolyte material, resulting in a respectable solar conversion efficiency of 8.0 % with one sample.

All current literature lends support to expected improvement of solar conversion efficiencies of DSSCs based on the unique hierarchical titanium dioxide nanoforest structure proposed here and imaged next.²⁶

Similarly to the zinc oxide-coated zinc particles, the synthesis protocols have yet to be finalized and will be reported on in the future.



Figure 2: Top view (left) and side view (right) of proposed titanium dioxide nanoforests.

Current Work

P25 Titanium Dioxide Photoanode Fabrication

P25 titanium dioxide photoanodes were fabricated through methods adapted from Liao et al.'s 2012 paper studying hierarchical yolk-shell titanium dioxide beads.²⁷ 15 mL of titanium dioxide paste was synthesized by combining 0.50 g of P25 TiO₂, 0.25 g of methyl cellulose, 15.0 mL of deionized water (DI-water), and 0.10 mL of glacial acetic acid into a 20-mL vial. A small magnetic stir bar was added and the solution was stirred at medium setting (and room temperature) for a full 24 hours before use. Several 1-in² pieces of 3.2-mm thick FTO glass (Sigma) were hand-washed with soap and tap water, rinsed with DI-water, and then immersed in an equivolume solution of DI-water, ethanol, and acetone (approximately 50 mL each). The FTO glass was then sonicated for 15 minutes at room temperature with the conductive side face-up. The samples were subsequently removed from the cleaning solution, then dried under low vacuum at 70 °C for 30 minutes.

100 mL of TiCl₄ (aq) was made by first adding approximately 100 mL of DI-water to a beaker, adding a clean stir bar, and placing the beaker in an ice bath. The ice bath was placed on top of a hot plate, and a vigorous stir setting was applied (heat was kept off). After 15 minutes, 0.439 mL of TiCl₄ was then added dropwise to the DI-water (10 seconds between drops).

After 30 minutes of heating, the FTO glass was removed from the low vacuum oven, placed in a beaker, and immersed with 100 mL of the ice-cold 40 mM TiCl_4 solution. The beaker was then placed back in the oven and heated at 70 °C for 30 minutes (in air, at ambient pressure). After 30 minutes, the glass was removed from solution, rinsed once with DI-water, then dried under low vacuum at 125 °C for 30 minutes.



Figure 3: Cross-sectional view of a P25 titanium dioxide photoanode. The resulting titanium dioxide layer is approximately 10-µm thick and displays optimal uniformity.

After allowing the glass to cool for 5 minutes at room temperature, one layer of 3M magic tape was applied to two parallel sides of the square FTO glass pieces to create a 60-µm tall well in which the titanium dioxide paste was applied by doctor-blading using a glass blade (a clean glass slide). After each doctor blading application of the titanium dioxide paste, the sample was heated in an oven at 125 °C for 5 minutes, then removed, and allowed to cool at room-temperature for 5 minutes. Ten coatings of titanium dioxide paste were applied to each piece of FTO glass. It is worth noting that after about 7 applications, little to no additional paste was added with each subsequent doctor blading application, indicating that the layer of deposited paste was approximately 60-µm tall.

After the doctor blading applications, the P25 photoanodes were trimmed, leaving an active area of 1 cm². The resulting samples were annealed in a tube furnace (in air, at ambient pressure) sequentially at 300 °C for 30 minutes, 400 °C for 30 minutes, and 500 °C for 30 minutes in order to remove all organic substances present in the thin film.²⁷

Solution-Based Platinum Nanoparticle-Deposited Cathode Fabrication

Platinum nanoparticles were deposited on 1-in² pieces of 3.2-mm thick FTO glass using adapted techniques by Gang et al.²⁸ Further, several experiments were conducted to deposit Pt/C securely onto FTO glass using 5% (by volume) nafion solution (aq) as a binding agent. Unfortunately, adhesion and stability of Pt/C on the FTO conductive layer persisted as an issue in all tests using I_3^{-/I^-} electrolyte solution and was subsequently voided as an option for a reliable cathode source. However, notable results were found in experiments using ascorbic acid as a reducing agent to precipitate platinum nanoparticles from K_2PtCl_4 in conjunction with 5% nafion solution.

To obtain the deposition pictured in Figure 4, FTO glass was first cleaned and dried using the procedure outlined for preparing the P25 photoanode. After drying for 30 minutes at 70 °C, the FTO glass was cooled for 5 minutes to room temperature. The FTO glass was then placed in a small beaker with the conductive side face-up and immersed in 17.5 mL of DI-water, followed by 1.0 mL of 5 mM K₂PtCl₄ (aq). The beaker was set in a secluded location to be left undisturbed, and the reduction reaction was started by adding 1.0 mL of 0.1 M ascorbic acid. The beaker was then covered using a watch glass.



Figure 4: Comparison of FTO glass surfaces, untreated (left) and treated with potassium tetrachloroplatinate(II) and ascorbic acid.

After 24 hours, the beaker was gently drained of solution using a plastic transfer pipette and allowed to dry in air, undisturbed for another 24 hours. Resultant nanoparticle sizes were 10 nm in diameter (it is noted that the surface area of platinum is exceptional in the sample pictured above). A different sample was prepared the same way, excepting that the solution was not drained and instead, heated at 125 °C under low vacuum conditions. The resultant platinum nanoparticle distribution was extremely sparse and highly clustered (<1 cluster per 10 µm).

In a seemingly counterintuitive parallel experiment, plentiful carbon coated-platinum nanocluster islands were observed by adding 0.5 mL of 5% nafion solution to the solution beaker before adding ascorbic acid. The deposition imaged below resulted from evaporating off the solvent at 125 °C under low vacuum conditions after 24 hours without any draining of the solution. In contrast, draining of the precursor solution, then drying the beaker resulted in significantly diminished presence of platinum on the conductive substrate. It is noted that the carbon coating (evident, as platinum was distinguished after etching of the carbon from the islands with an electron beam) potentially deactivates the catalytic effects of the platinum in reducing I_3^- to Γ in the electrolyte solution, rending the material useless for the applications intended in this study.



Figure 5: Carbon-coated platinum islands deposited using potassium tetrachloroplatinate(II), ascorbic acid, and nafion. Zoomed out image (left) and arbitrary zoomed in image (right).

Considering these results, it is posited that platinum is indeed precipitated from the water-K₂PtCl₄-ascorbic acid solution; however, surface adherence between the platinum nanoparticles and the FTO conductive layer is not significant, resulting in loss of most of the platinum nanoparticles during the draining of the solution. Gently draining the solution; however, allows the platinum nanoparticles to settle on the surface of the conductive layer of the FTO glass. So, sputter coated-platinum photocathodes were employed as the preferred photocathode source instead, as stability of platinum nanoparticles on the surface of the FTO glass was a concern in testing under liquid electrolyte solution conditions.

Dye Solution, Electrolyte, and Photocathode Fabrication

Dye solution was made by combining 9 mg of N719 dye, 5.895 grams of CH₃CN, and 5.813 grams of tert-butyl alcohol in normal conditions.²⁷ I₃ /I⁻ electrolyte solution was made by combining the following chemicals under normal conditions: 1.513 grams of PMII, 0.076 grams of I₂, 0.676 grams of tert-butyl pyridine, 0.118 grams of guanine thiocyanate, 0.067 grams of lithium iodide, 6.683 grams of acetonitrile, and 0.857 grams of tert-butyl isocyanide. Both dye solution and electrolyte solution were stored in dark conditions immediately after synthesis.

Platinum-coated FTO glass was used as a counter electrode. A 50-nm thick layer of platinum was deposited onto a single piece of FTO glass using the Emitech K575x Sputter Coater available at the MU Electron Microscopy Core, deposited using a power setting of 50 mW. The same platinumcoated FTO glass photocathode was used to test multiple samples without noticeable effects on cell performances.

Dye-Sensitized Solar Cell Assembly and Characterization

The photoanodes were stained using the following procedure: annealed titanium dioxide-coated FTO glass was placed in a glass petri dish with the P25 titanium dioxide-coated side face-up. 15 mL of dye solution (prepared as described in the previous section) was added to a glass petri dish holding the photoanodes, allowing the solution to significantly cover samples. The glass petri dish was then covered and left undisturbed for 24 hours. After removing the photoanodes from solution, the P25 titanium dioxide layer was rinsed gently with acetonitrile to remove any physisorbed dye-molecules. An aperture slightly larger than the photoanode surface area was cut from Scotch packing tape and placed over the photo anode to create a well for the electrolyte solution and a small separation between the photoanode and photocathode to prevent short circuit.

After adding 3 drops of electrolyte solution (prepared as described in the previous section), the platinum-coated counter-electrode was placed on top of the photoanode and positioned such that some area of each electrode was exposed on opposite sides to allow alligator clip connections. The assembly was held together by two binder clips on perpendicular, opposite sides. Any leaked electrolyte was wiped off with Kim wipes. Each newly assembled DSSC was allowed to rest for 5 minutes after assembly and before testing to ensure adequate absorption of the electrolyte solution into the titanium dioxide material. Electrical measurements were taken using a model 600E series electrochemical workstation (CH Instruments) by varying voltage and measuring resultant current through the exposed terminals of the solar cell. IV-curve measurements were taken in a dark room with the solar cell exposed to AM1.5G simulated sunlight (approximately 1014.3) W/m^2).

Results and Discussion

5 photovoltaic cells were prepared using the methods described in prior sections. The measurements and replicants were all found to be normally distributed.



Figure 6: Normal plot of sample solar conversion efficiencies.

The average current density (J_{sc}), average open circuit voltage (V_{oc}), fill factor (FF), and solar conversion efficiencies are 3.06 mA, 0.69 V, 0.48, and 0.99 %, respectively. In comparison, Liao et al. reported average current density open circuit voltage, fill factor, and solar conversion efficiencies of 14.00 mA, 0.84 V, 0.64, and 7.54 %, respectively, for their P25 titanium dioxide photoanode-based DSSC.

The difference in efficiencies is exceedingly high (over 7 times more efficiency was reported by Liao et al.). Though the P25 titanium dioxide photoanodes reported here were fabricated on a technique based on that reported in the 2012 paper, there are key differences that may contribute to the observed efficiency differences between the results reported here and the results reported by Liao et al. Firstly, Liao et al. deposited a compact TiO, blocking layer onto their conductive glass substrate before deposition of the P25 film using techniques published by Scolan and Sanchez.²⁹ Cameron and Peter published a paper in 2003, showing that a titanium dioxide blocking layer can significantly prevent the back reaction of electrons with tri-iodide ions in electrolyte solution, giving one possible explanation of the difference in solar conversion efficiencies: Liao et al. employed spin-coating as a method to deposit a dense film of TiO_2 , whereas here, TiO_2 was deposited in situ using TiCl₄ as a precursor.³⁰ It is speculated that the blocking layer in the former is more discrete and thus performs better for the purpose of preventing electron recombination at the substrate/electrolyte interface.

The second point of difference between the fabrication methods used by Liao et al. and those used in this study, is that doctor blading was employed to fabricate the P25 titanium dioxide layer characterized in this paper, whereas screen printing was employed by Liao et al. It is apparent that screen printing of P25 titanium dioxide ink can result in a thin-film that is much more uniform and consistent than any films able to be made by hand. It follows that the samples reported on within this paper should have more film defects that may contribute to a lower FF of the DSSC, effectively lowering the solar conversion efficiencies.

A third point of difference is that the films reported on in Liao et al.'s paper were post-treated with a 40 mM solution of $TiCl_4$ to improve photocurrent and photovoltaic performance. In the samples characterized here, this reaction was performed only during the pre-application of the P25 titanium dioxide slurry to make a thin blocking layer of P25 titanium dioxide on the FTO substrate. It is speculated that Liao et al. achieved a very thin P25 titanium dioxide blocking layer on their porous thin film, resulting in an energy barrier that prevented electrons which have migrated to the conduction band of the P25 titanium dioxide material from recombining with either the dye molecules or the tri-iodide ion present on the titanium dioxide's surface.

Another noteworthy item that may have contributed to decreased photovoltaic performance is that consecutive tests and measurements performed on the same sample resulted in steadily decreased performance.



Figure 7: Solar conversion efficiencies of samples decrease with iterative measuresments.

Photovoltaic cells were noticeably hotter during disassembly (after taking electrical measurements). A possible explanation for decreased photovoltaic performance of the cells studied here may be that resistance (of the platinum-coated FTO glass cathode) increases with increasing temperature, resulting in decreased reactivity at the platinum cathode interface, possibly introducing a limiting step in the redox system which regenerates the photo-oxidized dye molecules, where tri-iodide is reduced to iodide.



Figure 8: Open-circuit voltage and short-circuit current measurements obtained for a single sample tested consecutively without cool-down time.

This explanation is corroborated by V_{oc} and J_{sc} measurements displayed above. If resistance at the photocathode were to increase, voltage is expected to increase in accordance to Ohm's Law, V=IR. However, current also decreases, contributing to a decrease in voltage. It is apparent from the slopes of the above plots that current decreases at a faster rate than voltage, allowing the conclusion that this is the case. It is speculated that testing in a temperature-controlled environment would allow more consistent results and a higher average solar conversion efficiency of the samples examined within this paper.

Conclusions and Summary

This paper proposes the study of two novel nanostructures and their application as photoanode materials in DSSCs: zinc oxide-coated zinc nanoparticles and titanium dioxide nanoforests. The literature supports the ideas presented here, making the novel nanostructures promising candidates for improving solar conversion efficiencies of DSSCs. Completed work thus far has focused on fabrication of electrodes: a P25 titanium dioxide photoanode fabricated using low cost, simple techniques, and deposition of platinum nanoparticles on FTO glass using potassium tetrachloroplatinate(II), ascorbic acid, and nafion.

The assembled cell, intended to be a reference for comparison with DSSCs based on the novel proposed materials, has significantly lower than expected solar conversion efficiencies. Differences between the P25 titanium dioxide-based DSSC examined within this paper and a cell fabricated with a similar procedure in literature are discussed and explanations for differences in solar conversion efficiencies are posited. Notable differences include the use of blocking layers, doctor blading versus screen printing, and temperature control during testing conditions of the photovoltaic cells.

Acknowledgements

We thank the MU Ronald E. McNair Post-Baccalaureate Achievement Progam and the MU Electron Microscopy Core for their support of this study.

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Featured Scholar



Aaron Jay Rosengren, PhD Assistant Professor, Aerospace and Mechanical Engineering Department Assistant Professor, Applied Mathematics Graduate Interdisciplinary Program University of Arizona

During my long academic journey—nine years, as it turned out—I had incurred many debts and obligations, both personal and intellectual, which I have the great honor and pleasure in acknowledging. Certainly, my first foray into the vicinity of scientific research was through the Ronald E. McNair Postbaccalaureate Achievement Program during my undergraduate studies at the University of Missouri, and I should not fail to mention the order did accience on the second form.

to mention the splendid assistance I received from NaTashua Davis, Jeremy Bloss, and my mentor, Professor P. Frank Pai. Through this unique research experience, I was able to broaden my scientific perspective by interacting with students from diverse backgrounds and fields. In looking back over the years, perhaps most beneficial to my scientific career had been the advanced library and effective presentation skills I acquired during the program, which helped me survive my first conference presentation in Girdwood, Alaska, as a first-year PhD student, and had given me the confidence to express my thoughts freely and forcefully. Just as important, I learned how to conduct research independently and no longer shied away from seemingly intractable problems, but embraced such challenges with purpose, vigor, and humility. "Persist," as the 18th century French mathematician d'Alembert advised, "and faith will come to you."

The most memorable experience I had as a McNair Scholar was traveling to San Diego to attend the SPIE International Symposium on Smart Structures and Materials & Nondestructive Evaluation and Health Monitoring. Although I grew up near an airport in St. Louis, that was the first time in my life that I had been in an airplane. Seeing the Earth from an altitude of nearly 40,000 feet was truly captivating and reinforced my desire to pursue a PhD in the aerospace engineering field. I also recall later that year spending thirty straight hours in the lab in preparation for the McNair Scholars Conference at the end of the program. Perhaps it was the countless cups of coffee I consumed, but it was then that my decision to become a researcher became cemented.

In my final year as an undergraduate, I served as an ambassador for the McNair Program. This gave me the opportunity to speak at several diversity-focused events about the benefits of the program and to encourage students, particularly those in the STEM fields, to participate in undergraduate research. Having been a firstgeneration college student with a disadvantaged socioeconomic background, whose life today has been overwhelmingly influenced by college education and the outstanding mentors along the way, I retain a strong interest in helping those who are faced with similar academic hardships. As the product of an academically deficient K-12 public school system, and having struggled greatly to overcome these challenges in my scholarly pursuits, my goal is to serve as a role model like the late astronaut and physicist, Dr. McNair, and inspire students from similar backgrounds to seek advanced degrees. I am deeply honored to be leading a diverse lab at the University of Arizona, and look forward to mentoring my own McNair Scholar.



ser- and Dynamics-Based Technique for Damage Detection and Health Monitoring of Structures

P. Frank Pai, PhD, Mentor Department of Mechanical and Aerospace Engineering



2009 MU McNair Journal.

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Jeffrey Cathey (Summer 2017)	Chemical Engineering	Manufacturing Methods for Photoresist Adhesion in Nano-Antenna Fabrication	Patrick J. Pinerho				
Sierra Clemetson	Communication & Science Disorders	The Magnitude of the Cognate Effect as a Measure of Proficiencey in Spanish Classroom Learners	Roxana Botezatu				
Ryan Foltz	Psychology	Do Peers Know That Their Friends Have Dark Personalities?	Laura King				
Sarah Gebken	Biological Engineering	Targeted Genome Engineering Using CRISPR/Cas9 in Brassica Oleracea	J. Chris Pires & Makenzie Mabry				
Brittany Gregory	Psychology and Sociology	Teachers' Interactions with Students in Their Classrooms: Differences by Race, Gender and SES?	Wendy Reinke				
Jayla Head	Psychology	Exploring the Associations between Sexual Intensity, Skin Tone, and Relationship Quality among African American Young Adults	Antoinette Landor				
Erielle Jones	Sociology and History	Fly Like an Eagle: The Success of Stop ERA in the Missouri Senate 1975 & 1977	Keona Ervin				
Jessee Kruse (Summer 2017)	Biological Sciences	Metabolic Mapping of Inflammatory Cytokine, Degradative Enzyme, and Combined Production Levels in the Osteoarthritic Knee	Aaron Stoker				
Sara Lalk	Forestry	Armillaria: Light and Mushroom Production	Jeanne Mihail				
Tremaine Ledbetter	Psychology	Effects of Stereotype Thread on Older Adults' Associative Memory: The Role of Sensitivity and Criterion	Moshe Naveh- Benjamin & Stephen Rhodes				
Justin Moore	Psychology	Multi-Component Working Memory Performance in Individuals with Induced State Anxiety	Shawn Christ				
Jannice Newson	Soil, Environmental & Atmospheric Science	Burping Wetlands: Quantifying Greenhouse Gas Ebullation Rates across a Range of Sediment Organic Matter Content	Rebecca North				
Faith Ordonio	History	American Public Perception and Reaction to the Wagner-Rogers Bill of 1939	Catherine Rymph				
Meaghan Pearson	Statistics and Sociology	Expectancy Value Theory for Math	Matthew Burns				
Meghan Wheeler	Fisheries & Wildlife Sciences	Using Asian Carp As a Hunger Relief Strategy in Haiti	Mark Morgan				
Mario Wilson	Psychology	Social-Ecological Characteristics of Juvenile Sexual Offenders from Diverse Backgrounds: A Meditational Analysis	Charles Bourduin & Kaitlin Sheerin				

2017-2018 McNair Scholars



Back Row: Ryan Foltz, Justin Moore, Dakota Reeves, Jeffrey Cathey (Summer 2017 Scholar), Sage Williams, Tremaine Ledbetter, Sarah Lalk, Jeremy Bloss (Program Coordinator)

Middle Row: Jannice Newson, Meaghan Pearson, Sarah Gebken, Brittany Gregory, Jessee Kruse (Summer 2017 Scholar), Blake Acton

Front Row: NaTashua Davis (Director), Jayla Head, Anna Brett, Faith Ordonio, Megan Wheeler, Sierra Clemetson, Mario Wilson, Erielle Jones





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